ATV system test program, signals that have been through extensive processing such as would occur during a typical program production and distribution.

In the current television distribution system only the NTSC encoding standard is used for final link to the home. As a result it is quite simple to check the effect of any image processing system on the picture that will be received in the home. In fact, a test using NTSC receivers is included in the ATV test plan to cover NTSC compatibility issues where appropriate. In the future when HDTV is introduced, there maybe multiple systems for the final link to the home making it difficult and undesirable to test the acceptability of a proposed image processing system by its impact on all of the distribution systems. The ATV distribution systems selected should be those that can operate in the presence of processing artifacts without introducing further subjective degradation.

CBS therefore, proposes that the Planning Subcommittee take the necessary steps to include some processed signals in the ATV terrestrial broadcasting test program.

Best regards,

Bernard L. Dickens

Bernard L. Dickens
Member Advisory Committee
Planning Subcommittee WP-6

Joseph A. Flaherty
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cc Craig Tanner

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PS/WP1 & WP2-074

Dear Ren, October 3, 1990

As digital technology has advanced, the ability to generate television pictures that utilize the full extent of the spatial and temporal response capabilities of television systems is becoming more common. Several years ago, the Digital Video Interim Working Party of CCIR Study Group 11 was tasked with generating sequences of still and motion pictures to be used in evaluating the performance of digital compression systems for use in inter-studio transmission systems for CCIR Rec. 601 signals. One of the sequences chosen, over the objection of some members who felt it was too taxing since it was very unlikely to occur in a real television situation, was a sequence call "Diva with noise". This sequence starts out as a full picture of a woman with a typical background that gradually is squeezed to fill only a small area in the center of the picture. The remaining area of the picture is filled with random noise. Shortly after the meeting where the use of this sequence was discussed, one of the committee members noticed a sequence on his local television that used a similar effect as a bumper to introduce a program. It is quite apparent that with the availability of digital video effects generators, television pictures are no longer limited to pictures that are filtered by television cameras.

To add to the complexity of determining what is a reasonable picture content is the growing use of sophisticated digital devices such as standards converters and data compression systems. These devices make use of advanced motion adaptive techniques to retain the source resolution without sacrificing smoothness of notion. Since these devices are not perfect, they at times introduce artifacts in the output images. These artifacts may not be of sufficient magnitude to reject the pictures, and they may not even be visually apparent to any but the most expert of observers, but they can create spatial and temporal components that are not normally present in television images.

To resolve the dilemma of the need to set a performance requirement for pictures that cannot be defined a statement was added to the document on performance for data compression codecs by CCIR IWP 11/7. This statement requires that for signals that exceed the capability of the codec the degradation in performance must be graceful.

Planning Subcommittee Working Party 1 can answer the request of the Planning Subcommittee Chairman by adding an attribute relating to the need to gracefully handle all source signals that fall within the specification boundaries for the source system. This would include noisy source signals, since as shown previously, noise can be a part of the desired signal.

A possible test method for this attribute would be to use a signal such as the moving zone plate to locate signal content that could cause a given system problem and then to design a video test image sequence that exercises the problem area. The special test sequence would be passed through the system under test and the impaired picture at the output would be observed and rated by expert viewers. Since the same procedure would be followed for each system under test, the requirement to test all of the systems in the same manner would be met.

Another area that I do not think is covered by an attribute is what happens when switching between channels with a receiver designed for the ATV system. This problem was discussed at the last meeting of Systems Subcommittee WP-1. A similar situation exists when there is an interruption in the input signal to the receiver. Experience with other data compression systems would lead me to believe that there will be a period of picture loss until the repeat cycle of the transmitted data is completed. In ATV systems that exhibit this problem a means must be provided to cause this effect to be graceful.

I hope this discussion will expedite the work of your Working Party.

Best regards,

Bernard L. Dickens
Senior Staff Scientist
(212) 975-2003

Mr. Renville H. McMann Jr.
Chairman PSWP-1
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copies to:

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Alan S. Godber
Director,
Advanced Development

NBC

PS/WP1&2-075

Mr. Renville H. McMann,
Chairman, PS/WP1 ACATS,
963, Oenoke Ridge,
New Canaan, CT 06840

October 8th, 1990

Dear Ren,

Below, please find a contribution from NBC on the subjects previously identified for consideration at the next joint meeting of PS/WP1 and PS/WP2 on October 8th, 1990.

