Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Review of the Commission's	)	MM Docket No. 00-39
Rules and Policies	)	
Affecting the Conversion	)	
to Digital Television	)	
	)	

REPLY COMMENTS OF ZENITH ELECTRONICS CORPORATION

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SUMMARY

The transition of our nation's television service from analog to digital technology is well underway and a clear majority of DTV stakeholders – representing a large cross-section of consumers, broadcasters, manufacturers, unions and others – share the Commission's strong desire to ensure that the transition's momentum continues to grow. Such growth is threatened, however, by a handful of parties who continue to insist that the Commission reopen the DTV transmission standard to include the alternative use of COFDM modulation. These calls for change ignore what the FCC's Advisory Committee on Advanced Television Services, the Advanced Television Systems Committee, the Commission and many commenting parties have confirmed: that the 8-VSB standard provides multiple benefits distinguishing it as the superior choice for digital broadcasting in the United States.

In addition to its significant advantages with regard to data rate capacity and interference rejection, the 8-VSB standard provides greater assurance that a DTV station's service area will be generally equal to or greater than its NTSC service area, thereby allowing digital broadcasting to reach the maximum number of viewers possible. A study by Jules Cohen, one of the nation's most qualified and experienced broadcast consulting engineers, confirms 8-VSB's superior signal coverage. The Cohen study shows that utilization of COFDM by three New York City DTV stations (operating in the most populous and arguably most densely urban area of the nation) at the same power level as 8-VSB would result in less coverage and more interference to other stations than would utilization of 8-VSB. In fact, these stations' use of COFDM would result in a loss of service to millions of viewers. If the stations' COFDM power were

increased to overcome the reduction of their service from that provided by 8-VSB, the loss of viewers due to interference would be exacerbated. It is difficult to imagine how changing the DTV transmission standard and alienating viewers would lead to the smooth and swift transition envisioned by the Commission.

America is already on the best path to a swift transition. Zenith and other manufacturers are deeply engaged in intensive efforts to resolve any lingering concerns over the multipath reception performance of 8-VSB DTV receivers and are confident that innovations in DTV receiver technology will continue at a quick pace. In fact, Zenith has developed a "technology roadmap" charting its course toward the rapid resolution of over-the-air reception issues with each new generation of receiver.

In light of the refinements in 8-VSB receiver performance that are advancing, and the significant progress made in the transition thus far, reopening debate over the transmission standard would only needlessly disrupt the transition's growing momentum and delay the availability of DTV to the public. As the initial comments in this proceeding reflect, there is no debate over the fact that delay is the inevitable result of changing the DTV Standard. The only debate is over how long that delay will be. Whether one year, five years or longer, the benefits of digital television are too important to stall its implementation for any measure of time.

In view of the profound public interest benefits to be derived from digital technology, Zenith looks forward to continuing to work with the Commission and other DTV stakeholders to ensure that the shared vision of a smooth and swift DTV transition is realized and urges the Commission to reaffirm VSB as the DTV Standard's sole modulation system.

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Zenith Electronics Corporation ("Zenith") hereby submits its reply comments in the above-captioned proceeding concerning the continued successful conversion of our nation's television system from analog to digital television ("DTV") technology.[1]

I. INTRODUCTION

Zenith and many other commenting parties join with the Commission in its resolve to ensure the smooth and rapid transition to digital television broadcasting. The comments of the National Consumers League; National Council of Senior Citizens; Communications Workers of America *et. al.*; Belo; Fox Television Stations, Inc. and Fox Broadcasting Company; Motorola, Inc.; NxtWave Communications, Inc.; Philips Electronics North America Corporation; Thomson Consumer Electronics, Inc.; the Consumer Electronics Association; and iBlast Networks – to name just a few –

[1] See Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television, Notice of Proposed Rule Making, MM Docket No. 00-39, FCC 00-83 (rel. Mar. 8, 2000) ("NPRM").

underscore the strong collective desire of consumers, broadcasters, manufacturers, unions and other digital television stakeholders to keep the DTV transition on track and moving forward without delay.

This collective desire to avoid delay and bring the benefits of digital television technology to the public as quickly as possible is reflected in the many comments that urge the Commission to reaffirm the continued superiority of the 8-VSB transmission standard for digital broadcasting in the United States.[2] Some examples of the widespread support for the 8-VSB standard include the following:

- Belo, a broadcaster with 18 television stations, "believes that the Commission has adopted the best DTV broadcasting standard available for North America" and that "there is no reason to believe the standard does not have the capacity for continued improvement and adaptation for a host of services."[3]

- The International Brotherhood of Electrical Workers, a union representing thousands of workers engaged in the digital transition, is concerned that "any delays in instituting the decided upon digital 8-VSB standard would be both counterproductive and costly."[4]

- The National Consumers League, representing the interests of the most important players in the transition – the consumers – says that "it is in the best interests of consumers for the Commission to stay the course and

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[2] See Comments of Belo; Communications Workers of America/International Union of Electronic, Electrical, Salaried, Machine and Furniture Workers/AFL-CIO Department of Professional Employees ("CWA *et. al.*"); the Consumer Electronics Association ("CEA"); Fox Television Stations, Inc. and Fox Broadcasting Company; iBlast Networks ("iBlast"); the International Brotherhood of Electrical Workers ("IBEW"); Motorola, Inc. ("Motorola"); the National Consumers League ("NCL"); National Council of Senior Citizens; NxtWave Communications, Inc. ("NxtWave"); Philips Electronics North America Corporation ("Philips"); and Thomson Consumer Electronics, Inc. ("Thomson").

[3] Belo Comments at 5.

[4] IBEW Comments at 1.

reaffirm 8-VSB as the appropriate modulation system for DTV in the United States."[5]

- NxtWave Communications, Inc., a receiver chip designer, says that the 8-VSB Standard "is the best path to a quick transition to digital broadcasting."[6]

- iBlast Networks, an enterprise that is partnering with broadcasters to provide digital data services, notes 8-VSB's "fundamental advantages in signal strength, payload capacity and transient noise immunity" and urges the Commission "to embrace 8-VSB as a winning solution for digital broadcast."[7]

- The Consumer Electronics Association, the principal trade association representing the consumer electronics industry, believes that "[c]onsidering any non-compatible standard for DTV would create needless delay and marketplace confusion, disadvantage those who worked the hardest to attain the FCC's goals, and undermine the certainty that is necessary for rapid development of DTV products and services."[8]

These parties, like Zenith and many other commenting parties, are excited by the significant progress made in the transition since the Commission unanimously adopted the 8-VSB modulation system (as recommended by the FCC Advisory Committee on Advanced Television Services ("ACATS") and documented by the Advanced Television Systems Committee ("ATSC")) as the standard for DTV transmission. In view of the efforts of Zenith and other manufacturers to further enhance indoor reception with each successive generation of DTV receivers, the Commission's goal of a smooth and swift transition is clearly in sight.[9]

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[5] NCL Comments at 2.

[6] NxtWave Comments at 5.

[7] iBlast Comments at 2.

[8] CEA Comments at 24.

[9] See NxtWave Comments at 6-11; Philips Comments at 7-12; Thomson Comments at 11-13.

Zenith is disappointed, however, that a few commenting parties – most particularly Sinclair Broadcast Group, Inc. ("Sinclair") – are continuing to pursue an agenda which would bring unwarranted delay and disruption to the timely delivery of digital television to the public. These few commenters are once again calling for the Commission to modify the FCC's DTV Standard to permit the inclusion of a COFDM-based modulation scheme.[10] The claims made by these parties are no more persuasive now than they were four months ago when the Commission unanimously dismissed Sinclair's Petition for Expedited Rulemaking (the "Sinclair Petition") and wisely rejected arguments for adding COFDM to the DTV Standard.[11]

A clear majority of the commenting parties – representing a large cross-section of consumers, broadcasters and manufacturers alike – has voiced concern that the Commission not do anything which in any way slows the momentum growing in the DTV marketplace.[12] Considering that (1) the 8-VSB system was carefully selected based on the significant performance advantages it possesses as compared to all other digital modulation systems, including COFDM; (2) the state of DTV *receiver* technology is improving dramatically with regard to over-the-air reception; and (3) it is an undisputed fact that reopening the DTV Standard would delay the transition, there is no reason for

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[10] See Comments of Sinclair; Pappas Telecasting of Southern California, LLC ("Pappas"); Pegasus Communications Corporation; and Univision Communications, Inc. ("Univision").

[11] See Letter to Martin R. Leader, Esq., FCC 00-35 (rel. Feb. 4, 2000) (the "Sinclair Decision").

