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

In the Matter of	)	
	)	
The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010	)	WT Docket No. 96-86

REPLY COMMENTS OF MOTOROLA, INC.

Steve B. Sharkey
Robert D. Kubik
1350 I Street, NW
Suite 400
Washington, DC 20005-3305
TEL: 202.371.6953

July 6, 2006

TABLE OF CONTENTS

Summary i

I. Introduction and Summary. 2

II. The Record Demonstrates That Flexibility to Deploy Wideband and Broadband Operations is Essential to Meeting Public Safety's Needs. 3

III. Lucent Mischaracterizes Key Aspects of the Wideband and Broadband Technologies. ... 9

A. Coverage 10
B. Data Rates 14
C. Spectral Efficiency 16

IV. Protection of Public Safety Narrowband Voice Spectrum is Essential. 19

V. The FCC Should Adopt TIA-902(SAM) for Use on the Wideband Interoperability Channels. 21

VI. Conclusion. 23

Appendix A: Link Budgets for TIA-902(SAM) and EV-DO A-1
Appendix B: Recommended Rule Changes B-1

Summary

Motorola strongly supports the recommendation, expressed by virtually all participating public safety organizations, that the FCC's rules should provide flexibility for licensees to deploy either wideband or broadband technologies in the 700 MHz public safety allocation. Public safety agencies operate in a wide variety of environments and require different capabilities as a result of these differing environments; their diverse needs cannot be satisfied with a "one-size-fits-all" solution. Accordingly, Motorola supports adoption of the 700 MHz rechannelization proposal submitted by the National Public Safety Telecommunications Council (NPSTC), which provides a framework for public safety entities (in coordination with regional planning committees) to choose between wideband and/or broadband operations at 700 MHz.

In so doing, Motorola urges the FCC to reject the recommendations of broadband equipment manufacturers and integrators that public safety users should be forced to deploy only broadband technology in the 700 MHz data spectrum. In supporting their recommendation that the FCC should mandate the use of EV-DO broadband technology within the 700 MHz public safety allocation, these commenters mischaracterize the capabilities and performance of wideband technologies such as TIA-902(SAM). In these reply comments, Motorola provides further analysis to conclusively demonstrate that TIA-902(SAM) is a cost effective solution that can provide real-time video applications for public safety uses. While EV-DO will be an appropriate choice for some public safety organizations, the comments supporting its mandated use do not provide justification that outweighs the need for deployment flexibility as expressed by the vast majority of the public safety user community.

NPSTC and other public safety organizations are adamant that deployment of broadband systems in the 700 MHz band must be done in a manner that fully protects narrowband voice operations. Motorola agrees with the need for this condition and therefore provides suggested

rule changes to accomplish that goal. These recommended rule changes are based largely on the protections adopted to mitigate interference between disparate systems in the 800 MHz band.

Motorola reiterates its recommendation that the TIA-902(SAM) standard be adopted by the Commission for use on the wideband interoperability channels. This standard was developed jointly in an open standards process by the public safety community and with the participation of multiple manufacturers with the expressed purpose of meeting public safety, rather than commercial, requirements. The standard is documented and maintained for multiple manufacturer use by TIA/ANSI and Motorola has gone on record offering to license essential intellectual property rights (IPR) to other manufacturers on a royalty-free basis for interoperability use.

No other wideband or broadband data standard provides all these benefits. While a few commenters recommend off-the-shelf EV-DO as a broadband standard, that technology was developed based on the requirements of commercial system providers and not public safety. In addition, a survey of publicly available documents seems to demonstrate a concern in the industry about the IPR fees for CDMA-based technologies. In considering various technologies as a possible broadband interoperability standard, Motorola recommends that the Commission fully appreciate the intellectual property licensing issues for a candidate technology.

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

In the Matter of	)	
	)	
The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010	)))))	WT Docket No. 96-86

REPLY COMMENTS OF MOTOROLA, INC.

Motorola, Inc. ("Motorola") hereby replies to the comments submitted in response to the Eighth Notice of Proposed Rulemaking in the above-captioned proceeding.[1] As further discussed below, Motorola strongly supports the recommendation expressed by virtually all participating public safety organizations that the FCC's rules should provide licensees with flexibility to deploy either wideband or broadband technologies in the 700 MHz public safety allocation. In addition, Motorola agrees with NPSTC and other public safety entities that emphasize the need to protect the existing 700 MHz narrowband voice channels from interference from 700 MHz broadband deployment. In these reply comments, Motorola offers detailed recommended rules to effectuate such protection.

In supporting licensee flexibility to deploy either broadband or wideband technologies, Motorola urges the Commission to reject the position of some broadband equipment manufacturers that argue that public safety users should be forced to deploy only broadband technology in the 700 MHz data spectrum. The recommendation for a broadband mandate

---

[1] *The Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, Eighth Notice of Proposed Rulemaking, 21 FCC Rcd 3668 ("*8th NPRM*"). All comments on this *8th NPRM* are short-cited herein.

ignores the fact that the needs and circumstances across public safety agencies are diverse and cannot be satisfied with a "one-size-fits-all" solution.

I. Introduction and Summary.

Motorola believes that emergency first responders should have access to reliable and effective communications that meet their specific needs. Consistent with this belief, Motorola filed opening round comments supporting the band plan filed by the National Public Safety Telecommunications Council (NPSTC), which provides a framework for public safety entities – in coordination with regional planning committees (RPCs) – to choose to deploy wideband and/or broadband operations at 700 MHz.[2] The NPSTC plan is similar to a preliminary plan submitted by Motorola in December, 2005, that: 1) provided flexibility for wideband or broadband deployment, 2) included provisions to protect narrowband operations from interference, and 3) continued to provide channels for wideband interoperability.[3] The NPSTC proposal, which was vetted in the public safety community, provides users with some additional measure of flexibility in deploying wideband and broadband operations compared to Motorola's preliminary plan while still providing spectrum for wideband interoperability. Accordingly, Motorola supports adoption of the 700 MHz rechannelization proposal submitted by NPSTC.

While practically every public safety commenter and several other manufacturers agree with this flexible approach, a few manufacturers of broadband equipment instead recommend that the Commission mandate broadband technology with no provision for public safety users to deploy an alternative technology that would better meet their needs. As addressed more fully in

---

[2] Letter from Vincent R. Stile, Chair, National Public Safety and Telecommunications Council (NPSTC), to Michael J. Wilhelm, FCC, WT Docket Nos. 96-86, 05-157 (filed Feb. 6, 2006) ("*NPSTC Proposal*"); and NPSTC Comments.

[3] Letter from Steve B. Sharkey, Motorola, to Marlene H. Dortch, FCC, WT Docket Nos. 96-86, 05-157 (filed Dec. 9, 2005) ("Motorola Proposal"). *See also 8th NPRM* at ¶¶ 15 – 17.

Section II of these reply comments, Motorola strongly opposes this position, which ignores the needs of public safety users and mischaracterizes key aspects of both wideband and broadband technologies.

NPSTC's comments addressed the requirement to protect the adjacent 700 MHz public safety narrowband voice channels as broadband and wideband operations are deployed in that band. NPSTC's proposals support the use of guard bands and additional filtering when needed. Likewise, Sprint Nextel's comments addressed the importance of addressing interference before it occurs, citing the industry's experience in the 800 MHz band.[4] Consistent with those comments, Motorola fully supports the adoption of rules to protect the 700 MHz narrowband voice channels and provides specific recommendations in these reply comments.[5]

II. The Record Demonstrates That Flexibility to Deploy Wideband and Broadband Operations is Essential to Meeting Public Safety's Needs.

The comments in this proceeding clearly demonstrate that public safety agencies should be afforded the flexibility to deploy wideband channels of 50 kHz to 150 kHz, or to aggregate wideband channels beyond 150 kHz to enable the deployment of broadband systems. The following public safety agencies, user associations, regional planning committees and manufacturers either specifically commented on the need for such wideband and broadband flexibility or supported the NPSTC plan, which incorporates that flexibility:

- Association of Public-Safety Communications Officials, International (APCO)
- California Highway Patrol
- City and County of Denver
- Dataradio
- EADS Public Safety, Inc.

---

4 Sprint Nextel Comments at 1.

5 *See* Section III and Appendix B, *infra*.

- Joint Comments of International Association of Chiefs of Police, Major Cities Chiefs Association, National Sheriffs' Association and Major County Sheriffs' Association
- International Association of Fire Chiefs
- M/A-COM, Inc.
- Motorola, Inc.
- National Public Safety Telecommunications Council
- North Carolina State Highway Patrol
- Ohio Office of Information Technology
- Region 26 Regional Planning Committee
- Region 39 Regional Planning Committee
- Region 45 Regional Planning Committee
- Spectrum Coalition for Public Safety
- State of California
- State of Hawaii

The International Association of Chiefs of Police, the Major Cities Chiefs Association, the National Sheriffs' Association, and the Major County Sheriffs' Association, for example request the flexibility to choose "wideband, broadband, or both, depending on our specific needs within our various jurisdictions."[6] Similarly, the International Association of Fire Chiefs advised that the RPCs are in the best position to determine and coordinate local and state needs to deploy broadband, wideband or some combination of the two.[7]

In addition to public safety associations, individual public safety agencies also supported the flexibility to choose the solution that best meets their needs. The North Carolina State Highway Patrol comments state that the decision on how to divide the 700 MHz spectrum is best

---

[6] International Association of Chiefs of Police, Major Cities Chiefs Association, National Sheriffs' Association, Major County Sheriffs' Association Joint Reply Comments at 3.