1. Camera Noise and Other Production Equipment Artifacts and its impact on ATV Transmission Systems

   Noise in a source may be random noise, or coherent noise, the latter being of various types. This noise can be aggravated by various processes, particularly analog processing. Digital processes can introduce errors, as a result of error concealment, error correction, overload of the channel, or artifacts produced by signal compression techniques.

   Camera noise of the random variety will be present in varying degrees. It will be present in new cameras designed for ATV, and in existing cameras used for upconversion from NTSC and from PAL.

   A transmission system must be able to satisfactorily process images in the presence of random noise and a certain level of coherent noise such as clock noises from cameras. It must also be able to handle noise and artifacts from other production equipment.

2. Standards Conversion and its impact on ATV Transmission Systems

   Frame rate conversion will be used for a portion of the TV images to be transmitted. Motion artifacts will occur from frame rate change, and may impact the transmission system performance. If the source is interlace, further artifacts will probably occur.

   Line rate conversion may be used, if line rate of production standard of choice is not same as transmission standard. If source is interlace, then artifacts will occur, and may have an impact on the transmission system.

Upconversion from NTSC may be used, in which case artifacts will occur as in the line rate conversion case, assuming that the same frame rate is used in NTSC and ATV.

Upconversion from PAL may be used, in which case artifacts will occur as in the frame rate and line rate conversion case.

In the HDTV production plant downconversion to NTSC and PAL will be done. The impact on the NTSC and PAL images require consideration, but these are more affected by the choice of production standard.

All of these degradations would be reduced when a progressive scan HD production format is used.

A transmission system must be able to satisfactorily process these artifacts without magnifying them, or introducing additional artifacts of its own as a result of the conversion artifacts.

Hoping that these thoughts will be of assistance.

Yours Sincerely,

Alan S. Godber

Alan S. Godber

ASG
10/8/90
apswp1d1/1-2

DATE: September 10, 1990

TO: Jules Cohen Chairman, SS/WP-2 Field Testing Task Force

FROM: Ad Hoc Alternative Site Search Group

SUBJECT: Report requested for September 12, 1990 meeting

At the August 13th Field Test Task Force meeting, concern was expressed that financial considerations could unnecessarily limit field testing when alternatives may exist to the Washington, DC site and to the utilization of existing available equipment. With this in mind, you appointed an ad hoc group to investigate these possible alternatives. This group, consisting of Jim Kutzner, Jack Kean, Harvey Arnold and Tom Keller, met on September 4, 1990. All of us agree that the test plan is well conceived in its present state of development. The concerns are as follows:

1) The highly directional characteristics of the proposed horn antenna may not duplicate multipath conditions that exist in an urban environment. In particular, long period ghosting from structures or terrain features behind the antenna may be absent.

2) The use of relatively low power may further limit long period ghosting since distant reflections may be lost in the noise floor.

3) The combination of low power and less than average antenna height may yield non-representative coverage results for digitally based ATV systems in Grade B areas.

3) A major shortcoming of the laboratory testing program and one of the main factors driving the need for field testing is the ability to generate and therefore determine the effect of multiple impairments on ATV systems under test. The number of impairments at a given receive location could be limited by a reduced scale test area.

4) Any test plan should duplicate as nearly as possible the ultimate operation envisioned. Terrain will vary with venue but most UHF stations share similar height, power and omnidirectional antenna patterns.

You requested day time testing availability for eight hours a day, five days a week, for at least a four month period at a date to be determined by the progress of lab testing. Our investigations were understandably limited by the difficulty of reaching decision makers during the summer months. However, we did achieve the following:

We have a definite commitment from public station WNEQ Channel 23 Buffalo, NY. The antenna and line are very recent with good height and power. The proximity to Canada may be of great advantage because of Canadian resources and interest in this project.

At least one Connecticut commercial station begins daytime operations in mid afternoon and would presumably be available. (WHAI-TV Channel 43 Bridgeport) No contact has been made at this point but Jack Kean will be glad to do so. In addition, Seattle WA has two open UHF assignments plus tower and tall building location potential. Several PBS stations are tentatively available including Channel 26 in Charlotte, North Carolina. It is also believed that arrangements for full power testing on both UHF and VHF can be made with other PBS stations during summer months.