[12] See, e.g., Belo Comments at 2; CWA *et. al.* Comments at 3; CEA Comments at 24-25; iBlast Comments at 1; IBEW Comments at 1; Motorola Comments at 4-5; NCL Comments at 1-2; Philips Comments at 13-14; Thomson Comments at 9-10.

the Commission to even entertain the notion of augmenting the DTV Standard. Indeed, in view of the substantial chilling effect on DTV investment at all levels resulting from this completely unwarranted transmission standard debate, Zenith urges the Commission to put this issue to rest quickly, thereby maintaining the agency's steadfastness in ensuring that implementational issues (such as the progress of DTV receiver performance) do not continue to threaten the overall integrity and pace of the transition.

II. ARGUMENTS FOR REOPENING THE DTV STANDARD HAVE ALREADY BEEN RATIONALLY CONSIDERED AND THOUGHTFULLY REJECTED BY THE COMMISSION

Armed only with the results of limited demonstrations using early generation DTV receivers (in a few unique situations where NTSC service was not always receivable), some have attempted to stall the digital transition's momentum by insisting repeatedly that the DTV Standard needs to be changed because it cannot provide satisfactory "over-the-air" digital television service in urban areas using simple indoor antennas, particularly in areas with high multipath interference. In considering the Sinclair Petition, the Commission confronted this issue head-on and wisely rejected these arguments, concluding, *inter alia*, that:

- based on the relative merits of 8-VSB and COFDM, the 8-VSB system is better suited for DTV service in the United States;
- the relative benefits that might result from changing the DTV Standard to allow the use of COFDM modulation are unclear and would not outweigh the costs of making such a revision;
- allowing more than one transmission standard would be detrimental to consumers, broadcasters and consumer electronics manufacturers;
- consideration of a new DTV Standard would significantly delay the implementation and provision of DTV services to the public; and

- "reasonable solutions to the indoor reception and multipath interference issues…are being developed and are expected to be available in the near future."[13]

No commenting party has provided any new information to induce the Commission to reconsider any of the conclusions reached in its dismissal of the Sinclair Petition.

III. THERE IS NO BASIS FOR REOPENING THE DTV STANDARD

As demonstrated in Zenith's initial comments, and supported in several other comments, the 8-VSB transmission standard is meeting the performance goals for which it was selected following years of extensive laboratory and field testing of various competing systems. Those goals include superior signal coverage of existing NTSC service areas, a high bit-rate capacity and interference rejection.[14] Belo, for example, notes in its comments that the 8-VSB standard is "remarkably well suited for its intended purpose – to replicate and eventually replace NTSC broadcasting with DTV."[15] Nevertheless, in spite of the scientifically rigorous and exhaustive review process that resulted in the Commission's unanimous conclusion to adopt 8-VSB modulation as the DTV transmission standard, Sinclair now makes the unsubstantiated claim that 8-VSB is

[13] See Sinclair Decision.

[14] See Zenith Comments at 6-9; iBlast Comments at 2; NxtWave Comments at 5; Thomson Comments at 13-14.

[15] Belo Comments at 5.

a "broken technology" and is "causing the failure of the DTV transition."[16] Nothing could be further from the truth.

Sinclair's unwarranted claim is based primarily on one aspect of the 8-VSB system: its ability to provide adequate over-the-air service in those select urban areas that are subject to strong multipath interference. While some early generation DTV receivers fell short of expectations with regard to reception in strong multipath environments, this shortcoming was due to the state of receiver technology in some early receivers rushed to the marketplace to jumpstart the DTV transition, not some intrinsic deficiency in the DTV Standard's 8-VSB modulation system. The 8-VSB system was selected over other modulation systems in large part because of its greater capability to replicate the overall signal coverage areas of NTSC stations, a critical factor for the success of the transition. On balance, the urban multipath issues were viewed as more easily solved than the coverage shortfall inherent in non-VSB systems. As the DTV receiver refinements described in the initial comments of Zenith and other manufacturers clearly show, this conclusion has been borne out.[17] Zenith is confident that innovations in chip designs, equalizer improvements and other breakthroughs advancing DTV receiver performance will continue to move forward quickly, thus enabling DTV receivers to receive over-the-air 8-VSB digital broadcast transmissions via indoor antennas nearly everywhere – at least everywhere that satisfactory NTSC analog reception is achieved.

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[16] Sinclair Comments at 11.

[17] See NxtWave Comments at 6-11; Philips Comments at 7-12; Thomson Comments at 11-13.

A. THE RELATIVE MERITS OF 8-VSB DISTINGUISH IT AS SUPERIOR TO COFDM FOR DIGITAL BROADCASTING IN THE UNITED STATES

By focusing on the singular parameter of indoor reception, some choose to ignore what the ACATS, ATSC and Commission have repeatedly confirmed: that the 8-VSB system provides multiple benefits for the successful implementation of digital broadcasting in the United States. Specifically, 8-VSB exceeds COFDM's capabilities with regard to (1) carrier-to-noise performance; (2) overall coverage; (3) interference rejection for new DTV and existing NTSC services; and (4) maximization of net data rate to optimize high-definition television ("HDTV"), multiple standard-definition television ("SDTV") channels and DTV data applications.

1. CARRIER-TO-NOISE PERFORMANCE

The 8-VSB system always will have superior carrier-to-noise (C/N) performance and a lower peak-to-average ratio as compared to COFDM. These parameters are inherent in the two transmission systems and not subject to future receiver-only improvements. As such, 8-VSB technology is able to deliver greater overall coverage, while also providing superior interference protection for existing NTSC and new DTV services. Indeed, while 8-VSB receivers will be fully capable of achieving parity with COFDM in terms of handling strong multipath interference, the laws of physics mean that COFDM technology will forever prevent it from equaling 8-VSB in terms of carrier-to-noise performance (at comparable net data rates).

2. OVERALL COVERAGE

The 8-VSB system allows broadcasters to replicate, to the greatest extent possible, their entire NTSC service area from a single transmitter site at non-interfering power levels. In an effort to downplay COFDM's inferiority with regard to overall coverage, Sinclair argues in its comments that the Commission's priority should be "replication of NTSC *reception*, not raw signal coverage."[18] Since the beginning of the DTV transition, however, a top priority of the Commission (and broadcasters) has been ensuring that a DTV station's service area is generally equal to or better than its NTSC service area, thereby allowing digital broadcasting to reach the maximum number of viewers possible.[19] The 8-VSB standard's superior signal coverage, combined with the rapid advancements in the indoor reception capabilities of 8-VSB receivers, provides such assurance. The use of COFDM, on the other hand, would result in a significant loss of suburban and rural viewers who live on the fringe of a station's NTSC service area, far surpassing the comparatively fewer number of viewers in dense urban areas using indoor antennas who might be affected by multipath interference.

The superior C/N threshold and lower peak-to-average ratio inherent in the 8-VSB system (compared to COFDM systems) greatly enhances the assignment of DTV channels. The importance of C/N was recognized at the outset of the ACATS process,

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[18] Sinclair Comments at 14.

[19] Indeed, one of the Commission's primary concerns raised in this proceeding is whether it should adopt an explicit requirement that broadcasters provide full replication of their NTSC service areas by a date certain. NPRM at ¶ 21.

and was a primary reason for the selection of the 8-VSB modulation system by the Grand Alliance, the ACATS and the FCC.

Real-world parameters comparing ATSC/8-VSB and DVB/COFDM systems in a 6 MHz channel have enabled a qualitative and quantitative comparative analysis based on the FCC's channel allotment and authorized emission power plans. Such analysis was recently performed for the heavily populated areas (in terms of TV viewers and TV transmitting facilities) of New York City. The report from a highly experienced and well qualified professional consulting engineer, Jules Cohen, is attached as Appendix A.[20]

The study "shows a clear preference for the use of 8-VSB rather than COFDM from an allotment viewpoint" and concludes that:

> With identical effective radiated power and antenna height above average terrain, use of COFDM provides less coverage and results in more interference to other stations than 8-VSB. If the COFDM effective radiated power is increased to overcome the reduction of service from that provided by use of 8-VSB, interference is further aggravated, particularly to the analog stations continuing to operate at their assigned power levels. *Consequently, either fewer stations can be accommodated using a specified number of channels, or service areas must be reduced substantially.*[21]

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[20] Jules Cohen has more than five decades of experience as a professional consulting engineer in the field of broadcasting. Mr. Cohen has represented the Association for Maximum Service Television ("MSTV") in ATSC Subcommittees and Technology Groups, served on ATSC's Executive Committee and co-chaired a number of ATSC Technology Groups. Mr. Cohen was also deeply involved in the work of ACATS from its inception. Mr. Cohen's clients have included all five of the major television networks, the National Association of Broadcasters, MSTV, the Electronics Industries Association, major broadcast group owners and individual radio and television stations. The depth of Mr. Cohen's knowledge and expertise is further detailed in his professional background statement attached as Appendix B.