[7] International Association of Fire Chiefs (IAFC) Comments at 2.

left to the regional planning committees and that the Commission should not mandate a specific bandwidth for all users as proposed by Lucent.[8] Similarly, the State of Hawaii Department of Accounting and General Services urges the FCC to adopt a flexible band plan for the non-narrowband portions of the 700 MHz band so that the RPCs can accommodate broadband and/or wideband as they see fit, arguing that such a band plan maximizes the ability of first responders to adopt future technologies.[9]

The Spectrum Coalition for Public Safety, which is a strong proponent of broadband technology, also recognizes the need for and benefits of providing users flexibility to deploy wideband or broadband solutions stating that:

> [w]e believe the NPSTC proposal presents the best solution to the flexibility and protection needed in the band…. At this early stage, many of our members are not certain if broadband systems can be financially viable or provide adequate coverage. Therefore, while broadband speeds are preferable, we believe that ***the choice between wideband and broadband for data communications should be left to individual state, county and local governments*** who are in the best position to determine the approach that most fits their circumstances and meets their needs.[10]

Flexibility is also broadly supported by other manufacturers who offer equipment to the public safety market. For example, Dataradio encourages the FCC to adopt a "versatile and flexible plan that can accommodate a diverse set of existing and evolving technologies" by permitting the aggregation of 50 kHz channels in the 700 MHz band to any maximum number.[11] Similarly, EADS recommends a "flexible technology neutral approach of the broadband allocation in the 700 MHz which allows full competition and freedom of choice for the various

---

[8] North Carolina State Highway Patrol Comments at 1.

[9] Letter from Russ K. Saito, State Comptroller, State of Hawaii Department of Accounting and General Services, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 96-86, 3 (filed June 6, 2006).

[10] Spectrum Coalition for Public Safety Comments at 1 - 2 (emphasis in original).

[11] Dataradio Comments at 1.

public safety organizations, whatever their size and needs.[12] M/A-Com points out that the public safety community has not yet defined broadband application requirements for the 700 MHz public safety band and, therefore, the Commission should adopt a flexible band plan that can accommodate both wideband and, if desired, broadband operations in the 700 MHz public safety spectrum.[13]

The only commenters that oppose providing public safety users flexibility to choose wideband or broadband solutions are a few broadband manufacturers and integrators. In general, these opponents argue that wideband is already an outdated technology and, therefore, should not be permitted in the 700 MHz band.[14] For example, Lucent claims that EV-DO supports both higher data rates and greater coverage than wideband technologies and as such, wideband technologies are no longer appropriate in any situation.[15] Such arguments ignore the variety of needs present in the public safety community and mischaracterize aspects of the wideband and broadband technologies.

Opponents of public safety flexibility also argue that allowing public safety to choose between broadband and wideband would decrease the economies of scale that would result from utilizing a single technology. For example, Lockheed Martin argues that a flexible band plan would create spectrum and market fragmentation that would decrease economies of scale by regions' adoption of differing channel plans.[16] Similarly, Northrop Grumman argues that wideband equipment will be cost-prohibitive because it will only be available from a small

---

12 EADS Comments at 4.

13 M/A-Com Comments at 2.

14 *See, e.g.*, Lockheed Martin Comments at 2 ("broadband technologies have surpassed the capabilities originally envisioned for the wideband channels"); Northrop Grumman Information Technology Comments at 1 ("'wideband' has become an obsolete concept for public safety users").

15 Lucent Comments at 18-21.

16 Lockheed Martin Comments at 3.

number of vendors.[17] However, the claims on how public safety can benefit from the market economies of commercial 700 MHz EV-DO technology are, at best, premature. There is no existing 700 MHz EV-DO equipment and its future widespread availability is wholly dependent on 700 MHz commercial auction winners choosing to deploy that technology as opposed to other broadband alternatives. In addition, as discussed in greater detail in Section III of these reply comments, EV-DO devices designed principally for the consumer market are unlikely to provide the operating power or features required for public safety uses. Thus, public safety reliance of devices designed principally for the consumer market will necessitate customization that will undermine the commercial economies of scale.

Opponents further argue that a flexible band plan would reduce interoperability.[18] Interoperability, however, can be achieved under the NPSTC Plan. Indeed, the NPSTC Plan specifically provides for wideband interoperability channels that may only be used for public safety interoperability.[19] Moreover, some public safety entities have indicated they do not want a Commission requirement to implement a single technology.[20] Yet this is precisely what Lucent is seeking to do — mandate use of a single technology, EV-DO, across the entire 700 MHz public safety data band.[21] While interoperability is an important goal, it should not be implemented at the cost of depriving public safety entities the ability to deploy networks that

---

17 Northrop Grumman Information Technology Comments at 3.

18 *See, e.g.*, Lucent Comments at 32-33.

19 *NPSTC Proposal* at 3 (filed Feb. 6, 2006) (providing for a minimum of 2 3 MHz wideband interoperability channels).

20 *See, e.g.*, Region 39 700 MHz Regional Planning Committee Comments at 3.

21 Lucent Comments at 22-30 (advocating adoption of EV-DO as the single broadband technology standard for the 700 MHz band).

meet their specific day-to-day needs. As a number of public safety entities have advised, *operability* is as or more important than interoperability.[22]

Furthermore, Lucent would have the Commission mandate off-the-shelf EV-DO, a technology that does not provide the capability for unit-to-unit communications when public safety entities are outside of infrastructure coverage. Given the additional sites needed for broadband versus those required for voice or wideband, Lucent's recommendation for an off-the-shelf EV-DO mandate would merely lead to additional costs for more infrastructure that would have to be borne by public safety users with no option to make an alternative decision.

To be clear, Motorola is not anti EV-DO and is in fact a supplier of EV-DO handsets and infrastructure to commercial carrier customers. The recently introduced Motorola Q handheld with broadband data and voice phone capabilities operates on the EV-DO standard and has received excellent reviews from customers who rely on commercial carriers for their service. However, the scale and features of off-the-shelf EV-DO were designed for commercial carriers, not for public safety. While some public safety users may choose to deploy a broadband technology such as EV-DO as their best-fit solution, it is particularly inappropriate for some manufacturers and integrators to assume that they are inherently capable of making that decision for all public safety users.

In summary, these commercial interests that encourage the FCC to restructure the 700 MHz public safety band to allow only broadband operations fail to provide any reason that overcomes public safety's justifiable need for flexibility. Under NPSTC's Proposal, public safety users are free to choose the technology that best meets its needs, including an examination

---

[22] *See, e.g.*, Captain Eddie Reyes, Alexandria, VA Police Dept., *Basic Public Safety Communications and Interoperability*, PoliceOne.com (Apr. 10, 2006), http://www.policeone.com/pc_print.asp?vid=127284 (noting that public safety entities must focus on the operability of their communications systems before turning to interoperability).

of capabilities versus overall costs. As already addressed in Motorola's comments, the trade-offs between broadband and wideband deployment are significant.[23] Public safety agencies operate in a wide variety of environments and require different capabilities as a result of these differing environments.[24] All public safety agencies are taxpayer supported and must consider a cost-effective balance among many factors such as coverage, data rate, the need for unit-to-unit operation, overall interoperability requirements, reliability and compatibility with current systems.[25] Simply because broadband may offer greater nominal data rates if enough sites are deployed does not mean that broadband is the best technology to use in all public safety networks. Moreover, given the many comments in this proceeding submitted by public safety entities requesting continued flexibility to deploy wideband operations, there is no evidence that all public safety agencies consider wideband to be an obsolete technology.[26]

The record in this proceeding fully supports the flexibility for public safety users to choose between wideband and broadband technologies. The Commission should grant public safety this flexibility by approving the NPSTC plan and rejecting the recommendations of those that argue for a "broadband-only" approach.

III. Lucent Mischaracterizes Key Aspects of the Wideband and Broadband Technologies.

In an attempt to support its recommendation that the FCC mandate broadband technology without any user flexibility to deploy wideband, Lucent made a number of claims about EV-DO

---

23 Motorola Comments at 5-10.

24 *Id.* at 4.

25 Motorola Comments at 6-7.

26 *See, e.g.*, International Association of Fire Chiefs Comments at 1; North Carolina State Highway Patrol Comments at 1; Region 45 700 MHz Regional Planning Committee Comments at 1.

and TIA902(SAM) technologies. Primarily, Lucent claims that the coverage of EV-DO is better than that of SAM, that SAM does not provide the data rates needed by public safety and that EV-DO is more spectrally efficient.[27] Motorola has reviewed the Lucent analysis for EV-DO and SAM performance. Our analysis found significant errors in the Lucent claims, many of which appear to be based on Lucent's flawed assumptions about public safety system deployments as opposed to deployments of commercial systems. For a true comparison, any technology must be viewed in the context of how it will be deployed and used. This section of these reply comments examines the Lucent claims in more detail. In summary, Lucent has provided no factual basis upon which to conclude that public safety users would benefit from being denied the flexibility to choose the best fit solution, whether wideband or broadband.

A. Coverage

One of the potential benefits of broadband that public safety agencies have expressed is the option to purchase "commercial off-the-shelf" (COTS) equipment which enjoys greater economies of scale. To obtain greater economies of scale, however, the equipment that will be offered to public safety must also be sought after by a larger market, *e.g.*, commercial providers or their customers. In making its coverage comparisons, Lucent ignores this requirement. In its comments Lucent claims that:

> …relatively low-power (*i.e.* 800 mw EIRP) commercial broadband user devices utilizing 1.25 MHz channels in the 700 MHz band are capable of reliably supporting data rates of roughly 500 kbps for a range of 4.2 Miles in an urban environment, 7.9 miles in a suburban environment, and 25.6 miles in open areas.[28]

---

[27] Lucent Comments at 13-31.