The group understands that full power testing could be accomplished on CH-58 in Washington without interference to other stations. Nat Ostroff, President of Comark, has indicated his desire to make a 40 Kw klystrode transmitter available for such testing. Harry McKee, Vice President of Andrews Corp. has expressed interest in providing a antenna suitable for side mounting. These are not firm commitments but certainly worthwhile pursuing. This equipment could be employed either in Washington or at a venue with more representative height.

We urge that the test plan be written to allow change of both equipment and venue as circumstances dictate over time. We think that every attempt should be made to perform complete high power, omnidirectional testing for the reasons detailed above. If economics mandate only low power testing at the Washington site, we hope that some testing in Buffalo or other high power venue can be incorporated in the plan.

ZENITH

PS/WP1&2-077

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VIA FAX

October 8, 1990

Renville McMann, Chairman PS/WP1
c/o Alan Godber
NBC
30 Rockefeller Plaza
New York, N.Y., 10112
FAX: (212) 581-6687

Dear Ren,

We regret that Zenith cannot send a representative to the combined PS/WP1 & PS/WP2 meeting today in New York. The work and contribution of your group is vital for the selection of the best ATV system for the U.S.

According to the draft agenda sent out with today's meeting notice, you will be considering the addition of attributes which describe the effects of preprocessing and source noise on input signals to ATV systems. We are sending you this letter to express Zenith's support for testing ATV systems using both preprocessed images and images with source noise.

Preprocessing has become a common and important tool in television production. Inserts, special effects, editing, cuts, fades, etc., truly enhance the viewing experience of the public. Since these techniques can result in scenes which are not found naturally, it is totally possible that they may trigger artifacts from an ATV system which might otherwise go undetected. ATV systems are generally nonlinear systems which can react in surprising ways to unusual inputs.

The nonlinear processing of ATV systems can also respond in unusual ways to noisy inputs. To test this attribute, a single input signal should be tested with various degrees of additive noise and the results observed for the nature of a system's degradation.

We urge that your meeting come to the same conclusions and request that Zenith's opinion in this matter become a part the record for your meeting today.

Sincerely,

Ronald Lee

Ronald Lee

cc: C. Eilers - C. Heuer - W. Luplow

ATTRIBUTES/SYSTEMS MATRIX, REVISION 2

Section A: Attributes List

I. General Description (Proponent)

1. Compatibility
   - 1.1 NTSC Receiver
   - 1.2 VCR
   - 1.3 Channel
   - 1.4 Other ATV Systems

2. Transmission Scenario
   - 2.1 Number of channels required
   - 2.2 Channel Bandwidth
   - 2.3 Contiguous/Non-Contiguous

3. Terrestrial Implementation Scenarios

4. Intended Display Size/Viewing Angle (Measured)

II. System Attributes

1. ATV Image Issues
   - 1.1 Luminance spatial/temporal resolution
     - 1.1.1 Static Horizontal resolution - MTF curve
     - 1.1.2 Static Vertical resolution - MTF curve
     - 1.1.3 Static Diagonal resolution - MTF curve
     - 1.1.4 Dynamic Horizontal resolution - MTF curve
     - 1.1.5 Dynamic Vertical resolution - MTF curve
     - 1.1.6 Dynamic Diagonal resolution - MTF curve
     - 1.1.7 Graph of Samples/Frame vs Frame/Second rate
   - 1.2 Chrominance spatial/temporal resolution
     - 1.2.1 Static Horizontal resolution - MTF curve
     - 1.2.2 Static Vertical resolution - MTF curve
     - 1.2.3 Static Diagonal resolution - MTF curve
     - 1.2.4 Dynamic Horizontal resolution - MTF curve
     - 1.2.5 Dynamic Vertical resolution - MTF curve

1.2.6 Dynamic Diagonal resolution - MTF curve
1.2.7 Graph of Samples/Frame vs Frame/Second rate

1.3 Chromaticity/Colorimetry Characteristics
1.3.1 Color Difference Signals Axes
1.3.2 Transfer Characteristics

1.4 Artifacts
1.4.1 The performance of ATV systems which have been spatially or temporally prefiltered including the use of motion detection **(Rev.2)**
1.4.2 The performance of ATV systems in response to input signals having random noise, clock noise, etc, superimposed on them **(Rev.2)**