[21] Engineering Statement, Channel Allotment Considerations Comparing the Use of 8-VSB or COFDM, Jules Cohen, P.E., June 9, 2000 at p. 2 (emphasis added).

Using the FCC's own computer calculation technique, coverage calculations for three New York City DTV stations (WNBC-DT, WABC-DT and WPIX-DT) show that COFDM, operating at the same power level as 8-VSB, would result in an average of 656,000 fewer viewers for each of the stations. This result is, of course, contrary to the goal of bringing the benefits of DTV to all Americans. The Commission should be steadfast in its insistence that service areas are replicated to the greatest extent possible, so as to ensure the success of the DTV transition.

3. INTERFERENCE REJECTION FOR NEW DTV AND EXISTING NTSC SERVICES

An important advantage of the 8-VSB standard is its ability to minimize co-channel and adjacent channel interference to broadcasters' analog and digital signals. By contrast, a COFDM signal using the same power level as 8-VSB would not only provide less coverage but cause substantial interference with other NTSC and DTV stations. If COFDM power levels were increased to overcome the reduction of service from that provided by use of 8-VSB, the interference problem would only be exacerbated. Therefore, allowing broadcasters to use COFDM transmission most certainly would require the creation and adoption of a new DTV Table of Allotments, obviously not a desirable result. It is highly unlikely that such a digital channel assignment plan could be adopted that would accommodate all U.S. broadcasters.

Again, as the Cohen study demonstrates, interference calculations for the same three New York City DTV stations reveal that their use of COFDM would have a significant impact on existing analog and new DTV stations in the Northeast, resulting in the loss of millions of viewers. For analog stations operating either on the same channel

or the first adjacent channels, utilization of COFDM at the same power level as stations employing 8-VSB would result in a loss of analog service to 515,338; 264,059; and 206,708 viewers, respectively. If only the New York City stations used in the study increased their power by 5 dB in order to achieve COFDM coverage comparable to 8-VSB at the lower power level, it would result in a loss of analog service to 580,387; 298,373; and 258,214 viewers, respectively. Of course, if all digital stations increased power by 5 dB to accommodate COFDM, these viewer losses would be substantially increased. For digital stations operating either on the same channel or the first adjacent channels, use of COFDM would decrease the population served by an additional 1,372,025; 2,928,437; and 2,655,674, respectively, for the three New York City stations in the study.[22]

4. OPTIMIZATION FOR HDTV AND DTV DATA APPLICATIONS

The 8-VSB standard is more spectrum efficient than COFDM, in large part because COFDM trades off data capacity for robustness. The 8-VSB system's higher bit-rate capacity (which transmits data at a rate of 19.39 Mbps per 6 MHz channel) makes it not only superior for more demanding datacasting services, but also for HDTV transmissions, which for many digital television broadcasters remains the centerpiece application.

In light of the innovative new services that are now emerging to exploit the benefits of DTV technology, such as the datacasting services being developed by iBlast,

[22] Id. at Figures 2-7.

Geocast and others, achieving the highest possible data rate is crucial. For this and other reasons, iBlast has urged the Commission in this proceeding "to embrace 8-VSB as a winning solution for digital broadcast."[23]

Despite 8-VSB's clear data rate advantages, Sinclair claims that COFDM is better suited for portable applications because 8-VSB's data rate is "forever-frozen" at 19.39 Mbps."[24] As clearly stated in the DTV Standard, this statement is completely false. VSB technology was originally designed to have multiple modulation levels, including the high data rate 16-VSB modulation which exists in the DTV Standard. A flexible bi-rate mode – a multiplexing of normal and more robust (2-VSB) data – was rejected by the broadcasters during the ACATS process in favor of the parameters afforded by 8-VSB.[25]

It is clear that VSB technology has the flexibility for future enhancements which would support both portable and mobile applications.[26] In fact, to facilitate portable services, Zenith and others are actively pursuing the development of a backward-compatible extension to the DTV Standard which would employ a mixed data mode of two simultaneous transmissions of varying data rates and robustness.

If mobile services are desired, the DTV Standard certainly has the "headroom" for Zenith and other manufacturers to develop enabling technology that will support

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[23] iBlast Comments at 2.

[24] Sinclair Comments at iii.

[25] A complete family of VSB modes (2, 4, 8 and 16-VSB) is documented as an international standard (ITU-T J.83).

[26] See NxtWave Comments at 4; CEA Comments at 21.

such services. As Zenith stated in its initial comments, however, the development of enabling technology for mobile services should be pursued on a parallel path with the implementation of the existing DTV Standard so as not to delay the introduction of free over-the-air digital programming to the public and the timely return of valuable spectrum. Altering the DTV Standard by any other means than in a backward-compatible fashion would needlessly delay the DTV transition and create a level of uncertainty that would discourage manufacturers from investing in the development of these new services.

B. THE COMMITMENT OF ZENITH AND OTHER MANUFACTURERS TO IMPROVE INDOOR RECEPTION AND DRIVE THE TRANSITION FORWARD IS RESULTING IN SIGNIFICANT ADVANCEMENTS IN DTV RECEIVER PERFORMANCE

Zenith and other manufacturers acknowledge the inadequate multipath reception performance of some first generation DTV receivers. As the Commission and several commenters have noted, however, these early receiver problems are the result of receiver *implementation* issues and are not indicative of any flaw in the DTV Standard's use of 8-VSB modulation.[27] Indeed, the FCC's Office of Engineering and Technology correctly concluded that any multipath reception problems attributed to early 8-VSB receivers will be solved with expected set design improvements.[28] The need for such

[27] See Sinclair Decision at 3; CEA Comments at 22-23; NxtWave Comments at 3; Philips Comments at 6; Thomson Comments at 10.

[28] DTV Report on COFDM and 8-VSB Performance, FCC/OET 99-2 (dated Sept. 30, 1999) at 24.

improvements is typical whenever a complex new technology is implemented for the first time.

Recognizing from the onset that the indoor reception problem could be solved through refinements to DTV *receiver* technology (rather than changes to the DTV Standard), Zenith and other receiver manufacturers and chip designers are deeply engaged in intensive efforts to improve indoor reception in strong multipath interference environments. Based upon its own progress to date, and the significant advancements noted in the comments of others, Zenith is confident that innovations in DTV receiver technology and chip design will continue at a rapid pace, such that the issue of indoor reception will soon be limited to only the most aberrational of multipath environments.[29] This confidence is also noted in Philips' comments which state that based on its own progress to date, "indoor reception, utilizing the 8-VSB standard, will be a non-issue in the near future."[30] Similarly, Thomson's comments state that based on the level of effort already under way throughout the industry, Thomson expects that advancements in DTV receiver performance "will continue to the point where, in 2002, indoor antennas can be used nearly everywhere to receive an ATSC signal."[31]

Attached as Appendix C is a chart entitled "8-VSB Product Evolution" developed by Zenith that illustrates the actual and expected evolution of the company's 8-VSB receivers. This " technology roadmap" shows the significant enhancements

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[29] See CEA Comments at 23; NxtWave Comments at 9; Philips Comments at 6; Thomson Comments at 11

[30] Philips Comments at 7.

[31] Thomson Comments at 12.

made to date with regard to indoor reception performance and sets forth the company's plans for further advancements. Based upon the pace of refinements in receiver and chip technology made thus far, as well as prototype hardware development, the DTV receiver performance expectations outlined are achievable.

Specifically, the chart shows the significant performance improvements that go well beyond the Grand Alliance hardware that was selected as the "best of the best" in the extensive trials leading to the FCC rules for DTV. In particular, the third generation circuitry, which will be in products later this year, uses "predictive slice" technology, which greatly improves the speed, accuracy and resistance to noise of the adaptive equalizer in canceling ghosts. The fourth generation, which is already in prototype, augments the equalizer performance with improvements in the demodulator and synchronization, all of which combine to handle even stronger, longer ghosts and more difficult reception conditions. As these improvements are entering the pipeline, laboratory work is proceeding on fifth generation ideas to handle the rarest and most demanding of reception conditions.

Despite the proven commitment of Zenith and other manufacturers to improve indoor reception and continue driving the transition forward, Sinclair nevertheless claims that the consumer electronics industry does not care about terrestrial over-the-air broadcast television service.[32] This accusation is simply absurd. Zenith and other members of the consumer electronics industry have devoted substantial resources to the development and implementation of digital television. Indeed, as the comments make

[32] See Sinclair Comments at 20-21.

clear, receiver manufacturers and chip designers are passionately committed to improving DTV technology, driven not only by the forces of a competitive marketplace but a desire to ensure that the benefits of digital television reach all Americans as quickly as possible.