[28] *Id.* at 11 - 12.

Typical COTS EV-DO portable and mobile user devices operate with approximately 300 mw EIRP.[29] The amount of actual power available for data traffic is less due to overhead control channels that Lucent does not account for. For a rate of 9.6 kb/s at the cell edge, there is typically only 106 mw left for payload data power.[30] Accordingly, the Lucent 9.6 kb/s coverage calculation which purports to show that EV-DO can provide better coverage than TIA902 (SAM) is optimistic by about 9 dB on these parameters alone.

It is also likely that any public safety implementation of EV-DO would need to support both mobile and portable/PCMCIA based subscriber user end devices. This means that the system infrastructure must be designed to support lower power portable devices albeit at lower data rates. In turn, this requires higher power mobile transmitters to include enhanced power control dynamic range, which is already 60 dB. This is not a trivial task for a highly linear transmitter.

Another significant factor leading to Lucent's results appears to be the use of a SAM sensitivity number of -98 dBm.[31] This number used by Lucent is the uncoded 1% bit error rate (BER) specification that is used by receiver hardware designs to test at the lower physical layer, as defined in TIA-902.BAAB-A. SAM radio channel coding is defined in TIA-902.BAAD-A and defines powerful block product turbo codes that greatly increase faded receiver sensitivity. Considering these turbo codes in the analysis would lead to more realistic results.

Furthermore TIA TR-8.18 is currently in the process of defining SAM performance that indicates that a TU50 faded Carrier to Interference Noise Ratio (CINR) of 12 dB can be used for

---

[29] While specialized higher power units might be developed specifically for the public safety market, commercial economies of scale would not be applicable for such devices.

[30] For a broadband rate of 307 kb/s at the cell edge, there is 238 mw left for payload data power.

[31] *Id.*, Exhibit E at 6.

SAM 50 kHz at the QPSK cell edge.[32] As with the EV-DO projections, a 2 branch receive diversity base station is assumed, and this conservatively will decrease the CINR to a 9 dB figure of merit.

Lucent based its coverage analysis by selecting a 16 dBi gain antenna for the EV-DO link budget and both an 8 dBi antenna and 16 dBi antenna for the TIA-902(SAM) link budget.[33] There is no reason to use different antenna gains for this comparison and doing so biases the results in favor of Lucent's preferred outcome.

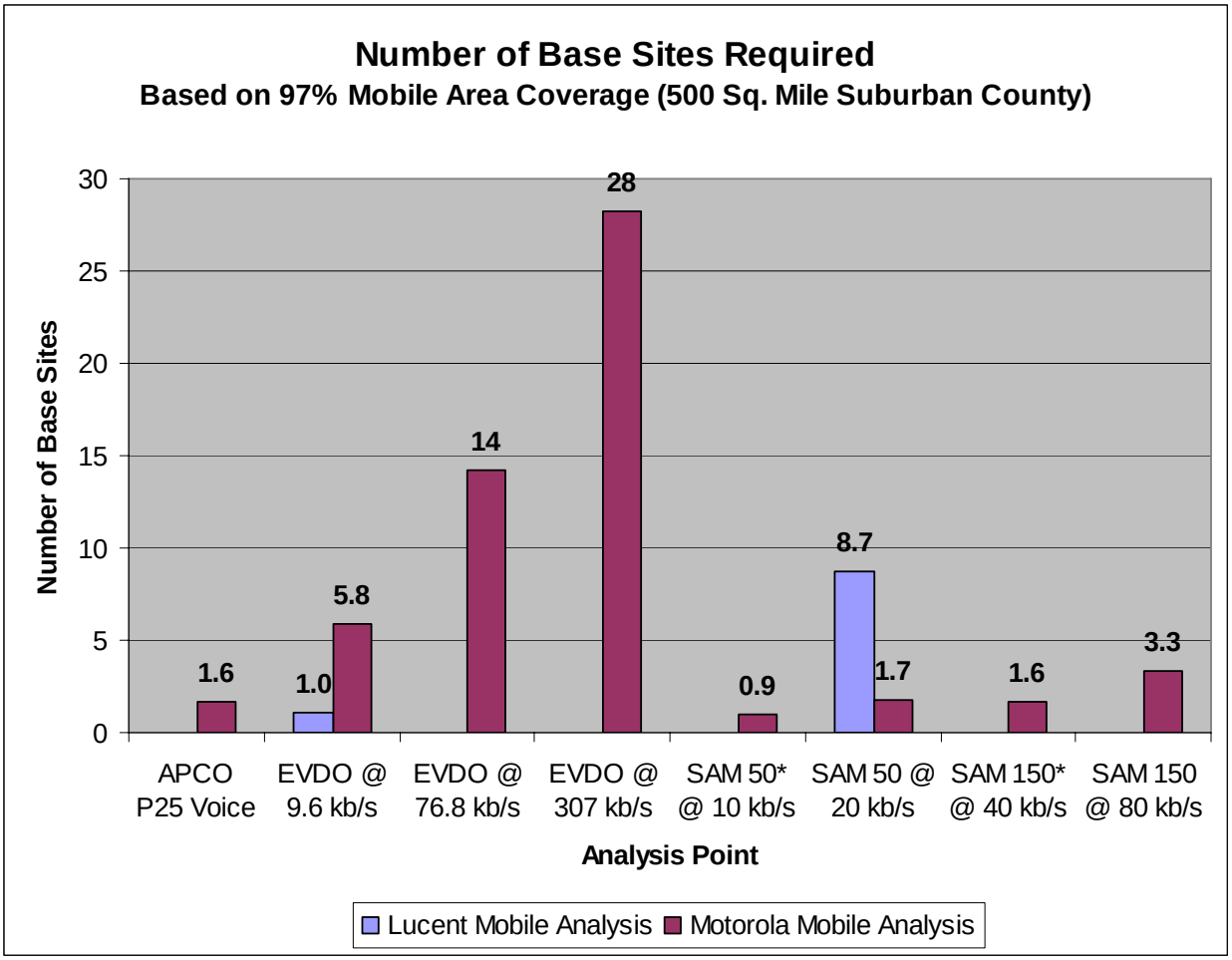
Motorola has provided a detailed link budget pertinent to the public safety environment for the TIA-902(SAM) and EV-DO technologies in Appendix A. The results of this analysis shows that SAM has better coverage range, thereby requiring fewer base sites, and better sector spectral efficiency for applications below 80 kb/s. EV-DO has greater overall channel throughput, but an EV-DO channel generally requires 8.3 to 25 times more spectrum. The results of our analysis are summarized in the following chart. The asterisk next to some of the TIA-902(SAM) results refers to equipment that incorporates Motorola designed performance enhancements to the existing standard that Motorola has submitted to the relevant standards body.[34] These enhancements would provide an additional 6 dB link budget gain:

---

[32] TU50 refers to a fading prediction tool for Typical Urban fading when a vehicle is traveling at 50 km/hour.

[33] *Id.*, Exhibit E at 5.

[34] Motorola has made some performance enhancement recommendations to TIA TR-8.5 that will permit SAM to obtain at least a 6 dB link budget gain. This will permit either a better coverage range, or better throughput with the same coverage range, as portrayed above. This technology upgrade will permit TIA-902(SAM) to utilize a 3 channel frequency reuse configuration for low density applications. The anticipated enhanced performance is shown in the chart below as well as the link budget in Appendix A.



As can be seen in the above chart, Lucent's overly-optimistic analysis[35] leads it to conclude that a single EV-DO site can provide a 9.6 kb/s data rate at the edge of the 500 square mile Suburban County coverage area; Motorola estimates that it would take nearly six EV-DO sites to achieve that level of coverage. Similarly, Lucent estimates that nine TIA-902(SAM) 50 kHz sites would be needed to provide at least 20 kb/s data rates throughout the 500 square mile Suburban County being considered; Motorola's analysis shows that it would take no more than two.

[35] *Id.*, Exhibit E at 5-8.

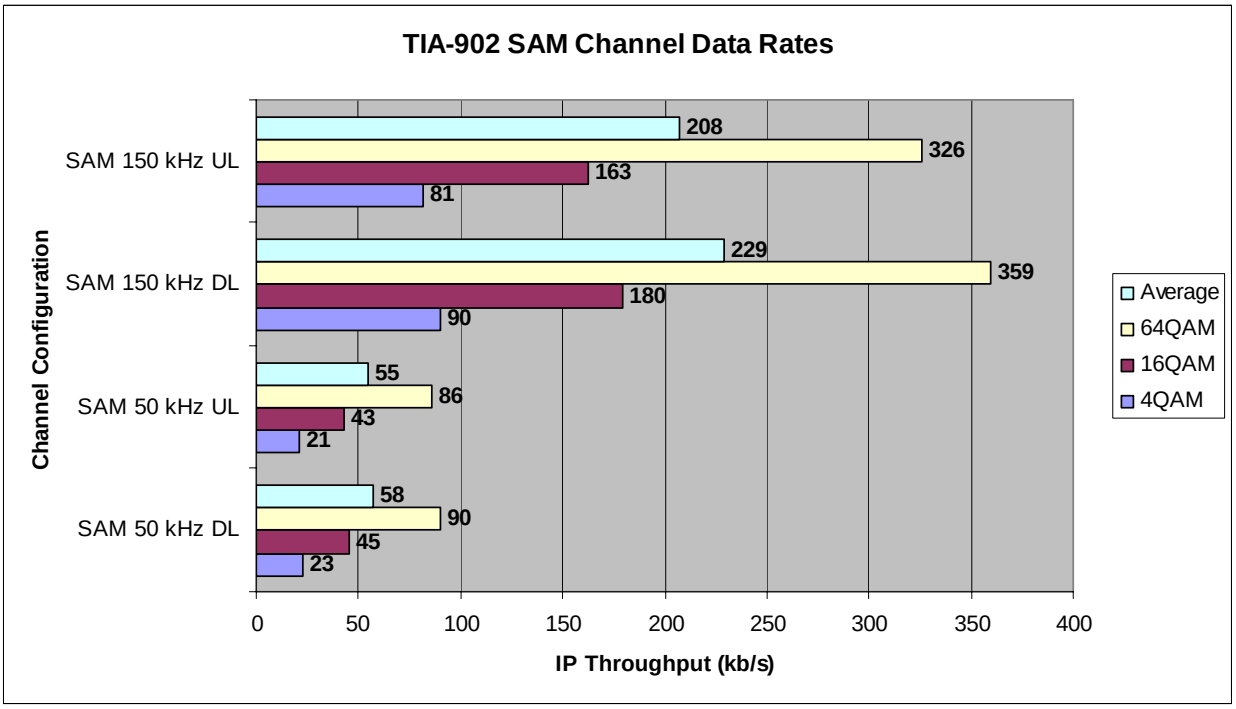
The main factor for this discrepancy in the analysis between Motorola and Lucent appears to be the EV-DO user device terminal radiated power for data traffic, the assumption on SAM receiver sensitivity and the antenna selection as noted above.