1.5 Transient Response

1.6 Aspect Ratio

1.7 Baseband Video Bandwidth

1.8 Subjective Assessment of Overall Picture Quality

2. Compatible NTSC Image Issues
2.1 Luminance spatial/temporal resolution
2.1.1 Static Horizontal resolution - MTF curve
2.1.2 Static Vertical resolution - MTF curve
2.1.3 Static Diagonal resolution - MTF curve
2.1.4 Dynamic Horizontal resolution - MTF curve
2.1.5 Dynamic Vertical resolution - MTF curve
2.1.6 Dynamic Diagonal resolution- MTF curve
2.1.7 Graph of Samples/Frame vs Frame/Second rate

2.2 Chrominance spatial/temporal resolution
2.2.1 Static Horizontal resolution - MTF curve
2.2.2 Static Vertical resolution - MTF curve
2.2.3 Static Diagonal resolution - MTF curve
2.2.4 Dynamic Horizontal resolution - MTF curve
2.2.5 Dynamic Vertical resolution - MTF curve
2.2.6 Dynamic Diagonal resolution - MTF curve
2.2.7 Graph of Samples/Frame vs Frame/Second rate

2.3 Colorimetry Transfer Characteristic

2.4 Artifacts

2.5 Sync/Blanking/Subcarrier Modifications

2.6 Transient Response

2.7 Aspect Ratio

2.8 Use of Overscan/Underscan

2.9 Subjective Assessment of Overall Picture Quality

2.10 Ghost Canceling
- 2.10.1 Does the system incorporate a ghost canceling training signal?
- 2.10.2 Can the system incorporate a ghost canceling training signal?
- 2.10.3 If a training signal is incorporated please describe:
  - 2.10.3.1: Wave form shape
  - 2.10.3.2: Spectrum
  - 2.10.3.3: Repetition rate

3. ATV Audio Issues

3.1 Number of Channels

3.2 Modulation Scheme

3.3 Signal-to-noise Ratio (per channel) (dB)

3.4 Non-linear
- 3.4.1 Total Harmonic Distortion (THD)
- 3.4.2 Intermodulation Distortion

3.5 Channel Crosstalk (dB) (Audio/Audio, Video/Audio)

3.6 Audio/Video Delay (lip sync) (± ms)

3.7 Dynamic Range (dB)

3.8 Frequency Response (±dB)

3.9 Noise Reduction (if used)
- 3.9.1 Analog/Digital?
- 3.9.2 Noise Improvement (dB)
- 3.9.3 Bandwidth Requirement (Hz)

3.9.4 Artifacts of Noise Reduction
- 3.9.4.1 Non-Linear Distortion
- 3.9.4.2 Crosstalk (dB)
- 3.9.4.3 A/V Delay (ms)
- 3.9.4.4 Dynamic Range (dB)
- 3.9.4.5 Frequency Response (±dB)
- 3.9.4.6 Pumping
- 3.9 4.7 Any other artifacts

3.10 Companding/Compression (if used)
- 3.10.1 Analog/Digital?
- 3.10.2 Noise Improvement (dB)
- 3.10.3 Bandwidth Requirement (Hz)
- 3.10.4 Artifacts of Companding/Compression
  - 3.10.4.1 Non-Linear Distortion
  - 3.10.4.2 Crosstalk (dB)
  - 3.10.4.3 A/V Delay (ms)
  - 3.10.4.4 Dynamic Range (dB)
  - 3.10.4.5 Frequency Response (±dB)
  - 3.10.4.6 Pumping
  - 3.10.4.7 Any other artifacts

3.11 Audio Security (if available)
- 3.11.1 Analog/Digital?
- 3.11.2 Level of Security
- 3.11.3 Bandwidth Requirement (Hz)
- 3.11.4 Scrambling Techniques **(Rev.2)**
- 3.11.5 Artifacts of Security Technique
  - 3.11.5.1 Non-Linear Distortion
  - 3.11.5.2 Crosstalk (dB)
  - 3.11.5.3 A/V Delay (±ms)
  - 3.11.5.4 Dynamic Range (dB)
  - 3.11.5.5 Frequency Response (±dB)
  - 3.11.5.6 Any other artifacts