C. REOPENING DEBATE OVER THE TRANSMISSION STANDARD WOULD SIGNIFICANTLY DISRUPT AND DELAY THE DIGITAL TRANSITION

Zenith commends the Commission for its resolve in this proceeding to identify and eliminate the potential sources of delay which may impede the digital transition's progress. As the initial comments in this proceeding vividly document, the most glaring source of delay currently threatening the transition (aside from a lack of HDTV programming) is the unnecessary debate over the DTV transmission standard. In light of the considerable advances being made to improve indoor reception, Zenith urges the Commission to end this debate and confirm VSB as the DTV Standard's one and only modulation system, so as to remove the uncertainty and confusion in the DTV marketplace that is chilling investment at all levels.

Virtually every commenting party in this proceeding which addressed the 8-VSB transmission standard, including Sinclair, acknowledged that a change in the DTV Standard would delay the transition.[33] While there is some dispute among commenters over exactly how long this delay would be, most parties agreed with Zenith's view that

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[33] See Sinclair Comments at 35; Belo Comments at 5; CWA *et. al.* Comments at 1-3; CEA Comments at 24-25; iBlast Comments at 1; IBEW Comments at 1-3; Motorola Comments at 4-5; NCL Comments at 2; National Council of Senior Citizens Comments at 1; NxtWave Comments at 5; Philips Comments at 13-14; Thomson Comments at 9.

any delay could have dire consequences for the transition, and urged the Commission to resist any efforts to reopen the standard.[34] For example, iBlast notes that "a delay to study 8-VSB/COFDM issues necessarily would delay access by millions of Americans to the free broadband services that iBlast and its broadcast partners are poised to launch."[35] Similarly, the National Consumers League says "any such delay would needlessly bring the DTV transition to a standstill" and "would be detrimental both for the economy and for consumers."[36] Finally, the Communications Workers of America *et. al.* warn that "given the extent and the success of the transition to date, any effort to change the standard would place the entire industry in jeopardy, waste years of development and investment, and most likely force the Commission and all interested parties to start all over from square one."[37]

In short, reopening the DTV Standard would (1) require extensive research and testing to determine COFDM's interference characteristics; (2) require a complete overhaul and retooling of the DTV Table of Allotments; (3) cause consumers and broadcasters to postpone purchasing DTV equipment; (4) freeze the development and deployment of DTV technology; (5) possibly render obsolete the DTV equipment already in the marketplace; and (6) further delay the recovery of the spectrum allocated

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[34] See, e.g., Belo Comments at 5; iBlast Comments at 1; NCL Comments at 2; Philips Comments at 13-14.

[35] iBlast Comments at 1.

[36] NCL Comments at 1-2.

[37] CWA *et. al.* Comments at 3.

for public safety and other uses at the end of the DTV transition.[38]

Recognizing the obvious "snowball" effect that a change in the DTV Standard would create, Zenith concurs with the Commission's conclusion that a change in the transmission standard would result in a "multi-year effort" and would cause a "significant delay in the implementation and provision of DTV services to the public."[39] By contrast, Sinclair speculates that the integration of COFDM technology into the DTV Standard could be completed "in little more than a year."[40] In any event, whether the delay would be one year (which is seriously doubtful) or five years (as Motorola estimates in its comments) or longer, the inevitable and serious disruption to the transition's momentum attendant with reopening the DTV Standard cannot be justified in light of the rapid advancements in 8-VSB receiver performance that have been documented in this proceeding.

D. SINCLAIR GROSSLY MISCHARACTERIZES THE INDOOR RECEPTION ISSUE'S EFFECT ON THE TRANSITION

Despite the acknowledged superiority of the 8-VSB transmission standard for our nation's digital television service, and the Commission's thoughtful but firm rejection of the Sinclair Petition, Sinclair nevertheless continues to call for the inclusion of COFDM in the DTV Standard. Sinclair's comments, however, are merely a rehash of the matters raised in its Petition. And instead of offering anything new, Sinclair has simply

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[38] See Zenith Comments at 11-14; Motorola Comments at 4-5; Philips Comments at 13-14.

[39] Sinclair Decision at 3.

[40] Sinclair Comments at 35.

tried to "dress up" its well-worn arguments with unsubstantiated claims and unfounded accusations.[41]

First, Sinclair tries to bring credibility to its position that 8-VSB does not provide adequate indoor reception by offering trade press reports that "NBC and others" have confirmed Sinclair's findings.[42] The claim, however, carries no weight. The FCC has already dismissed Sinclair's findings, noting that "Sinclair has done no more than to demonstrate a shortcoming of early DTV receiver implementation, rather than a basic flaw in the ATSC standard or an indication that service replication is unachievable."[43]

Moreover, rather than relying upon a news report of statistically insignificant tests conducted at only a handful of sites, or claiming vaguely that "others" support its position, Zenith in its initial comments directed the Commission's attention to the very recent well-documented scientific study conducted by CBS which concluded that "it is evident that the current ATSC system is replicating the NTSC reception coverages for both indoor and outdoor reception" and that "8-VSB remains a viable system for providing DTV service and replication of the broadcasters' service area."[44] The CBS

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[41] Zenith must correct Sinclair's false accusation that, in contrast to Sinclair's demonstration of COFDM's capabilities at the 2000 NAB Convention in Las Vegas, Zenith conducted a "secret demonstration" of 8-VSB performance at the Venetian Hotel. Sinclair Comments at 10. This is not true. In fact, Zenith gave numerous demonstrations of 8-VSB's performance at the Las Vegas Convention Center (nowhere near the Venetian Hotel) and is quite confident that representatives of DVB attended at least one of those demonstrations.

[42] Sinclair Comments at 8.

[43] Sinclair Decision at 3.

[44] KYW-DT DTV Field Test Report, Walter Sidas, P.E., CBS Engineering, March 28, 2000.

study included reception tests at 128 outdoor and 42 indoor sites within the coverage area of KYW-DT in Philadelphia, Pennsylvania. By contrast, the data from the reported NBC study has never been shared, and Sinclair's comments provide no specifics whatsoever concerning the tests of NBC or the amorphous "others."

Second, Sinclair claims that half of all broadcasters now openly favor COFDM technology.[45] Interestingly, only half a dozen or so broadcasters submitted comments addressing the modulation issue. This unfounded claim of having the overwhelming support of broadcasters calls all of Sinclair's claims into question.

Third, Sinclair states, again without any evidence whatsoever, that consumers are unhappy with DTV receiver performance, particularly with regards to indoor reception.[46] The Joint Broadcasters make this claim as well, again without basis.[47] If indeed consumers are complaining, they are not complaining to Zenith or other manufacturers. In fact, the Consumer Electronics Association and other manufacturers report that the DTV products in the marketplace today have been extremely well-received by tens of thousands of consumers, many of them "early adopters."[48] Anecdotal evidence from real HDTV owners and frequent viewers confirms that they are in fact quite happy with their HDTV products, reception and viewing experience, according to HDTV Magazine, a leading online consumer publication covering the DTV transition. Among the viewer comments posted on the HDTV Magazine site via its

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[45] Sinclair Comments at 20.

[46] Sinclair Comments at ii.

[47] Joint Broadcasters Comments at 23.

online bulletin board, and attached as Appendix D, are such statements as "[t]he 8-VSB modulation performance, from my experience, has been excellent" and "[a]lthough I live 15 miles from the transmitters and my house is surrounded by trees, I receive all five DTV stations using an indoor antenna."

Fourth, in stark contrast to Sinclair's outrageous claim that it is the indoor reception issue that is causing the failure of the digital transition, Zenith points the Commission's attention to the comments submitted by the National Consumers League and the Consumer Electronics Association which note the real (and most important) impediment to the transition: a lack of quality DTV and HDTV programming.[49] Consumers need content as an incentive to purchase DTV receivers. Only if broadcasters begin offering increasing amounts of digitally-produced programming – especially HDTV – will consumers begin to embrace digital technology and accelerate the pace of the transition. Again, the comments of real HDTV owners and viewers is illustrative. Some of the comments received by HDTV Magazine (and attached as Appendix E) include "[o]nce you see [HDTV] you will be hooked and won't want to accept anything else" and "[t]o date I have had six people over to see HDTV and every one of them was totally blown away by it."