B. Data Rates

It should also be noted that TIA902 (SAM) is a wideband (50 – 150 kHz) channel technology and has never been promoted as broadband. The term broadband typically means user data throughputs rates of at least 500 kb/s, and typically 1 Mb/s. Wireless LANs (*e.g.*, WiFi) support user data throughputs on the order of 1 to 20 Mb/s, while outdoor MESH networked Wireless LANs typically provide 500 kb/s to 10 Mb/s.

However, merely characterizing a technology as wideband or broadband does not define the applications that can be supported. Lucent and other broadband proponents inappropriately claim that wideband TIA-902 (SAM) is inadequate for public safety video and data.[36] However, the Motorola Greenhouse system pilot of the SAM 150 kHz technology, deployed in Pinellas County, Florida, supported full duplex video rates of 45 – 90 kbps. These rates were deemed highly useful to the Public Safety community by the pilot participant. The pilot system utilized only 16QAM modulation and could have supported greater peak video rates with 64QAM as it is now defined in the TIA-902.BAAB-A SAM Standard. The following table summarizes the data rates for TIA-902 (SAM) for various channel widths and modulation schemes for both the uplink (UL) and downlink (DL):

[36] Lucent Comments at 19; Qualcomm Comments at 8-9, 20, 29.



In addressing the data rate characteristics of EV-DO for public safety in its comments, Lucent comments that:

> For example, full-motion video (i.e. 30 frames per second ("fps")) requires very high data rates, e.g., 500 kbps or greater, to achieve the resolution quality typically found on Personal Digital Assistants ("PDAs"). Even lower quality limited-motion video (*i.e*. 15 fps), requires minimum data rates in the 100-300 kbps range. All current broadband technologies support air interface bandwidths in excess of 1.25 MHz, and therefore reliable data rates in excess of 500 kbps.[37]

While EV-DO has "peak" advertised channel rates of 3.1 Mb/s downlink and 1.8 Mb/s uplink, the average user experience will not match these theoretical peak rates. Call detail record data from actual commercial field deployments show that mobile units with diversity antennas average 1000 to 1200 kbps in the downlink direction. Using coverage prediction tools on target commercial markets, Motorola typically sees the 95% reliability edge signal-to-noise ratio varies from 0 to -2 db, which corresponds to a downlink rate of approximately 400 to 600 kbps.

---

[37] Lucent Comments at 19.

Although lower than the advertised theoretical peak rates, this does provide a significant forward data throughput.

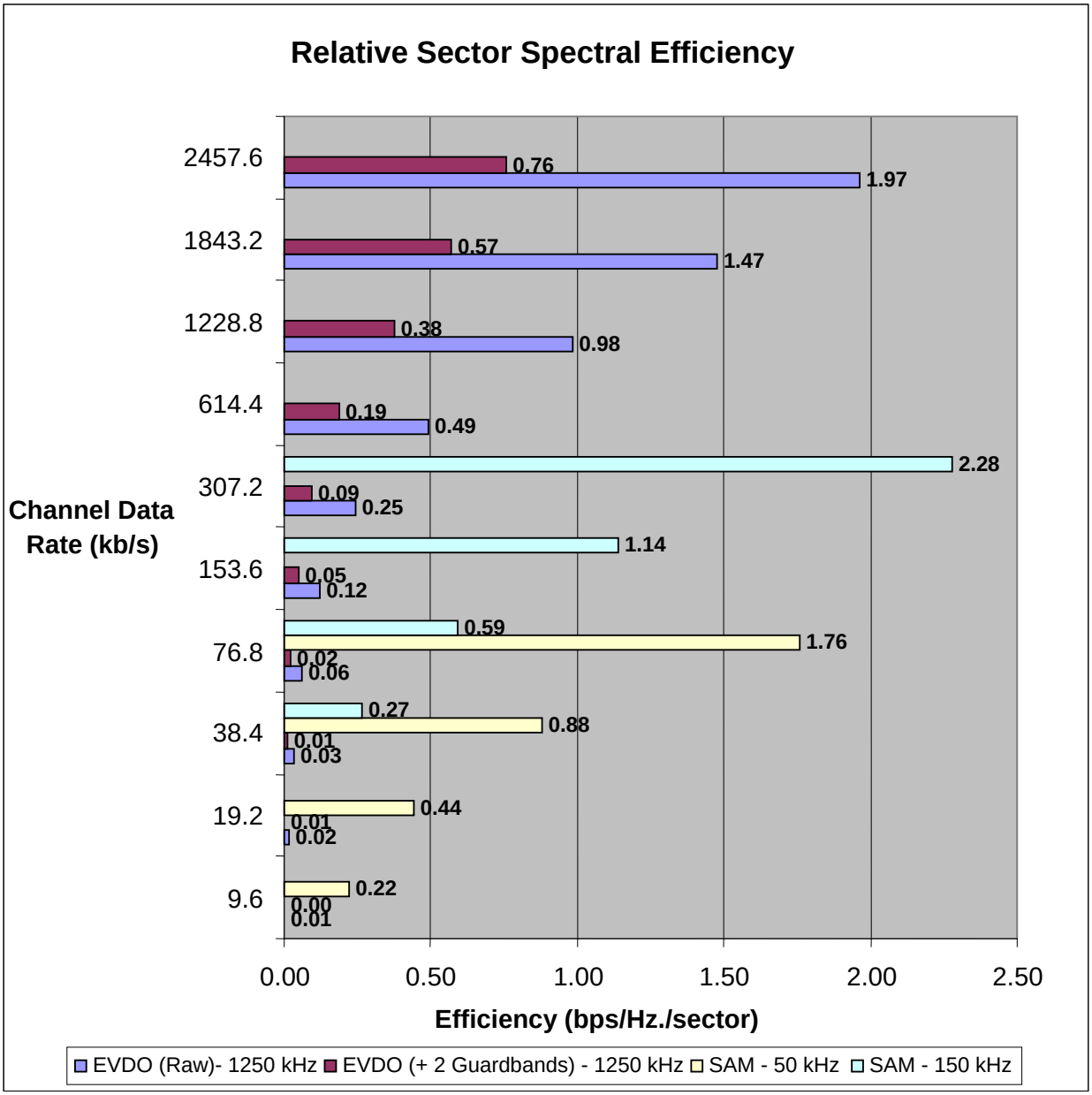
The EV-DO air interface should be capable of supporting 200 to 300 kbps video for 95% of the coverage area on the uplink given proper system planning. The primary limit to uplink performance is the limited 200 to 300 mW power used on the current commercially available mobiles. For public safety applications, the power of the mobile unit could be increased to allow high speed over a broader coverage area or the number of sites would need to be increased. This is a classic system design trade. Ironically, after touting these high data rates, Lucent's analysis uses an EV-DO cell edge rate of 9.6 and 19.2 kb/s (rather than 500 kb/s) in its comparison to SAM technology.[38] These lower edge rates would also mean that sector throughputs and spectral efficiencies for EV-DO will be significantly less than the speeds being promoted as the rationale to deploy broadband. The range extension of EV-DO to 9.6 kb/s at the cell edge thus does not truly represent a useful coverage range for deploying broadband.

C. Spectral Efficiency

The following chart "Relative Sector Spectral Efficiency" shows the relative sector data throughput delivery in terms of spectral efficiency. As can be discerned from this chart, TIA-902(SAM) 50 kHz is a viable solution for public safety system deployments that do not require greater than 20 kb/s for 95% of the area on the cell edge. For public safety system deployments that do not require greater than 80 kb/s for 95% of the area on the cell edge, then TIA-90(SAM) 150 kHz is a viable solution. For public safety system deployments that require greater than 80 kb/s for 95% of the area on the cell edge, then EV-DO may be used. However, EV-DO deployments that do not support at least 200 – 300 kb/s on the edge of the cell under loaded

[38] *Id.*, Exhibit E at 5-6.

conditions are generally not considered an efficient use of limited public safety spectrum. Public Safety RPC's should consider the above when evaluating proposals for wideband or broadband implementation.