3.12 Encoded Audio Baseband and RF Spectrum

3.13 Stereo Separation

3.14 Subjective assessment by an expert panel **(Rev.2)**

4. Degradation of Compatible NTSC Audio (MTS)
   - 4.1 Intercarrier Audio

4.2 Audio/Video Delay (lip sync) (±ms)

5. Ancillary Signals
   5.1 Provisions for Ancillary signals
   5.2 Lines available for Ancillary signals in compatible NTSC signal

6. Terrestrial Transmission Issues
   6.1 Characterization of Compatibility
   6.2 Noise Susceptibility
   6.3 Susceptibility to Multipath or Echo
   6.4 Susceptibility to Interference on picture and sound **(Rev.2)**
      6.4.1 Adjacent Channel Interference
      6.4.2 Co-Channel Interference
      6.4.3 Airplane Flutter
      6.4.4 Impulse Noise
      6.4.5 Other

   6.5 Susceptibility to Group Delay Errors

   6.6 Susceptibility to Non-Linear Distortions

   6.7 Transmitter/Antenna Requirements
      6.7.1 Required Number of Transmitters/Antennas
      6.7.2 Complexity of Transmitter/Antenna
      6.7.3 Use of Present Transmitter/Antenna

   6.8 Bandwidth Requirements
      6.8.1 Near Term
      6.8.2 Long Term

   6.9 Transmission Field Testing
      6.9.1 At least one (1) location exhibiting average amount of difficulty, and **(Rev 2.)**
      6.9.2 At least one (1) location considered "difficult" **(Rev.2)**

   6.10 Coverage Relative to NTSC

   6.11 Gracefulness of Degradation
      6.11.1 Video
      6.11.2 Audio
      6.11.3 Audio vs Video

7. Suitability for Alternate Media Distribution
   7.1 Suitability for Cable Television Distribution

7.1.1 Channel Bandwidth
7.1.2 Co-Channel Interference
7.1.3 Adjacent Channel Interference
7.1.4 Interference To /From Other Services
7.1.4.1 Navigation
7.1.4.2 Amateur Radio
7.1.4.3 FM Radio
7.1.4.4 Citizens Band
7.1.4.5 Industrial Band
7.1.5 Effect of Micro-Reflections
7.1.6 Intermodulation Distortion
7.1.7 Channel Loading
7.1.8 Cross Modulation Distortion
7.1.9 Composite Triple Beat Distortion
7.1.10 Second Order Distortion
7.1.11 Minimum C/N Requirements
7.1.12 Security System Issues
7.1.13 Propagation Delay
7.1.14 Compatibility with AGC of Distribution Systems
7.1.15 Peak Power
7.1.16 Frequency Accuracy
7.1.17 Sensitivity to Phase Noise

7.2 Suitability for Satellite Distribution
7.2.1 Baseband Video Bandwidth
7.2.2 Baseband Audio Bandwidth
7.2.3 Audio Bandwidth Requirement
7.2.4 Exciter Modifications
7.2.5 Uplink Power Requirements
7.2.6 Optimum FM Deviation
7.2.7 Minimum C/N
7.2.8 Minimum Antenna Size
7.2.9 Satellite Receiver Requirements
7.2.9.1 Clamping
7.2.9.2 De-emphasis
7.2.9.3 IF Bandwidth
7.2.10 Compatibility with Satellite Security Systems
7.2.11 FM Channel Artifacts

7.3 Suitability for Other Terrestrial Distribution Systems
7.3.1 Amplitude Modulated Links (AML)
7.3.2 Frequency Modulated Links (FML)
7.3.3 Microwave Distribution Service (MDS)
7.3.4 Multi-Channel MDS (MMDS)

7.3.5 Fiber-Optic Cables (FO)
7.3.6 Telephone Company Lines (TELCO)
7.3.7 Video Cassette Recorders (VCR)
7.3.8 Video Disk Recorders