Despite broadcasters' promises to provide HDTV, Sinclair has nevertheless opted to show its hand by disclosing its view that HDTV is only a "niche service" and that it is more interested in "flexible business models" that demand over-the-air service

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[48] See CEA Comments at 6; Thomson Comments at 15.

[49] NCL Comments at 2; CEA Comments at 7-11.

in high multipath areas which typically do not receive acceptable NTSC service.[50] In short, Sinclair is dismissing what was designed to be the "killer application" for attracting viewers, spurring the sale of DTV receivers and moving the transition forward.[51]

Contrary to Sinclair's view, HDTV is not a "niche service." The DTV Standard was developed with HDTV featured as the centerpiece to drive the DTV transition. While the other services provided by the DTV Standard, such as simultaneous transmission of standard-definition programs and data carriage, are important, it is the vastly improved video and audio quality of HDTV that make it a primary vehicle for introducing digital television to consumers. Moreover, while Zenith certainly supports legitimate broadcaster plans to provide new services on their digital spectrum, the provision of such services must be consistent with broadcasters' continued delivery of free over-the-air programming. Ensuring that viewers continue to enjoy free television service should continue to be the primary focus of the transition, as mandated explicitly by Congress.[52] Displacing free over-the-air television with potential new services would have catastrophic consequences for the pace of the transition. Accordingly, Zenith urges the Commission to encourage the broadcast industry to

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[50] See Sinclair Comments at 22.

[51] In its comments, Sinclair says that it "is prepared to operate consistent with the existing ATSC DTV standard and meet all applicable DTV implementation deadlines." Sinclair Comments at 2. Nevertheless, Sinclair has yet to commence delivering regular digital television programming (as opposed to COFDM demonstrations) on a single one of the 61 stations it owns or programs, even though a number of those stations had a digital on-air deadline of November 1, 1999.

[52] See 47 U.S.C. § 336.

increase its efforts to offer compelling services such as HDTV programming on a wide-scale basis.

Finally, Sinclair and its few allies try to make much of the fact that other countries have adopted COFDM technology for their digital television systems. Pappas and Univision go so far as to make broad – but unfounded – claims like COFDM has a "track record of success" in Europe and is "a proven and reliable technology implemented worldwide."[53] These statements are not true. The only country where the deployment of COFDM has any significance is the United Kingdom. No other country has implemented COFDM on a large scale like the United Kingdom's OnDigital pay TV service.

The OnDigital service was designed for rooftop and loft (or attic) antennas, not indoor antennas. Thus, the United Kingdom's DTV system is an irrelevant source for the argument that COFDM is better suited for over-the-air indoor reception. In fact, the OnDigital viewing experience has not been trouble-free as shown by comments received from OnDigital viewers, attached as Appendix F.

In any event, the choices made by other countries to adopt COFDM are irrelevant when one considers the specific advantages of 8-VSB technology that led the ACATS, ATSC and FCC to conclude that 8-VSB is the right choice for digital broadcasting in America. While the actual implementation of COFDM is not widespread (as some claim), the broad deployment of 8-VSB in the United States continues to grow. According to the National Association of Broadcasters, 134

[53] Pappas Comments at 5; Univision Comments at 15.

television stations in 49 markets are currently broadcasting digitally using the 8-VSB standard, covering approximately 63 percent of the nation's television households. In light of the significant progress made to bring DTV to the American public and the number of viewers, broadcasters and other DTV stakeholders who are relying on this progress to continue unabated, the consequences of changing the DTV transmission standard at this point in the transition cannot be underestimated.

E. 8-VSB IS A VIABLE TECHNOLOGY FOR ON-CHANNEL RETRANSMISSION METHODS

The claim made by Sinclair and a few other commenters that COFDM is better suited for allowing the use of on-channel retransmission methods (*i.e.*, boosters) is simply nonsense.[54] Although presented under the guise of being an additional advantage of COFDM, the assertion that COFDM better facilitates the use of on-channel boosters is really just a thinly-veiled attempt to deflect attention away from the fact that 8-VSB signals provide significantly greater overall coverage to broadcasters' existing service areas, including their market fringes. In any event, in contrast to the unsubstantiated claims of Sinclair and its supporters, verified technical studies exist confirming that the DTV Standard will support the use of on-channel boosters. In particular, Zenith directs the Commission's attention to the study conducted by the Advanced Television Technology Center which concludes that the "ATSC Digital Television (DTV) Standard

[54] See Sinclair Comments at 36-41; Pappas Comments at 9; Univision Comments at 26-27.

through the use of the 8-VSB modulation technique, provides sufficient performance margins to allow for the practical introduction of On-Channel Repeaters."[55]

CONCLUSION

As the initial comments in this proceeding make clear, Zenith and most other DTV stakeholders (including consumers, broadcasters, manufacturers, unions and others) share the Commission's vision of a nation in which all Americans are able to enjoy the benefits of digital television, particularly HDTV. In this regard, Zenith commends the Commission for its efforts to eliminate potential delays to the digital transition and ensure that this vision becomes a reality as soon as possible.

Despite the insistence by a handful of commenting parties that the Commission reopen the debate over the DTV transmission standard, there is no doubt that the selection of 8-VSB modulation by broadcasters, ACATS and the Commission was the right choice for ensuring a smooth and swift transition. In addition to its other advantages, the 8-VSB standard provides greater assurance that each DTV station can replicate its corresponding NTSC service area without a significant loss of viewers. Moreover, as Zenith's "technology roadmap" illustrates, significant progress has been made with regard to the over-the-air reception of 8-VSB receivers. Zenith is confident that these improvements will continue at a rapid pace with each successive generation of receiver. A change in the DTV Standard at this point would only serve to disrupt the

[55] On-Channel Repeaters for Digital Television Implementation and Testing, Walt Husak, Charles Einolf and Stan Salamon, Advanced Television Technology Center, April 20, 1999.

transition's momentum and needlessly delay the availability of digital television to the public.

Accordingly, with the goal line clearly in sight, Zenith urges the Commission to not let an implementation issue like DTV receiver multipath performance throw the transition off course when so many other benefits have been achieved. Zenith looks forward to continuing to work with the Commission and other DTV stakeholders to ensure that the shared vision of a quick and successful DTV transition is realized and urges the Commission to reaffirm VSB as the DTV Standard's sole modulation system.

Respectfully submitted,

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June 16, 2000

APPENDIX A

Jules Cohen, P.E.
Consulting Engineer

ENGINEERING STATEMENT
CHANNEL ALLOTMENT CONSIDERATIONS
COMPARING THE USE OF 8-VSB OR COFDM

Introduction

A study[1] has been made of the impact on digital channel allotments using, alternatively, 8-VSB or COFDM modulation. In addition to comparing the effect on a single primary station, the impact on other cochannel and adjacent channel analog and digital stations was studied also.

In order to provide the analysis under "real world" conditions, three New York City stations and stations potentially affected by those operations were considered. The primary stations studied and their digital assignments are: WNBC-DT, channel 28, WABC-DT, channel 45, and WPIX-DT (WB Network), channel 33. New York City, in the northeastern part of the United States, was chosen because the high density of television stations in that region presents a challenging television allotment problem. In an area already seemingly pressed to the limit, the need to maintain existing analog stations for an indefinite period of time while simultaneously providing for the new digital service required doubling the number of channel allotments with no increase in spectrum usage assigned to the television service.

Summary of Conclusions

The analysis provided in detail herein, based on Brazilian laboratory determinations of white noise threshold and appropriate desired-to-undesired (D/U) ratios for digital-to-digital and digital-to-

[1] Sponsor of the study was Zenith Electronics Corporation.

analog cochannel signals, shows a clear preference for the use of 8-VSB rather than COFDM from an allotment viewpoint. With identical effective radiated power and antenna height above average terrain, use of COFDM provides less coverage and results in more interference to other stations than 8-VSB. If the COFDM effective radiated power is increased to overcome the reduction of service from that provided by use of 8-VSB, interference is further aggravated, particularly to the analog stations continuing to operate at their assigned power levels. Consequently, either fewer stations can be accommodated using a specified number of channels, or service areas must be reduced substantially.

Methodology and Results

To provide the analysis shown herein, use was made of the computer software developed by the United States Federal Communications Commission (FCC) except that the input to the program was modified as appropriate to use the Brazilian developed parameters[2] for noise-limited coverage and interference. The FCC program uses contour distance calculations employing field strength versus distance data from its own rules, but determines population lost due to interference by the

[2] As measured in the SET/ABERT Final Report on the Comparative Trials of the Digital Television Systems, First Part, February, 2000.