The figure above shows that both TIA-902(SAM) and EV-DO are highly spectrally efficient at their peak data rates. However, when a system is designed with a large site

separation, the edge-of-cell bit rate will be a fraction of the peak rate and the efficiency will be reduced. If high peak data rates are not required, it is more efficient to use a technology with a smaller bandwidth. Even when accounting for EV-DO single frequency reuse versus TIA-902(SAM)'s three channel reuse, and the option to use sectored antennas for EV-DO, TIA-902(SAM) is more efficient for cell edge data rates less than 80 kb/s.

While the spectrum efficiency results Lucent claims[39] in its comments may be applicable to dense carrier deployments with 3 carriers in each of 3 sectors at each and every base site, it is unlikely to be applicable for public safety system deployments. In its comments, Lucent claims high spectral efficiencies without defining what conditions and parameters were used, especially the traffic loading and edge data rate.[40] Lucent later portrays very low edge rate communications as low as 4.8 kb/s, which would undoubtedly bring the reverse link spectral efficiency far below that of its previous claims. Lucent also relies on 3 way sectored cells, each with 3 carriers, which are less likely to be used in cost-constrained public safety implementations.

In summary, Lucent's analysis inconsistently uses various data rate measures and other performance metrics in an attempt to justify adoption of a broadband-only decision. A low data rate is used to boost coverage results, however that same low data rate is not used to address applications, promote the use of broad channels or to calculate spectrum efficiency. Motorola believes that the Commission should reject Lucent's analysis and enable the public safety community's stated requirement for flexibility to deploy wideband or broadband solutions that best fit the requirements of a given agency.

---

39 *Id.* at 16.

40 *Id.*, Exhibit B at 1.

IV. Protection of Public Safety Narrowband Voice Spectrum is Essential.

NPSTC, Motorola and other commenters emphasize the need to protect voice operations from the deployment of data systems.[41] In part, this reflects the high priority that public safety places on its lifeline mission critical voice operations.

Sprint Nextel, which has first hand experience with interference in the 800 MHz band, urges the Commission to ensure that potential interference is addressed up front in the process.[42] In addition, Sprint-Nextel comments that:

> Creating wider channels in the 700 MHz band may increase the number and variety of intermodulation components that are able to reach a wide range of both in-band and out-of-band frequencies. Furthermore, the wider the bandwidth of a particular channel, the more difficult it becomes to shift frequencies to eliminate or minimize harmful intermodulation components. Consequently, adopting a broadband channelization plan could make it more difficult to mitigate, much less prevent, intermodulation interference.[43]

In Appendix B to these reply comments, Motorola provides specific recommended rule changes to address the protection of voice operations. These rule changes center around three general areas:

- Out of band emission limits, including external filtering;
- Limits regarding the signal levels on the ground in close proximity to broadband or wideband antenna sites;
- Provisions defining responsibility to resolve interference, should it occur.

As noted in the initial Motorola comments,[44] a combination of guard band spectrum and requisite base station transmitter filtering is needed to control interference from out of band emissions (OOBE). The derivation of guard band requirements was developed based on readily

---

41 *See, e.g.*, NPSTC Comments at 13; Motorola Comments at 10.

42 Sprint Nextel Comments at 3.

43 *Id*.

44 Motorola Comments at 12-13.

available filtering for both broadband and wideband base transmitters. Additional filtering is more critical for broadband than for wideband since wideband deployment requires fewer sites and has a much greater likelihood of collocating with the voice systems being protected.

Appendix B of these reply comments provide specific recommendations regarding adjacent channel and out of band protection levels. Editorial notes in Appendix B also provide additional clarification regarding the derivation of these recommended ACP levels.

At 800 MHz, much of the interference experienced was the result of "near-far" problems. That is, the interfering signal was nearby and very strong, whereas the desired signal could be transmitted from some distance away and comparatively weak in strength. It was determined that these near-far problems are exacerbated when mixing relatively low site commercial type systems with relatively high site public safety systems. This occurred because lower site systems typically place a much stronger signal at or near ground level where mobile and portable public safety receive antennas are located. Therefore, one way to reduce the probability that near-far interference will occur is to limit the signal level at ground level in close proximity to a potentially interfering base station transmit antenna. The recommended rules in Appendix B include such provisions.

Despite best efforts to set rules up front that avoid interference, situations could arise in which interference occurs. Because any interference would be harmful to public safety mission critical voice operations it is essential that this potential be addressed. Accordingly, Motorola recommends as part of the rules that provisions similar to those adopted at 800 MHz to address post-rebanding interference be adopted at 700 MHz for the deployment of broadband or wideband operations. Appendix B includes such provisions as part of the recommended rule changes for the 700 MHz band.

V. The FCC Should Adopt TIA-902(SAM) for Use on the Wideband Interoperability Channels.

In its comments, Motorola recommended that the TIA-902(SAM) standard be adopted by the Commission as the wideband interoperability standard.[45] In supporting this recommendation, Motorola noted that: 1) the standard was developed jointly in an open standards process by the public safety community and with the participation of multiple manufacturers; 2) development of the standard was based on public safety rather than commercial requirements; 3) the standard is documented and maintained for multiple manufacturer use by TIA/ANSI; use of the standard is consistent with the highest level of interoperability on the Department of Homeland Security Interoperability Continuum; and 4) Motorola has gone on record offering to license essential intellectual property to other manufacturers on a royalty-free basis for interoperability use.[46]

No other wideband or broadband data standard provides all these benefits. Also, the public safety leadership endorsed TIA902(SAM) as a wideband interoperability standard. The International Association of Fire Chiefs recommend that for agencies that need to ensure wideband interoperability, the Commission should require the TIA-902 (SAM) standard.[47] In addition, NPSTC which represents 13 user associations with an aggregate of thousands of public safety members also recommended that TIA-902 (SAM) be used as the interoperability standard for those agencies requiring wideband interoperability.[48] To clarify, while it may also improve interoperability, Motorola did not recommend that broadband radios be required to include a wideband capability.

---

45 *Id.* at 15-20.

46 *Id*. at 19-20.

47 International Association of Fire Chiefs Comments at 2-3.

48 NPSTC Comments at 18. NPSTC supports use of the TIA-902 (SAM) standard on the wideband interoperability channels but does not support a mandate that every wideband or broadband radio be required to include TIA-902 (SAM) to be FCC certified.

Lucent and Qualcomm recommend off-the-shelf EV-DO as a broadband standard. The EV-DO standard was developed based on the requirements of commercial system providers, not public safety requirements. The optimization priorities and scale of commercial systems are significantly different than those of most public safety systems. In addition, a survey of publicly available documents seems to demonstrate a concern in the industry about the intellectual property (IPR) fees for technologies licensed by Qualcomm. According to these documents, some entities even seem to be considering switching technologies or changing business plans because of the IPR licensing fees:

> Shares of CDMA technology pioneer Qualcomm have come under tremendous pressure over the past one month, losing a market cap of $11.7bn on the back of Reliance Communication, one of its major customers, mulling the option of switching to GSM technology due to issues related to royalty payment. Reliance is South Asia's largest CDMA player and pays a hefty royalty to Qualcomm for using the technology for providing telecom services across the country.[49]
>
> and,
>
> Nokia last week announced it would stop negotiating with Japan's Sanyo to establish a joint venture to strengthen its CDMA business. It cited Qualcomm's excessive royalties demands, which it said would make it difficult to make profits in emerging markets India and China. Earlier, the Finnish company filed a complaint against the U.S. business with the European Commission for charging excessive royalties. Qualcomm early this month responded with a suit against the mobile phone maker at the U.S. International Trade Commission for six patent violations.[50]

In considering various technologies as a possible broadband interoperability standard, Motorola recommends that the Commission fully appreciate the intellectual property licensing issues for a candidate technology. As noted previously, Motorola is already on record as

---

[49] *Qualcomm Loses $11 bn in m-cap*, THE ECONOMIC TIMES, (July 4, 2006), http://economictimes.indiatimes.com/articleshow/1702910.cms.

[50] *Nokia, Qualcomm in CDMA Royalties Wrangle*, ENGLISH.CHOSUN.COM (June 26, 2006), http://english.chosun.com/w21data/html/news/200606/200606260025.html

committing royalty-free licensing of essential IPR it holds for interoperability use at 700 MHz of both TIA-902(SAM) wideband as well as P25 Phase 1 narrowband standards. However, to Motorola's knowledge, no such commitments have been made for EV-DO as part of Qualcomm's and Lucent's recommendations that it be chosen as a broadband interoperability standard.

VI. Conclusion.

For the reasons detailed above, the FCC should adopt NPSTC's proposed band plan for modifying the 700 MHz public safety band. This plan provides public safety agencies a high degree of flexibility to tailor their communications networks to their needs. While broadband can provide benefits of higher overall data rates, particularly at locations near the base station antenna, it comes at the cost of installing and maintaining a far greater number of sites and therefore may prove to be cost prohibitive for a number of public safety agencies.

Accordingly, in any revised band plan, the FCC must provide licensees flexibility to choose between wideband and/or broadband technologies, not just on a regional basis but also within regions pursuant to plans developed by the RPCs. Such flexibility will provide public safety entities the opportunity to choose technologies based on the most appropriate data solution meeting these requirements, taking into account trade offs between data rate, coverage, cost requirements, spectrum efficiency and interference impact rather than a regulatory mandate as Lucent proposes.

NPSTC has also emphasized the need to protect narrowband voice operations and Motorola has provided recommended rules herein to help provide that protection. Mission critical voice services that are being deployed in the 700 MHz narrowband channels provide the backbone of public safety communications and must be fully protected from interference.

The Commission should also adopt the TIA 902(SAM) standard for use on the wideband interoperability channels in order to lay the foundation for achieving the highest level of interoperability among users. Finally, while Motorola fully supports the accommodation of broadband technologies as an option in this band, we believe that the spectrum available is ultimately insufficient to meet the needs of public safety. Therefore, we urge the Commission to continue to identify and allocate additional spectrum for public safety broadband operations.