7.4 Transmission Security

8. Consumer Equipment Issues
8.1 Complexity of Receivers

8.2 Receiver Input/Output Characteristics
8.2.1 RF Interface
8.2.2 Baseband Video Interface
8.2.3 Baseband Audio Interface
8.2.4 Interfacing with Ancillary Signals
8.2.5 Receiver Antenna Systems Requirements

8.3 Compatibility with Existing NTSC Consumer Equipment
8.3.1 RF Compatibility
8.3.2 Baseband Video Compatibility
8.3.3 Baseband Audio Compatibility
8.3.4 IDTV Receiver Compatibility

8.4 Allows Multi-Standard Display Devices

9. Other Considerations
9.1 Practicality of Near-Term Technological Implementation
9.2 Long-Term Viability/Rate of Obsolescence
9.3 Upgradability/Extendability
9.4 Studio/Plant Compatibility

Section B:

EXPLANATORY NOTES OF ATTRIBUTES/SYSTEMS MATRIX

Items on the Attributes/System Matrix for which no explanatory note is provided were deemed to be self-explanatory.

I. General Description (Proponent)

Section I shall be used by a system proponent to define the features of the system being proposed. The features shall be defined and organized under the headings of the following subsections 1 through 4.

Section I. General Description (Proponent) shall consist of a description of the proponent system in narrative form, which covers all of the features and characteristics of the system which the proponent wishes to be included in the public record, and which will be used by various groups to analyze and understand the system proposed, and to compare with other proposed systems.

1. Compatibility

1.1 NTSC Receiver
The proponent shall state if the transmitted ATV signal can be viewed on conventional NTSC receivers without additional hardware. The proponent shall set forth the details of any lack of compliance with all applicable FCC Rules and Regulations.

1.2 VCR
The proponent shall state if and if so, how the system maintains compatibility with video cassette recorders as presently designed and available to and for use in the consumer market. Compatibility of a proposed system with the above VCR's shall be defined in terms of the capability of the signal to be recorded and played back, and the quality of the resultant video, audio and any ancillary services or features in comparison to the performance of such VCR's with present day standard NTSC signals.

1.3 Channel
The proponent shall state if the ATV system operates consistent with the present 6 MHz channelization scheme. The proponent shall set forth the details of any lack of compliance with applicable FCC Rules.

1.4 Other ATV Systems
The proponent shall identify compatibility with other proposed ATV systems. The proponent shall specifically classify those key system components necessary to ensure compatibility.

2. Transmission Scenario

2.1 Number of Channels Required
The proponent shall state the number of transmission channels required and the bandwidth of each. Specifically what transmission channelization scheme is being proposed shall be defined by the proponent.

2.2 Channel Bandwidth
The proponent shall state if the ATV system will be accommodated within the 6 MHz bandwidth channels presently allocated for television broadcasting. If additional channels are to be used, what spectrum (bandwidth and frequency) is proposed.

2.3 Contiguous/Non-Contiguous
Those proponents requiring more spectrum than the 6 MHz channels currently allocated, shall state whether the spectrum needed for augmentation must be adjoining the present allocation or if it can be in another frequency band.

3. Terrestrial Implementation Scenarios

The proponent shall state what steps would be necessary to implement the proposed systems. All pertinent changes and/or additions which would be required to be made to the present terrestrial broadcast system to fully implement the proposed system should be defined including sequence of changes and timetable.

4. Intended Display Size/Viewing Angle (Measured)

The proponent shall state what maximum size of video display and/or maximum viewing angle of display the proposed system is intended to support. The display size shall be defined in height and width of viewable image. Overscan percentage shall be y % in the vertical direction and x % in the horizontal direction.

II.

1. ATV Images Issues

1.1 Luminance spatial/temporal resolution

In a manner analogous to the description of an electrical filter by its frequency response, entire television systems or components of such systems can be characterized by their spatial and temporal frequency responses. In this case the inputs and outputs are sinusoidal function of space or time. The modulation transfer function (MTF) is the ratio of the magnitudes of output and input plotted as a function of frequency. For example, the "vertical frequency response" is measured by using, as input, an intensity function that varies sinusoidally in the vertical direction.[1] The spatial frequency is usually specified in samples (or cycles) per active picture height.[2] For example, a pattern of alternating black and white scan lines in an NTSC frame with 480 active lines would have a fundamental frequency of 240 cycles or 480 samples per picture height.