	8-VSB	COFDM
White noise threshold	15 dB	20 dB
D/U limit, Cochannel digital into digital	15 dB	20 dB
D/U limit, Cochannel digital into analog, ITU-R Grade 4	37 dB	40 dB

Longley-Rice method, a program that better accounts for terrain irregularities. The Longley-Rice model was developed originally in 1965 by scientists at the National Bureau of Standards (now the National Institute of Standards and Technology) and improved substantially over the years through a number of changes and adaptation to computer use.

As an initial step after input of data defining the study to be made, the program determines what stations, derived from a database including all United States and adjacent foreign station assignments, may be affected. The program then permits the calculation of station-by-station service provided and interference received. Output includes total coverage, coverage limited by terrain, interference from authorized analog stations, additional interference from digital allotments, interference from digital allotments only, and remaining interference-free service.

In accompanying tabulations, results of the computation process are shown. Figure 1 shows the analyses of digital service calculated to be provided by the primary stations WNBC-DT, WABC-DT and WPIX-DT. These stations are assigned channels 28, 45 and 33, respectively. Figures 2 through 7 illustrate the impact of the operation of the primary stations on other cochannel and adjacent channel stations, both analog and digital.

With respect to analog stations, calculations have been made assuming 8-VSB, COFDM operating at the same effective radiated power as for 8-VSB, and COFDM with the primary station effective radiated power increased by 5 decibels to extend noise-limited coverage to equal that of 8-VSB. Since only the primary station and no other digital operation was assumed to operate at the

higher power level, interference to the analog stations is substantially understated since interference is received from more than one digital station.

With respect to digital stations, COFDM power was assumed only at the same level as for 8-VSB. To do otherwise would have required extensive changes in the station database. In producing this limited, illustrative study, such changes did not appear to be justified.

In the analog station analyses, noise-limited coverage (NLC) is determined solely by the operating parameters of the analog station and terrain, so it remains the same no matter what digital modulation method may be used. In many instances, additional service lost due to interference from digital sources does not change when the primary digital station power is increased. The reason for this is that stations other than the primary station are determining the extent of digital interference and those other station powers have not been increased in this study. For a determination of the total magnitude of service lost through use of COFDM with greater power to match the NLC achievable with 8-VSB at less power, the study would have to be extended by modifying the power of all digital stations in the database.

Impact on Broadcast Television Service

Impact of the use of COFDM rather than 8-VSB can be summarized by data extracted from the accompanying tabulations. If digital operations employed COFDM modulation rather than 8-VSB, and the same effective radiated power is assumed for both systems, the additional population losses to analog cochannel and first adjacent channel operations potentially affected by WNBC-DT,

WABC-DT and WPIX-DT would be 515,338, 264,059 and 206,708, respectively. In order to achieve COFDM noise-limited coverage comparable to that achievable with 8-VSB, effective radiated power of the three digital operations would have to be increased 5 decibels (3.16 times). The consequence of raising the power at only the single New York station in each instance would result in cochannel and adjacent channel analog stations losing the following populations beyond the impact of the use of 8-VSB: 580,387, 298,373 and 258,214, respectively. If all assigned digital operations increased power by 5 decibels over their 8-VSB assignments, the foregoing population losses would be increased substantially.

The effect of the use of COFDM rather than 8-VSB, and at the same effective radiated power level to minimize analog population losses, would substantially decrease the noise-limited coverage of digital operations as well. Considering New York stations WNBC-DT, WABC-DT and WPIX-DT, and cochannel and first adjacent channel digital assignments potentially affected by those three operations, lost populations would be:1,372,025, 2,928,437 and 2,655,674, respectively.

Jules Cohen, P.E.

June 9, 2000

Figure 1

ANALYSIS OF PRIMARY STATION SERVICE				
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	Total Losses	Population Served
WNBC-DT, New York, NY (28)				
8-VSB	18,362,207	67,594	235,061	18,127,146
COFDM	17,601,946	36,020	111,228	17,490,718
WABC-DT, New York, NY (45)				
8-VSB	17,927,226	77,437	121,685	17,805,541
COFDM	17,207,332	35,580	53,673	17,153,659
WPIX-DT, New York, NY (33)				
8-VSB	18,010,853	378,608	428,400	17,582,453
COFDM	17,226,212	315,944	326,127	16,900,085

Figure 2

COCHANNEL AND FIRST ADJACENT ANALOG STATIONS POTENTIALLY AFFECTED BY WNBC-DT			
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	% Loss
WLWC, New Bedford, MA (28)			
8-VSB	4,069,265	40,511	1.0
COFDM	4,069,265	47,317	1.2
COFDM + 5dB	4,069,265	52,815	1.3
WUNI, Worcester, MA (27)			
8-VSB	6,325,925	753	0.0
COFDM	6,325,925	2,205	0.0
COFDM + 5dB	6,325,925	2,205	0.0
WCPB, Salisbury, MD (28)			
8-VSB	341,047	0	0.0
COFDM	341,047	0	0.0
COFDM + 5dB	341,047	1,156	0.3
WHTM-TV, Harrisburg, PA (27)			
8-VSB	1,654,074	210,958	12.8
COFDM	1,654,074	273,263	16.5
COFDM + 5dB	1,654,074	273,263	16.5
WTXF, Philadelphia, PA (29)			
8-VSB	7,561,033	884,376	11.7
COFDM	7,561,033	1,013,559	13.4
COFDM + 5dB	7,561,033	1,024,485	13.5
WBRE-TV, Wilkes-Barre, PA (28)			
8-VSB	1,620,810	32,857	2.0
COFDM	1,620,810	347,687	21.5
COFDM + 5dB	1,620,810	393,869	24.3
WVER, Rutland, VT (28)			
8-VSB	239,430	11	0.0
COFDM	239,430	773	0.3
COFDM + 5dB	239,430	2,060	0.9

Figure 3

COCHANNEL AND FIRST ADJACENT DTV STATIONS POTENTIALLY AFFECTED BY WNBC-DT				
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	Total Losses	Population Served
WFPT-DT, Frederick, MD (28)				
8-VSB	3,256,531	959,841	1,339,131	1,917,400
COFDM	2,453,207	486,225	735,647	1,717,560
WUNI-DT, Worcester, MA (29)				
8-VSB	6,643,130	941,084	1,037,303	5,605,827
COFDM	6,025,970	895,549	899,816	5,126,154
WGTW-DT, Burlington, NJ (27)				
8-VSB	6,776,515	54,442	284,711	6,491,804
COFDM	6,351,215	35,154	102,934	6,248,281
WTBY-DT, Poughkeepsie, NY (27)				
8-VSB	3,446,810	760,604	1,362,023	2,084,787
COFDM	2,100,793	272,526	464,995	1,635,798

Figure 4

COCHANNEL AND FIRST ADJACENT ANALOG STATIONS POTENTIALLY AFFECTED BY WABC-DT			
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	% Loss
WGBX-TV, Boston, MA (44)			
8-VSB	5,793,125	412,147	7.1
COFDM	5,793,125	572,299	9.9
COFDM + 5 dB	5,793,125	572,299	9.9
WHRC, Norwell, MA (46)			
8-VSB	2,532,892	354,715	14.0
COFDM	2,532,892	427,281	16.9
COFDM + 5 dB	2,532,892	427,281	16.9
WBFF, Baltimore, MD (45)			
8-VSB	5,808,747	157,511	2.7
COFDM	5,808,747	163,911	2.8
COFDM + 5 dB	5,808,747	193,879	3.3
WSKG-TV, Binghamton, NY (46)			
8-VSB	445,730	491	0.1
COFDM	445,730	1,312	0.3
COFDM + 5 dB	445,730	1,312	0.3
WMHQ, Schenectady, NY (45)			
8-VSB	1,072,931	20,992	2.0
COFDM	1,072,931	26,202	2.4
COFDM + 5 dB	1,072,931	30,548	2.8
WVIA-TV, Scranton, PA (44)			
8-VSB	1,069,341	111,421	10.4
COFDM	1,069,341	130,331	12.2
COFDM + 5 dB	1,069,341	130,331	12.2

Figure 5

COCHANNEL AND FIRST ADJACENT DTV STATIONS POTENTIALLY AFFECTED BY WABC-DT				
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	Total Losses	Population Served
WEDN-DT, Nowich, CT (45)				
8-VSB	1,906,431	710,039	895,093	1,011,338
COFDM	1,344,157	419,574	562,023	782,134
WBFF-DT, Baltimore, MD (46)				
8-VSB	6,072,848	149,865	154,240	5,918,608
COFDM	5,405,045	73,717	75,655	5,329,390
WNYW-DT, New York, NY (44)				
8-VSB	18,312,706	246,222	342,877	17,969,829
COFDM	17,573,977	56,024	100,096	17,473,881
WNYS-DT, Syracuse, NY (44)				
8-VSB	1,088,472	2,068	14,013	1,074,459
COFDM	979,979	38	3,282	976,697
WFMZ-DT, Allentown, PA (46)				
8-VSB	4,521,750	86,561	182,003	4,339,747
COFDM	2,984,098	35,046	160,656	2,823,442