Respectfully submitted,

Motorola, Inc.

By: /S/ *Steve B. Sharkey*
Steve B. Sharkey
Director, Spectrum and Standards Strategy

By: /S/ Robert D. Kubik
Robert D. Kubik
Director, Telecom Relations Global

1350 I Street, NW
Suite 400
Washington, DC 20005-3305
TEL: 202.371.6900

Dated: July 6, 2006

APPENDIX A: LINK BUDGETS FOR TIA-902(SAM) AND EV-DO

Motorola has reviewed the Lucent projected link budgets, and offers up a more detailed analysis that has corrected errors for TIA-902(SAM) and applied more reasonable COTS based EV-DO projections that are expected to be actually available and deployed.

Subscriber Effective Power

The EV-DO uplink power is shared between the data channel and various overhead control channels that were not accounted for in the Lucent coverage analysis, which has lead to false conclusions. This is particularly impacting on the low data rate edge contour projections as the 4.8 – 19.2 kb/s high capacity channel configurations have -6.6 to -4.5 dB of traffic channel power relative to total PA transmit power. Channels operating at higher data rates are configured to have on the order of -1 to -2 dB of traffic channel power relative to total PA transmitted power.

When a portable user device such as a cell phone or PDA is used in close proximity of the human body additional propagation losses occur. These are typically on the order of 5 dB for existing public safety radio with external antennas, and can be as much as 10 dB or more for internal PDA antennas according to both the electrical antenna design and actual operating position. We propose to use a nominal loss of 5 dB, but note that actual product antenna testing and operating position must be accounted for in the actual field design.

[Reference 3GPP2 C.S0032-A "Recommended Minimum Performance Specifications for cdma2000 High Rate Packet Data Access Network"]

Base Station Receiver Sensitivity

The 3GPP2 performance specifications define receiver sensitivity for 5 different channel configurations (AWGN, 3, 8, 30, and 100 km/h) and the TIA-902 specifications are for a typical urban environment at 50 km/h. The EV-DO Eb/Nt specification ranges from .63 dB to 3.99 dB, so we use a middle value of 2.3 dB. The specification also lists that power control is to be enabled for this test so we will not include the 4 dB power control headroom value that Qualcomm used so as to not be too conservative.

[Reference 3GPP2 C.S0032-A "Recommended Minimum Performance Specifications for cdma2000 High Rate Packet Data Access Network"]

Base Station Noise Figure

While Lucent used a 4 dB parameter, Qualcomm supplied a 5 dB estimate for this parameter. We have used a 6 dB figure that will be the same for all technologies, as it is felt to be more representative of typical fielded systems.

Rise over Thermal (ROT)

While everyday operating user traffic densities of Public Safety systems may be very low on average, the system has to be designed for mission critical applications. An incident scene for

emergency communications can become a traffic hot zone instantly, and hence Motorola feels confidently that Public Safety systems must be designed with this operational scenario in mind. Motorola will use the same 5.5 dB figure that Lucent used for its loaded embedded cell analysis.

Base Station Antenna Gain

There is no valid reason why a 16.1 dBi gain sectored antenna should be used for EV-DO in comparison of an 8 dBi Omni directional antenna for SAM. Both technologies can be deployed with either antenna type and this should be made the same for a valid comparison. A value of 16.1 dBi will be used for both technologies.

Frequency Reuse

The current standard for TIA-902 (SAM) currently permits deployments with 7 channel frequency reuse as Lucent noted in their analysis. The proposed enhancements will permit SAM operation with as little as 3 channel frequency reuse and that is what is portrayed in the link budget tables as noted with an *.

Comparison to APCO Project 25 Voice Coverage Ranges

It is significant to note that a typical APCO Project 25 link margin for the mobile uplink case is 154.2 dB. Note that the link margin (called Median Path Loss in the tables) for the 50 kHz SAM mobile case is 153.8 dB, hence 50 kHz SAM has a range that for practical purposes is as good as APCO 25 voice systems. This allows 50 kHz SAM base stations to cover the same area as APCO 25 voice stations from the same sites utilized for the APCO 25 voice system with no additional site development.

In addition, by including the impact of the performance enhancements Motorola has recommended to the TIA, 150 kHz SAM will have the same range as APCO 25 voice systems and will allow 150 kHz SAM sites to utilize the same sites as APCO 25 voice systems with no additional site development. Collocation is not only very economical but also greatly reduces most forms of interference by eliminating the near-far scenarios that exist between APCO 25 and cellular technologies in the 800 MHz band today. Thus, SAM will be a very appealing choice for public safety users except those that require high-resolution, high-frame-rate video.

CDMA1X- EV-DO					
Link Budget - Uplink					
Nominal Data Rate	kb/s	9.6	76.8	153.6	307
		Mobile	Mobile	Mobile	Mobile
Terminal Power	mw	300	300	300	300
Terminal Power	dBm	24.8	24.8	24.8	24.8
Antenna Line	dB	-2	-2	-2	-2
Antenna Gain	dBi	2	2	2	2
EIRP	dBm	24.8	24.8	24.8	24.8
EIRP	mw	300	300	300	300
Portable Body Loss	dB	0	0	0	0
Overhead Channels	dB	-4.5	-2	-1.5	-1
Adjusted Power	dBm	20.3	22.8	23.3	23.8
Adjusted Power	mw	106	189	212	238
BTS ENBW	kHz	1228.8	1228.8	1228.8	1228.8
BTS ENBW	dB-Hz	60.9	60.9	60.9	60.9
BTS Nf	dB	6	6	6	6
BTS Thermal Noise (Nt)	dBm	-107.1	-107.1	-107.1	-107.1
Eb/Nt	dB	2.3	2.3	2.3	2.3
Faded Data Sensitivity	dBm	-125.9	-116.8	-113.8	-110.8
Rise over Thermal	dB	5.5	5.5	5.5	5.5
Adjusted Sensitivity	dBm	-120.4	-111.3	-108.3	-105.3
BTS Jumper Loss	dB	1.0	1.0	1.0	1.0
BTS Line Loss	dB	3.0	3.0	3.0	3.0
Antenna Jumper Loss	dB	1.0	1.0	1.0	1.0
BTS Antenna Gain	dBi	16.1	16.1	16.1	16.1
Effective Rx Sensitivity	dBm	-131.5	-122.4	-119.4	-116.4
Slow Fading Sigma	dB	8	8	8.0	8.0
Slow Fading (97% Area)	dB	10.2	10.2	10.2	10.2
Soft HO	dB	3.4	3.4	3.4	3.4
BL/VL	dB	0	0	0	0
Median Path Loss	dB	144.9	138.4	135.9	133.4
	BTS Antenna				
Range (Miles)	Height (M)				
Urban	40	2.7	1.7	1.5	1.2
Suburban	50	5.7	3.7	3.1	2.6
Town	60	14.9	10.2	8.6	7.2
Area (Sq. Miles)					
Urban		18.5	7.7	5.5	3.9
Suburban		85.5	35.1	24.9	17.7
Town		577.7	271.6	191.8	135.6
Number of Sites					
Urban City (Downtown)	10	0.5	1.3	1.8	2.5
Suburban County	500	5.8	14.3	20.1	28.3
Rural County	500	0.9	1.8	2.6	3.7

TIA-902 SAM / TIA-102 APCO P25						
						APCO P25
Link Budget - Uplink		50 kHz	150 kHz	50 kHz *	150 kHz *	12.5 kHz
		Mobile	Mobile	Mobile	Mobile	Mobile
Terminal Power	W	10	10	10	10	30
Terminal Power	dBm	40.0	40.0	40.0	40.0	44.8
Antenna Line	dB	-2	-2	-2	-2	-2
Antenna Gain	dBi	2	2	2	2	2
EIRP	dBm	40.0	40.0	40.0	40.0	44.8
EIRP	mw	10000	10000	10000	10000	30000
Portable Body Loss	dB	0	0	0	0	0
Overhead Channels	dB	0	0	0	0	0
Adjusted Power	dBm	40.0	40.0	40.0	40.0	44.8
BTS ENBW	kHz	38.4	115.2	38.4	115.2	5.76
BTS ENBW	dB-Hz	45.8	50.6	45.8	50.6	37.6
BTS Nf	dB	6	6	6	6	6
BTS Thermal Noise	dBm	-122.2	-117.4	-122.2	-117.4	-130.4
Cell Edge Data Rate	kb/s	22	88	11	44	Voice
ROT	dB	0.2	0.2	1.0	1.0	0.2
Fast Fading TU50	dB	12.0	12.0	6.0	6.0	16.5
2 Branch MRC	dB	3	3	3	3	0
Faded Data Sensitivity	dBm	-113.0	-108.2	-118.2	-113.4	-113.7
BTS Jumper Loss	dB	1.0	1.0	1.0	1.0	1.0
BTS Line Loss	dB	3.0	3.0	3.0	3.0	3.0
Antenna Jumper Loss	dB	1.0	1.0	1.0	1.0	1.0
BTS Antenna Gain	dBi	16.1	16.1	16.1	16.1	11.0
Effective Rx Sensitivity	dBm	-124.1	-119.3	-129.3	-124.5	-119.7
Slow Fading Sigma	dB	8	8	8	8	8
Slow Fading (97% Area)	dB	10.2	10.2	10.2	10.2	10.2
Soft HO	dB	0	0	0	0	0
BL/VL	dB	0	0	0	0	0
Median Path Loss	dB	153.8	149.0	159.0	154.2	154.2
Range (Miles)						
Urban		4.8	3.5	6.9	5.0	5.0
Suburban		10.5	7.6	14.3	10.8	10.8
Town		22.2	18.1	27.3	22.6	22.6
Area (Sq. Miles)						
Urban		60.9	32.2	122.2	64.5	64.4
Suburban		288.1	150.3	528.3	305.4	304.6
Town		1280.4	847.8	1936.6	1326.7	1324.7
Number of Sites						
Urban City (Downtown)	10	0.2	0.3	0.1	0.2	0.2
Suburban County	500	1.7	3.3	0.9	1.6	1.6
Rural County	500	0.4	0.6	0.3	0.4	0.4

APPENDIX B: RECOMMENDED RULE CHANGES

In this appendix, Motorola provides recommended modifications to existing Part 90 rules in order to provide adequate interference protection to 700 MHz narrowband voice channels from 700 MHz broadband deployment. A generalized description of the recommended changes is first provided followed by amended rule language.