Horizontal frequency is often stated as "cycles (or samples) per picture height," even though it is the horizontal direction that is being characterized. This value may be converted to samples/picture width by multiplying by the aspect ratio.

---

1 Since light values must always by nonnegative, these sinusoidal variations must be superimposed a suitable (specified) dc level.

2 A "sample" in this sense is a "picture element," "pel," or "pixel." There are two samples per cycle.

The need to have a measure of diagonal resolution comes about because many systems have diminished diagonal resolution. Because the corner is cut out of the 2-dimensional frequency plane in various ways, "diagonal" resolution should be measured.

It is desired to have a single number to characterize the MTF-vs-frequency curve such as "Otto Shades Ne."

Nearly all TV systems have different resolution in the stationary and moving areas. The "dynamic" resolution curves and numbers refer to this phenomenon. In some cases this is because of camera integration. The effect we are referring to here is not related to camera integration, but rather to the blurring caused either by spatiotemporal subsampling or transmitting the spatial high frequency components at a lower frame rate. This differing response requires plotting a second set of curves specifying the performance in image areas subject to this effect. Note that this measure does not directly give the spatial resolution of moving objects; that depends on the velocity of the moving object.

The purpose of the graph of samples/frame vs frame rate is to give another fairly simple measure of the diminished spatial performance as a function of frame rate, this time independent of the relative vertical, horizontal, and diagonal resolution. This graph also indicates the efficiency with which the system utilizes the channel for transmitting image samples. For the purposes of this graph, a picture element is considered resolved at frequencies having 30% response. For a further explanation of this curve, see PC/WP1/yy.

1.2 Chrominance spatial/temporal resolution

This is done as in section 1.1. For systems having different resolution for the two chrominance signals, separate data is required for each.

1.3 Chromaticity/Colorimetry Characteristics

Colorimetric fidelity is the transparent passage of the color signal through a given system.

1.3.1 Color Difference Signals Axes

For luminance/chrominance systems, the axes of the chrominance plane are to be indicated on the CIE chromaticity diagram. Alternatively, the equations of transformation between RGB (referred to the system primaries) and YUV (or YIQ) signals can be given. For further information see the recently adopted SMPTE standard for 1125/60 studio systems. (SMPTE 240M.)

1.3.2 Transfer Characteristics

Any systematic color shift the transmission system introduces for small or large color signals.

1.4 Artifacts

Some systems may have artifacts (such as cross effects in NTSC) including blurring of moving objects, spatial or temporal aliasing, unsmooth motion rendition, side panel effects, geometric distortions, etc., that cannot easily be characterized numerically. Such defects should be described in plain text.

1.5 Transient response

The response of the system to luminance and chrominance step and impulse functions, both spatially and temporally, should be given.

1.6 Aspect ratio

This is the ratio of the width to the height of the entire image less blanking periods, as displayed on a receiver having correct geometry and no overscan.

1.7 Baseband Video Bandwidth

This is the bandwidth of the signal or signals applied to the transmitter. In a composite system, it is the bandwidth of the composite signal. In a multiplexed time component system, it is the bandwidth of the signal after all the components are time-base transformed and multiplexed together. If more than one video signal is applied to the transmitter, it is the sum of their separate bandwidths.

1.8 Subjective Assessment of Overall Picture Quality

This is the rating given by viewers, under specified viewing conditions, with specified subject matter. The test should be carried out under studio conditions (no transmission degradation) under "average" at-home conditions, and under "poor" at-home conditions. (To be defined.) The test should be carried out with natural scenes and test scenes and material including computer-generated material.

All systems should be evaluated with the same type of source material and motion portrayal should be included. The source material should be of sufficient high quality so as to not limit transmission system performance. The same display devices should be used for all systems if practical.

2. <u>Compatible NTSC Image Issues</u>

For compatible systems, the same measures of image quality should be obtained on "standard" (to be defined) NTSC receivers as well as ATV receivers.

2.5 Sync/Blanking/Subcarrier Modifications

The proposed systems shall note any deviations from the specifications noted in FCC Rules, Part 73.

2.7 Aspect Ratio

Specify the aspect ratio of the compatible picture. Provide a description of how aspect ratio is achieved in a compatible fashion. Describe any compromises or artifacts in the compatible NTSC picture. Is "pan-and-scan" included?