Figure 6

COCHANNEL AND FIRST ADJACENT ANALOG STATIONS POTENTIALLY AFFECTED BY WPIX-DT			
	NLC Not Affected by Terrain Losses	Lost to Additional Interference by DTV	% Loss
WHMM, Washington, DC (32)			
8-VSB	5,832,825	185,349	3.2
COFDM	5,832,825	344,831	5.9
COFDM + 5dB	5,832,825	344,831	5.9
WMGC-TV, Binghamton, NY (34)			
8-VSB	478,466	3,647	0.8
COFDM	478,466	6,617	1.4
COFDM + 5dB	478,466	6,617	1.4
WXFV, Utica, NY (33)			
8-VSB	625,252	102,472	16.4
COFDM	625,252	113,415	18.1
COFDM + 5dB	625,252	113,415	18.1
WITF-TV, Harrisburg, PA (33)			
8-VSB	1,793,766	62,439	3.5
COFDM	1,793,766	93,948	5.2
COFDM + 5dB	1,793,766	145,454	8.1
WETK, Burlington, VT (33)			
8-VSB	415,590	2,130	0.5
COFDM	415,590	3,934	0.9
COFDM + 5dB	415,590	3,934	0.9

Figure 7

COCHANNEL AND FIRST ADJACENT DTV STATIONS POTENTIALLY AFFECTED BY WPIX-DT				
	NLC Not Affected by Terrain Losses	Lost to Additional nterference by DT	Total Losses	Population Served
WFSB-DT, Hartford, CT (33)				
8-VSB	3,997,520	732,944	748,400	3,249,120
COFDM	3,649,550	647,825	657,302	2,992,248
WEDH-DT, Hartford, CT (32)				
8-VSB	3,146,832	161,683	161,683	2,985,149
COFDM	2,738,612	70,415	70,415	2,668,197
WTWS-DT, New London, CT (34)				
8-VSB	3,312,668	889,203	892,839	2,419,829
COFDM	2,627,077	791,834	792,132	1,834,945
WHMM-DT, Washington, DC (33)				
8-VSB	5,838,719	207,708	290,256	5,548,463
COFDM	5,447,409	127,899	151,613	5,295,796
WNBU-DT, Concord, NH (33)				
8-VSB	1,965,400	42,858	52,865	1,912,535
COFDM	1,592,281	27,249	39,770	1,552,511
WMHT-DT, Schenectady, NY (34)				
8-VSB	1,223,984	2,024	31,045	1,192,939
COFDM	1,127,939	3,467	10,329	1,117,610
WYBE-DT, Philadelphia, PA (34)				
8-VSB	5,743,894	91,730	98,162	5,645,732
COFDM	5,431,610	110,514	113,947	5,317,663
WPSG-DT, Philadelphia, PA (32)				
8-VSB	6,528,380	129,842	159,267	6,369,113
COFDM	6,009,553	20,476	25,073	5,984,480
WSWB-DT, Scranton, PA (32)				
8-VSB	797,433	26,933	31,808	765,625
COFDM	734,752	18,658	26,214	708,538
WETK-DT, Burlington, VT (32)				
8-VSB	446,510	105	528	445,982
COFDM	407,556	731	731	406,825

APPENDIX B

Jules Cohen P.E.

Consulting Engineer

PROFESSIONAL BACKGROUND OF JULES COHEN

Jules Cohen received the degree of Bachelor of Science in Electrical Engineering from the University of Washington (Seattle) in 1938. His first professional experience was with consulting engineering firms in the city of Seattle, then with the Bonneville Power Administration, a division of the U.S. Department of Interior, where he served as a junior engineer and assistant engineer in the substation design section. He was commissioned in the Navy in May of 1942 and served for three and one-half years as a naval officer during World War II. His duties included training at Harvard, at MIT and at the Naval Air Technical Training Center in Corpus Christi. He was a project officer on radar beacons at the Radiation Laboratory at MIT, then at the Bureau of Ships. Under the Commander, Service Forces, Pacific Fleet, he was in responsible charge of the radar beacon program for the Pacific Fleet. His last duty station in the Navy was as Executive Officer of the Electronics Division, Commander, Service Forces, Pacific Fleet.

Following release from the Navy, he entered the field of consulting engineering and has been so engaged for 54 years. During 46 of those 54 years, he has been either a sole principal, a partner, or an officer in a consulting engineering firm. He has been licensed to practice as a professional engineer in the District of Columbia since June of 1952, and has been licensed to practice in the field of electrical engineering as a certified professional engineer in the Commonwealth of Virginia since June of 1954. During the period of his professional practice, he has provided professional engineering services in the field of broadcasting, in particular, and communications, in general. On January 1, 1988, he retired from the presidency of Jules Cohen & Associates, P.C., but has continued providing professional consulting service to selected clients.

Over 10,000 projects of varying levels of complexity have been carried out by the engineering firm of which he was either sole member, partner or officer. Work performed has included radio-frequency propagation studies, interference studies, frequency allocation surveys, radiation hazard evaluations, standard broadcast directional antenna design and adjustment, AM, FM and TV field strength measurements, television picture quality assessment, satellite earth station studies, the planning and placement of cellular and other communications structures, studio and transmitter plant layouts for both radio and television, equipment evaluation, and extensive work involving the engineering aspects of changes in the rules of the Federal Communications Commission (FCC).

He was the author of Appendix C of the 1975 Cable Television Advisory Committee Panel II report to the FCC. That Appendix dealt with the problem of echoes in television systems. He is also the author of the section on low power television in the 1986 edition of the McGraw-Hill Encyclopedia of Science and Technology. He was a co-author of Section 2.9, Human Exposure to RF Radiation in the Eighth Edition of the National Association of Broadcasters Engineering Handbook. As chairman of the engineering committee concerned with interference to television broadcasting from noncommercial FM stations, he played a major role in the development of the rules adopted by the FCC governing the assignment of FM stations in the frequency band from 88.1 to 91.9 MHz. He represented television broadcast interests as co-chairman of the Technical Analysis Working Group of the Land Mobile Radio/UHF Television Technical Advisory Committee.

From the time of its inception in 1983 to 1996, Jules Cohen represented the Association for Maximum Service Television, Inc. (MSTV) in Subcommittees and Technology Groups of the Advanced

Television Systems Committee (ATSC). From 1996 to September, 1998, he represented the IEEE Broadcast Technology Society on the Executive Committee of the ATSC. He has participated as a member, co-chairman or vice chairman of a number of ATSC Technical Groups. As stated in its Charter, the purpose of ATSC "[I]s to explore the need for and, where appropriate, to coordinate development of voluntary national technical standards for Advanced Television Systems."

His participation in the work of the Advisory Committee on Advanced Television Service (ACATS) began in November, 1987, the starting date set by the Federal Communications Commission, and continued until the completion of the Advisory Committee's work in November, 1995. He was a member of Working Parties 1 and 2 of the Systems Subcommittee (SS/WP-1 and 2), and Working Parties 3, 4 and 6 of the Planning Subcommittee (PS/WP-3, 4 and 6). Under SS/WP-2, he chaired the Field Testing Task Force. That Task Force completed field testing of the Grand Alliance Digital Television System in October, 1995. Mr. Cohen had a major role in preparing both the specifications for the field testing and preparation of the report following field testing. Under PS/WP-3, he chaired the Spectrum Analysis Working Group.

Clients have included all five of the major television networks (ABC, CBS, NBC, Fox and PBS), the National Association of Broadcasters (NAB), the Association for Maximum Service Television, the Electronic Industries Association, major group owners, individual radio and television stations, and Cellular System and Personal Communications System providers. He has also provided professional engineering services to community and citizen groups relative to the placement of broadcast or wireless communications facilities.