Band Plan.
The proposed modifications are consistent with the NPSTC proposal. In Section 90.531(d)(3)(i)-(iii), 50 kHz wideband channel pairs may be aggregated to form one, two, or three broadband channel pairs at specific locations within the wideband spectrum allocation. In Section 90.531(c)(1), it is proposed to move three 50 kHz wideband channel pairs to the upper band edge and three 50 kHz wideband channel pairs to the lower edge of band. In Section 90.531(c)(1)(i), two of these channel pairs (one at each edge) are proposed to be designate as nationwide wideband interoperability calling channel pairs. In Section 90.531(c)(1)(ii), the remaining four channel pairs are proposed to be designated as nationwide interoperability channel pairs.

Motorola is also proposing to retain twelve wideband interoperability channel pairs. These channel pairs could be used for interoperability or they could be used as part of multi-agency wideband systems. This proposal is similar to use of certain narrowband interoperability channel pairs for secondary trunked operations. The decision on the use of these channels would be made at the regional level.

Emission Limits.
Major near-far interference mechanisms observed in 800 MHz band from the deployment of dissimilar technologies within same spectrum band were due to high undesired signal levels from continuous carriers. Higher emission limits combined with lower site isolation result in a rise in public safety subscriber noise floor. Low site isolation also contributed to intermodulation interference in subscriber receivers. If the dissimilar technologies have significantly different deployment strategies and coverage requirements, sites from one system can end up located where interference is maximized to or from the other system. Coordination between broadband and narrowband licensees in the selection of sites can reduce, but not always eliminate, the potential for interference.

NPSTC has defined protection of narrowband voice as a priority. Narrowband should be protected equally whether it is deployed first or last. To minimize pre-coordination between licensees, emission rules and network design guidelines for technologies deployed in 700 MHz wideband spectrum must provide a minimum level of interference protection to narrowband subscribers. Otherwise, wideband/broadband licensees may have to resolve interference to narrowband long after deployment.

In order to accommodate three 1.25 MHz broadband channels, the NPSTC band plan proposes a 0.975 kHz guard band between edge of a broadband channel and closest wideband interoperability channel. The proposal would protect wideband and narrowband to at least the same levels as Part 27 operators must protect public safety narrowband beyond the 0.975 MHz

guard band.[1] Since 700 MHz narrowband channels are likely to be used to expand existing 800 MHz systems, threshold interference level for 700 MHz narrowband channels must also be similar to current 800 MHz design levels. The proposed threshold level is no more than 3 dB rise in receiver noise floor of a TIA-102 Standard Class A receiver, meaning that the interference level into subscriber receivers must be at, or below, -125 dBm.

Several assumptions must be made about broadband transmitter and site design characteristics in order to establish proper emission limits to meet this criteria such as current standards development, typical transmitter power levels, achievable emission attenuation, and typical port-to-port site isolation. Typical broadband transmitters have power output in the 43 to 46 dBm range. Assuming a common power amplifier is used for the deployment of two or three broadband channels, worst case combined output power would be in 47 to 48 dBm range (50 to 60 watts). Motorola's previously showed base transmitter filtering with greater than 25 dB attenuation was available to meet interference criteria at 0.975 MHz offset from the broadband channel edge.[2] Site isolation, from transmitter output port to receiver input port, is dependent upon antenna height and vertical antenna pattern, both of which are typically under the control of the network designer. Since low site isolation leads to receiver intermodulation, we must assume that site isolation is high enough to minimize intermodulation, yet low enough that out-of-band emissions are still a source of interference. This occurs whenever site isolation is below 80 dB, or undesired signal levels on the ground exceed -40 dBm.

Current CDMA standards for base transmitters[3] require meeting -45 dBc/30 kHz at greater than 0.750 MHz from a single CDMA carrier. The OOBE level of -46 dBm/6.25 kHz found in Section 27.53(c) does not have to be met until 3.25 MHz offset from CDMA carrier. Lucent states they can meet the -46 dBm/6.25 kHz level with 1.125 MHz guard band for three carrier transmitter with additional filtering.[4] The proposed ACP table was developed assuming that level could be met, with or without additional filtering, for NPSTC's proposed 0.975 MHz guard band.

The proposed Broadband Base emission limits in 90.543(a) were derived as follows: Base transmitter power and site isolation assumptions used to determine level at edge of guard band for + 48 dBm broadband transmitter and 75 dB of site isolation. ACP based upon sum of transmitter emissions and filter attenuation in center of 50 kHz wideband channel centered at offset to meet -125 dBm level. (1.625 MHz offset = 0.625 MHz (½ broadband channel) + 0.975 MHz guard band + 0.025 kHz (½ wideband channel)). TIA IS-97-F standard was used to establish levels closest to edge of broadband channel, or -45 dBc/30 kHz @ 750 kHz for base transmitters. Several intermediate levels were defined to allow geographically separated networks to use the wideband channels within guard band with established levels of interference.

---

1 *See* Section 27.53(c) of the Commission's Rules.

2 Comments of Motorola, WT Docket No. 96-86, submitted June 6, 2006 at 12.

3 TIA-97-F Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations – February 17, 2005.

4 *See* Comments of Lucent, WT Docket No. 96-86, submitted June 6, 2006, at Exhibit G, page 3.

On inbound path, -35 dBm/6.25 kHz subscriber OOBE limit and 75 dB isolation could provide 15 dB of noise floor degradation from broadband subscribers to narrowband base receivers when narrowband site is located at edge of broadband cell where broadband subscribers operate at maximum power. Without significant improvement in subscriber emissions, licensees will be required to coordinate site placement and/or mitigate interference to narrowband after installation. The proposed Broadband Subscriber emission limits in 90.543(a) assume -35 dBm/6.25 kHz is best protection available and could be achieved within 0.975 MHz guard band. TIA IS-97-F standard was used to establish levels closest to edge of broadband channel, or -42 dBc/30 kHz @ 885 kHz for subscriber transmitters.

Changes are proposed to ACP Measurement Procedure in 90.543(b) and Setting Reference Level in 90.543(b)(1) to accommodate 1.25 MHz bandwidth channels and transmitters designed to simultaneously transmit multiple channels.

Wideband Interoperability
Section 90.547 is proposed to be modified to include compliance to TIA-902 standards for the eighteen wideband interoperability channels defined in 90.531(c)(1).

Signal Strength Limits
Some commenters have proposed limiting undesired signal levels on the ground near antenna sites as a method to minimize near-far interference between dissimilar technologies or deployments.[5] Instead of banning certain types of network deployments, licensee would decide the best method to comply. Network designer could control site placement, transmitter power, antenna height, antenna gain, and/or antenna pattern to minimize interference. An alternative is extensive coordination of site placement between licensees to minimize near-far interference, which may be difficult if narrowband voice is not the first system deployed. For TIA-102 Class A subscribers, intermodulation and out-of-band emissions become issues when undesired signal levels reach -35 to -40 dBm range. Motorola believes that a level of 50 microwatts/square meter, which equals -35 dBm at the output of a isotropic antenna (-33 dBm out of a ½ wave dipole antenna) is a reasonable level.

Interference Mitigation Procedure
In the event that one licensee feels that it is receiving interference from another licensee's deployment, there must be methodology to quantify the level of interference. Motorola proposes to use the same methodology adopted in the 800 MHz band proceeding as codified in Section 90.672 *et seq*. The interference victim must first verify that there is sufficient level of desired signal for reliable communications and determine the source(s) of interference. If interference is verified, offending licensee(s) must make modifications to provide victim at least 20 dB of C/(I+N) protection.

---

[5] *See* Implementing the Visions for 700 MHz: Rebanding the Upper 700 MHz A and B Blocks for Next Generation Wireless Broadband, A White Paper Submitted by Upper 700 MHz A and B Block Licensees, August 3, 2005, at 27.

Recommended Rule Changes
Deletions are depicted by strikethroughs; new text is underlined

1. Paragraphs (c) and (d) of Section 90.531(c) and (d) are proposed to be revised to read as follows:

§ 90.531 Band Plan

* * * * * *

(c) * * *

(1) *Wideband Interoperability channels.* The following wideband channels are designated for nationwide Interoperability licensing and use~~, but are not available for licensing or use pending Commission adoption of a wideband Interoperability standard~~: 001/121, 002/122, 003/123, 022/142, 023/143, 024/144, 043/163, 044/164, 045/165, 076/196, 077/197, 078/198, 097/217, 098/218, 099/219, 118/238, 119/239, and 120/240.

(i) *Wideband calling Interoperability channels.* The following channel pairs are dedicated nationwide for the express purpose of *Interoperability* calling only: 001/121 and 118/238. They may not be used primarily for routine, day-to-day communications. Encryption is prohibited on the designated calling channels.