2.8 Use of Overscan/Underscan

Does the system require the use of overscan or underscan in the NTSC receiver to conceal sound, data, or picture information?

2.9 Subject Assessment of Overall Picture Quality

These tests should be performed in parallel and with the same materials as in Section 1.8.

3. <u>ATV Audio Issues</u>

3.1 Numbers of Channels - Number of audio channels and intended use of those channels.

3.2 Modulation Scheme
FM, Digital or other Modulation System

3.3 Signal to Noise Ratio (per channel) (dB)
Self explanatory.

3.4 Nonlinear Distortion
3.4.1 The THD of each audio channel should be specified (%).
3.4.2 The Intermodulation Distortion of each audio should be specified.

3.5 Channel Crosstalk (dB) (Audio/Audio, Video/Audio)
Channel Crosstalk will be measured in each audio program channel and may originate from any other or combination of other audio program channels or the video channel.

3.6 Audio/Video Delay (lip sync) (±ms)
Lip sync errors may be caused by system video or audio signal processing.

3.7 Dynamic Range (dB)
Should be specified for each channel.

4. Degradation of Compatible NTSC Audio (MTS)

4.1 Can the proposed system in any way affect intercarrier audio recovery.

5. Ancillary Signals

Ancillary signals include the broad range of non-video or sound signals that are carried with the television signal. They include both program related and non-program related signals.

5.1 Provisions for Ancillary signals

Under this topic, the provisions for carrying ancillary signals included in each ATV system should be described including the method and the amount of data.

5.2 Lines available for Ancillary signals in compatible NTSC signal

Under this topic the number of vertical interval lines in the compatible NTSC signal that are available for use by the broadcaster should be listed.

6. Terrestrial Transmission Issues

NOTE: For systems employing a main channel and an augmentation channel, the susceptibilities of each to noise, multipath, etc. should be evaluated separately. For compatible systems, both ATV and NTSC compatible signals should be fully evaluated.

6.1 Characterization of Compatibility

Compatible with existing receivers?
Compatible with existing channels?
Compatible with existing transmitters?

6.2 Susceptibility to Noise

For what carrier-to-noise ratio is noise just perceptible in the picture? What indirect effect(s) does noise have? What effects are caused by reduced carrier-to-noise ratio? Subjective tests of carrier-to-noise ratio vs picture quality should be performed.

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6.3 Susceptibility to Multipath or Echo

Under a variety of multipath conditions, what direct and indirect effects does multipath have? What is the required ratio of desired signal to undersired signals to make all such effects imperceptible? When strongest signal is a reflection, do leading signals present a special problem? What problems are there when multipath is complex, as with smear caused by vegetation?

Performance should be examined with a variety of single and multiple echoes of different phases and amplitudes and with time variations representing those found in characterization of the terrestrial transmission media.

6.4 Susceptibility to Interference

6.4.1 Adjacent Channel Interference

Indicate the desired signal to undesired adjacent signal ratio for which adjacent channel interference is just perceptible in the ATV picture for each type of adjacent channel signal under varying desired signal level conditions. Where augmentation channel signal bandwidth is other than 6MHz further consider all possible cases for augmentation channel frequency assignment(s) within the adjacent channel.

	UPPER	LOWER
NSTC		
main ATV		
augmentation ATV		

Indicate the desired signal to undersired adjacent channel signal ratio for which adjacent channel interference is just perceptible in existing NTSC receivers in each case.

Where augmentation channel signal bandwidth is other than 6 MHz further consider all possible cases for augmentation channel frequency assignment(s) within the adjacent channel.

	Upper	Lower
main ATV		
augmentation ATV		

6.4.2 Co-Channel Interference

Indicate the desired (D)/ undesired (U) ratio for which co-channel interference is just perceptible in each case. Where augmentation channel signal bandwidth is other than 6 MHz, further consider all possible cases for augmentation channel frequency assignment(s) within the adjacent channel.

		D		
		NTSC	main ATV	Aug. ATV
U	NTSC			
	main ATV			
	augmentation ATV			

6.4.3 Airplane Flutter

Indicate what direct and indirect effects airplane flutter has. Is system more or less susceptible than NTSC system is to airplane flutter?