For more than twenty years, he has worked extensively in the field of nonionizing radiation effects. He has done research in the scientific literature devoted to the subject, participated in the Bioelectromagnetics Society Symposia held yearly from 1979 through 1995, as well as 1998 and 1999, completed courses in Hazardous Electromagnetic Radiation offered by the George Washington University, the Management of Electromagnetic Energy Hazards offered by Cook College, Rutgers University, and Electric and Magnetic Field Health Research: Assessing the Science, offered by the Harvard School of Public Health, attended meetings of the Electromagnetic Radiation Management Advisory Council, participated in Michaelson Research Conferences in 1994, 1995, 1997, 1998 and 1999, moderated panels on the Biological Effects of Nonionizing Radiation at the 1979, 1983 and 1988 annual conventions of the NAB, delivered invited papers on the Biological Effects of Nonionizing Radiation in the 1979, 1984 and 1993 meetings of the Broadcast Technology Society of the Institute of Electrical and Electronics Engineers, and, by invitation, provided a critique of the first and second 1979 drafts and the 1985 draft of a RF/Microwave Criteria document of the National Institute for Occupational Safety and Health.

He was a member of American National Standards Institute (ANSI) Committee C95 that developed the 1982 ANSI Standard C95.1-1982 Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. He is a member of IEEE Standards Coordinating Committee 28 (SCC 28) and Subcommittee IV which completed a revision to ANSI Standard C95.1-1982 (now identified as IEEE C95.1-1991 or ANSI/IEEE C95.1-1992). Subcommittee IV is continuing evaluation of scientific literature for a possible further updating of the standard. He is a member of SCC 28 Subcommittee I that developed IEEE Standard C95.3-1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. He is a member of the IEEE Committee on Man and Radiation (COMAR). He is also a member of Committee 89-2 of the National Council on Radiation Protection and Measurements (NCRP). Committee. 89-2 has prepared NCRP Report No. 119, A Practical Guide to the Determinations of Human Exposure to Radiofrequency Fields. Under contract to the National Association of

Broadcasters, he prepared a suggested revision to FCC OST Bulletin No. 65, taking into account the ANSI/IEEE 1992 exposure guide.

He has made RF exposure measurements at both the World Trade Center and Empire State Building in New York City. Over the past twenty years, he has also made RF exposure measurements at numerous locations on behalf of broadcast station licensees, cell phone operators and municipalities.

He has been qualified as an expert witness in Federal court, other courts, local boards and councils, and in hearings before the FCC and FAA. Most recently, his expert testimony was accepted in the United States District Court for the Southern District of Florida in the matter of CBS, Inc. *et al* v. PrimeTime 24 Joint Venture, C.A. No. 96-3650-CIV-Nesbitt.

He is a member of Tau Beta Pi, engineering scholastic honorary, a member of the National Society of Professional Engineers, a Life Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Life Fellow of the Society of Motion Picture and Television Engineers, a charter member of the Bioelectromagnetics Society, a past president of the Association of Federal Communications Consulting Engineers and former chairman of that association's Radiation Hazard Subcommittee. He was selected for the 1988 NAB Engineering Achievement Award, a 1990 Achievement Award of the Broadcast Pioneers Washington, D.C. chapter and a 1999 award from the IEEE Broadcast Technology Society for a lifetime of service to the broadcasting industry and to the Society. During the year 2000 convention of the NAB, he received a further award from the NAB engineers for his over fifty years of service to the broadcast community and a Pioneers award from the Broadcasters' Foundation.

April 26, 2000

APPENDIX C

8 VSB Product Evolution

Model Year	1998	1999	2000	2001	2002
Generation	**1st**	**2nd**	**3rd**	**4th**	**5th**
Configuration	3 chip set • Analog demodulator • Sync/equalizer (EQ) • Error correction (EC)	2 Chip set • Analog demodulator • Sync/EQ/EC	2 Chip set • Analog demodulator • Sync/EQ/EC	Single chip • Digital demodulator/Sync EQ/EC	Single chip • Digital demodulator/Sync EQ/EC
Features	First integrated circuit version	Reduced Power & Cost	Longer & Faster Ghosts	Stronger, Faster & Very Short Ghosts	Stronger, Faster & Pre-Ghosts
Enabling Technology	Parallel Tap Update	Smaller IC Geometry	Predictive Slice	Digital Demodulator Improved Sync	Advanced equalization
Performance					
Length (post)	20 μs	20 μs	44 μs	44 μs	44 μs
Length (pre)	3 μs	3 μs	3 μs	20 μs	25 μs
Amplitude, 1μS	70%	70%	80%	90%	95%
Speed (50% ghost)	5 Hz	5 Hz	8 Hz	12 Hz	20 Hz

APPENDIX D

Comments From HDTV Magazine Subscribers
On 8-VSB Reception

Although I live 15 miles from the transmitters, and my house is surrounded by trees, I receive all five DTV stations using an indoor antenna. I also receive two Baltimore DTV stations 55 miles away using an outdoor antenna.

- Ed Williams

Anyone who watches a movie in HD, that is anyone who cares about picture quality even a little bit, would be a convert. And all from a $19 Radio Shack antenna.

- Jeff, Boston MA

Stunning image clarity and quality from WCBS-DT (channel 56) in New York City! It's the kind of picture that made me go out and purchase an HDTV set eight months ago.

- Rob

The quality of the HD broadcast from WFAA in Dallas is fantastic.

- Randy P

KOMO-TV (HD-38) in Seattle is broadcasting every local newscast in HDTV. The pictures are incredible! I'm viewing the signal 35 miles away from their transmitter and the picture is perfect.

- Jim K, Puyallup WA

At present I receive Ch 42 WHDH-DT (NBC) and Ch 20 WCVB-DT (ABC). Both are received with very good signal level with no signal drops.

- P Joy, Tewksbury, MA

I'm about 15 miles from the Washington, DC transmitters. All stations are clear and strong…no pixels.

- Al Z

Quite reliable, especially from NBC and CBS.

- JH in LA

The 8vsb modulation performance, from my experience, has been excellent.

- Robert R

I live south of Washington DC and I'm able to receive all digital broadcasts available in my area – oh, BTW, the signals are quite stable for all channels, and I'm using an indoor antenna in the loft of my town home.

- Mike F

HDTV Magazine is an online source of DTV news and information. All quotes have been posted on the site via the online bulletin board.

APPENDIX E

Comments From HDTV Magazine Subscribers
On HDTV Customer Satisfaction

It is amazing how fast one can get used to watching HD and not want to watch anything less.

- Ryan

It was beyond expectation. I had several friends over during the match, and it was fun to watch their reaction. I had the capability to switch to NTSC on the local CBS affiliate (KPIX), and the differences caused their jaws to drop.

- Bob S

ABC's movie last night in HDTV was wonderful. A friend of mine that watched it with me left saying, "I have to buy one of these TV's."

- Randall D

To date I have had six people over to see HDTV, and every one of them was totally blown away by it.

- Ronald O

I just got my set up together last week and I can honestly say this was how I had hoped HDTV would be. Even though I knew it would be good, I'm actually shocked it was that good. In my opinion, much better than a movie theater.

- Jeff

Once you see it you will be hooked and won't want to accept anything else.

- Ed W.

The higher resolution of HDTV makes viewing much easier, it's like driving out of the fog into bright sunshine.

- Robert

I invited 7 friends who had never seen HDTV before over to watch the Dallas vs Minnesota Monday night game. Grown men turned into little kids. Comments ranged from "It's like looking through a window" to "I can't believe you are getting this kind of clarity from an antenna on the roof!" As the final guest left, I heard him whisper to the guy next to him, "How am I going to convince my wife that I have to have this?!"

- Kristen C

I, like most parents, try to minimize my children's time in front of "the tube." HDTV's brilliant color and clear picture, makes my job even more challenging! They are totally mesmerized by this wonderful new technology.

- S Davis

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APPENDIX F

Comments From OnDigital Viewers
On COFDM Reception

I see occasional blocking when the washing machine switches on, and other times perhaps with other flats in my block using inductive devices.

- Tony Stanley

I do however see a lot of what looks like ignition noise. Certain cars going past cause breakup (often with a loud audio "click") and even a couple of occasions have caused the picture to freeze permanently.

- Tony Walton

Whenever I switch an electric device on/off, both sound and picture get interrupted, sometimes pretty badly. The device could be as simple as a little lamp, so it gets quite annoying after a while. I got a surge protector which also claims to protect against "voltage spikes." No difference.

- Dmitri Pavlovsky

On Sunday afternoon a neighbor about 20 metres away was using a Hoover for collecting autumn leaves. The picture and sound became unwatchable for the duration of this jaunt (about 45 mins.).

- Bryan Jones

I get glitches every minute or two. The sound stutters and there's a plash of small boxes scattered across the screen. It does get annoying when it picks on the key word in a piece dialogue, and it cuts out so you don't know what's going on in the programme you're trying to watch. I feel lucky if it goes 10 minutes without a glitch.

- John

I get random lock-ups and have since day 1.

-Jason Tozer

All quotes were posted in England's UK.tech.digital-tv discussion forum on www.deja.com.