(ii) *Wideband Interoperability channels.* The following channel pairs are dedicated nationwide for the express purpose of *Interoperability* only: 002/122, 003/123, 119/239, and 120/240. They may not be used primarily for routine, day-to-day communications.

(iii) *Wideband secondary Interoperability channels.* The following Wideband Interoperability channel pairs, at the discretion of the appropriate regional planning committee, may be used as wideband general use channels in multi-agency systems on a secondary basis to conventional Interoperability operations: 022/142, 023/143, 024/144, 043/163, 044/164, 045/165, 076/196, 077/197, 078/198, 097/217, 098/218, and 099/219. For every five wideband general use channels in a system, entities may obtain a license to operate on one of the above secondary Interoperability channel pairs. The maximum number of secondary Interoperability channel pairs that can be included in any one system is six.

~~(2) *Wideband reserve channels.* The following wideband channels are reserved: 1–27, 94–120, 121–147, 214–240.~~

(3) * * *

(d) * * *

* * * * *

(3) *Broadband channels*. Contiguous wideband general use and wideband secondary interoperability (50 kHz) channels in the ranges of 004-117 and 124-237 may be used in combination to form broadband channels and associated guard channels.

(i) *One Broadband Channel*. Channels in the ranges of 029-092 and 149-212 may be combined to form one 1.25 MHz broadband channel and associated guard channels. (64 channels)

(ii) *Two Broadband Channels*. Channels in the ranges of 029-117 and 149-237 may be used in combination to form two broadband channels, or aggregated to form one 2.5 MHz channel, and associated guard channels. (89 channels)

(iii) *Three Broadband Channels*. Channels in the ranges of 004-117 and 124-237 may be used in combination to form three broadband channels, or aggregated to form one 3.75 MHz channel, and associated guard channels. (114 channels)

2. New paragraph (e) is proposed to be added to Section 90.541 to read as follows:

§ 90.541 Transmitting power limits.

* * * * *

(e) *Power flux density limit*. For base and fixed stations operating in the 767– 773 MHz band, the power flux density that would be produced by such stations through a combination of antenna height and vertical gain pattern must not exceed [25 or 50] microwatts per square meter on the ground over the area extending to 1 km from the base of the antenna mounting structure.

3. New ACP tables are proposed to be added following paragraph (a) and paragraph (b) in Section 90.543 are proposed to be revised to read as follows.

§ 90.543 Emission Limitations.

(a) * * *

1.25 MHz Base Transmitter ACP Requirements			
Offset from channel center	Offset from channel edge	Measurement Bandwidth (kHz)	Maximum ACP (dBc)
< 0.750 MHz			0
0.775 MHz	0.150 MHz	50	-43
1.025 MHz	0.400 MHz	50	-60
1.325 MHz	0.700 MHz	50	-75
> 1.625 MHz	> 1.000 MHz	50	-90
Below 764 MHz		100	43 + 10*log(P)
Above 806 MHz		100	43 + 10*log(P)

Note: Broadband ACP limitations may be met with external filtering.

1.25 MHz Mobile Transmitter ACP Requirements			
Offset from channel center	Offset from channel edge	Measurement Bandwidth (kHz)	Maximum ACP (dBc)
< 0.885 MHz		0	0
0.900 MHz	0.275 MHz	50	-40
1.125 MHz	0.500 MHz	50	-47
1.375 MHz	0.750 MHz	50	-54
> 1.625 MHz	> 1.000 MHz	50	-61
Below 764 MHz		100	43 + 10*log(P)
Above 806 MHz		100	43 + 10*log(P)

Note: Broadband ACP limitations may be met with external filtering.

(b) *ACP measurement procedure*. The following are the procedures for making the transmitter ACP measurements. For all measurements modulate the transmitter as it would be modulated in normal operating conditions. For time division multiple access (TDMA) systems, the measurements are to be made under TDMA operation only during time slots when the transmitter is active. All measurements are made at the transmitter's output port. If a transmitter has an integral antenna, a suitable power coupling device shall be used to couple the RF signal to the measurement instrument. The coupling device shall substantially maintain the proper transmitter load impedance. If the transmitter is designed for simultaneously transmitting

multiple channels, the ACP measurement is to be made at offset from channel edge using the maximum number of channels the transmitter is designed to transmit with the maximum transmitter power distributed among the channels as it would be in normal operating conditions. The ACP measurements may be made with a spectrum analyzer capable of making direct ACP measurements. ‘‘Measurement bandwidth’’, as used for non-swept measurements, implies an instrument that measures the power in many narrow bandwidths equal to the nominal resolution bandwidth and integrates these powers to determine the total power in the specified measurement bandwidth.

(1) *Setting reference level*. Set transmitter to maximum output power. Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth to the channel size. For example, for a 6.25 kHz transmitter, set the measurement bandwidth to 6.25 kHz; for a 150 kHz transmitter, set the measurement bandwidth to 150 kHz; for a 1.25 MHz transmitter, set the measurement bandwidth to 1.25 MHz. If the transmitter is designed for simultaneously transmitting multiple channels, set the measurement bandwidth to the bandwidth of the maximum number of channels the transmitter is designed to transmit with the maximum transmitter power distributed among the channels as it would be in normal operating conditions. Set the frequency offset of the measurement bandwidth to zero and adjust the center frequency of the instrument to the assigned center frequency to measure the average power level of the transmitter. Record this power level in dBm as the ‘‘reference power level’’.

4. The section title of Section 90.547 is proposed to be revised and a new paragraph (c) is proposed to be added to read as follows:

§ 90.547 ~~Narrowband~~ Interoperability channel capability Requirement.

* * * * *

(c) Except as noted in this section, mobile and portable transmitters operating on the six nationwide wideband Calling and Interoperability channel pairs (see 90.531 (c)(1)(i)& (ii) above) in the 764–776 MHz and 794–806 MHz frequency bands must be capable of operating pursuant to the standards specified in this part. Mobile and portable transmitters operating on the other twelve wideband secondary Interoperability channel pairs (see 90.531 (c)(1)(iii) above) must be capable of operating pursuant to the standards specified in this part when operating as interoperability channels.

5. New paragraph (b) of Section 90.548 is proposed to be added. Existing paragraph (b) is proposed to be renumbered as new paragraph (c).

§ 90.548 Interoperability Technical Standards.

* * * * *

(b) Transmitters operating on those wideband channels in the 764–776 and 794–806 MHz band designated for interoperability (See 90.531(c)(1)) shall conform to the following technical standards:

(1) Transmitters designed for wideband operation shall include a 50 kHz bandwidth mode of operation conforming to the following standards, which are incorporated by reference: TIA-902.BAAB-A - SAM Physical Layer (PHY), TIA-902.BAAD-A - SAM Radio Channel Coding (CHC), TIA-902.BAAC - WAI Media Access Control/Radio Link Adaptation (MAC/RLA), TIA-902.BAAE - WAI Logical Link Control (LLC), TIA-902.BAEB - WAI Packet Data Specification (PDS), TIA-902.BAAF - WAI Mobility Management (MM).

(c) * * *

6. New Section 90.5xx is proposed to be added to read as follows:

§ 90.5xx Unacceptable interference to narrowband and wideband licensees from broadband systems.

(a) *Definition*. Unacceptable interference to narrowband licensees in the 700 MHz Public Safety band will be deemed to occur when the below conditions are met:

(1) A transceiver at a site at which interference is encountered:

(i) Is in good repair and operating condition, and is receiving:

(A) A median desired signal of −104 dBm or higher, as measured at the R.F. input of the receiver of a mobile unit; or
(B) A median desired signal of −101 dBm or higher, as measured at the R.F. input of the receiver of a portable i.e. hand-held unit; and, either

(ii) Is a voice transceiver:

(A) With manufacturer published performance specifications for the receiver section of the transceiver equal to, or exceeding, the minimum standards set out in paragraph (b) of this section, and;
(B) Receiving an undesired signal or signals which cause the measured Carrier to Noise plus Interference (C/(I+N)) ratio of the receiver section of said transceiver to be less than 20 dB, or;

(iii) Is a non-voice transceiver receiving an undesired signal or signals which cause the measured bit error rate (BER) (or some comparable specification) of the receiver section of said transceiver to be more than the value reasonably designated by the manufacturer.

(2) Provided, however, that if the receiver section of the mobile or portable voice

transceiver does not conform to the standards set out in paragraph (b) of this section, then that transceiver shall be deemed subject to unacceptable interference only at sites where the median desired signal satisfies the applicable threshold measured signal power in paragraphs (a)(1)(i) of this section after an upward adjustment to account for the difference in receiver section performance. The upward adjustment shall be equal to the increase in the desired signal required to restore the receiver section of the subject transceiver to the 20 dB C/(I+N) ratio of paragraph (a)(1)(ii)(B) of this section. The adjusted threshold levels shall then define the minimum measured signal power(s) in lieu of paragraphs (a)(1)(i) of this section at which the licensee using such non-compliant transceiver is entitled to interference protection.

(b) Minimum Receiver Requirements. Voice transceivers capable of operating in the 764-776/794-806 MHz portion of the 700 MHz band shall have the following minimum performance specifications in order for the system in which such transceivers are used to claim entitlement to full protection against unacceptable interference. (See paragraph (a)(2) of this section.)

(1) Voice units intended for mobile use: 75 dB intermodulation rejection ratio; 75 dB adjacent channel rejection ratio; −116 dBm reference sensitivity.

(2) Voice units intended for portable use: 70 dB intermodulation rejection ratio; 70 dB adjacent channel rejection ratio; −116 dBm reference sensitivity.