DESIGN CONSIDERATIONS FOR AN ADVANCED TV TEST FACILITY

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ABSTRACT

Advanced Television (ATV) represents an enormous potential, not only for CATV, but also for the Television and Electronics industry as a whole. Presently, the FCC and others are analyzing the various proposed ATV systems, in an effort to determine the optimum system(s) for delivery. Accurate, thorough and impartial evaluation of the proposed ATV systems is an essential element in the selection process to ensure that the best system is selected.

This paper will describe design considerations for establishing a test facility for evaluating the proposed ATV systems. While there are still many unresolved issues relating to source material, equipment availability and test procedure finalization, facility design and construction can be initiated. Specific areas of the facility design to be discussed include the overall testing strategy, facility layout, video and audio aspects, ventilation and powering requirements, and access and security concerns. The items highlighted will allow for both objective and subjective testing on a wide variety of media.

OVERALL TESTING STRATEGY

In addition to ensuring compatibility with existing NTSC cable systems, ATV testing is critical for a variety of reasons, the most important of which is consumer acceptance. Ultimately, the consumer must decide whether the perceived benefits of Advanced TV justify the cost premium associated with owning an ATV receiver and viewing ATV services. While few will question that ATV can and will technically deliver a better picture, consumer acceptance is by no means assured, particularly given the current cost and availability estimates for ATV receivers. Complicating the consumer decision is competition from pre-recorded tapes and discs, which offer some of the same benefits of ATV at a reduced cost.

Consumer acceptance can therefore be broken down into two parts: 1) Ensuring that the best picture technically possible is presented to the home and, 2) Determining what the consumer is willing to pay to have Advanced Television. Both these elements of ATV testing must be accommodated through objective, subjective, and consumer preference testing in order to undertake a thorough evaluation of ATV. Advance knowledge of this information before actual ATV market introduction is essential to ensure that not only the best system is put in place, but also that once it is in place it will be accepted by the marketplace.

The term "Advanced Television" includes not only high definition televisions systems, but also enhancements and improvements to present day NTSC based systems. Distinction between the two is largely a matter of bandwidth requirements, performance improvements, NTSC compatibility, cost and marketplace availability. Since all forms of ATV may be potential contenders in the marketplace of the 1990's and beyond, they must be carefully analyzed both objectively and subjectively to determine their viability.

When NTSC was introduced, delivery to the home was largely determined by terrestrial over the air transmission, directly to the consumer's television. The advent and growth of cable, DBS, fiber in the future, and other alternative media has considerably changed the outlook for the introduction and delivery of Advanced Television. This new media environment of the 90's requires performance considerations and, therefore, testing on all the possible media responsible for ultimate delivery of the ATV signal in the home.

FACILITY LAYOUT

The design and construction of the physical structure for performing ATV testing requires attention to key details, to assure that a flexible and neutral environment is attained for ATV testing. Adequate provisions for lighting, ventilation, AC powering, interconnections, isolation, access, security, storage, fire protection, and people flow must all be considered in the design. Since audio as well as video characterization of the ATV system is essential, special considerations must also be given to audio aspects of the design.

Ideally, the test facility should be divided into separate areas for subjective and objective testing. This allows for subjective and consumer preference testing in a more controlled environment than a conventional lab would support. Signaling and control between the areas becomes important, particularly during consumer preference testing, where control of the test material, impairments, signal routing or video and audio settings may be desired.

Linear "signal flow" should also be maintained in the facility (from source to presentation) to minimize cable routing and potential feedback problems. Access points to the ATV signal for routing, monitoring, and measurement must also be easily accessible without incurring signal degradation or modification. Signal flow should also allow for convenient interconnection with the desired media, impairments, or simulators to be used during the ATV testing.

VIDEO CONSIDERATIONS

Subjective viewing and consumer preference testing of Advanced Television dictates an environment that is neutral and free from distractions, so that accurate, impartial, and "focused" solo or comparison testing can be accomplished. Critical design parameters to be considered to ensure a neutral viewing environment and minimize distractions include correct ambient lighting, viewing distance and offset angle, wall treatments and environmental control. Psycho-visual research and good engineering practices influence the majority of these key parameters.

Specific ambient lighting and wall preparation requirements for the subjective viewing area are highlighted in CCIR Guideline 500-3. The key emphasis here is that the ATV system under evaluation is to be the "center of attraction" so that the eye (and mind) is not distracted by the surrounding environment. Neutral walls, ceilings, and floors, in both textures and color are optimally recommended to retain subjective attention. Ambient lighting set to 10% of the viewing screen illumination is appropriate. Additionally, a computer controlled lighting system is recommended to "remember" preset lighting conditions to remove ambiguity.

Viewing distance and angle have an immediate impact on the physical constraints of the test facility, in that they dictate room size and shape. Conventional wisdom supports the premise that ATV subjective testing should be done at a distance 3-4x's picture height. While the true benefits of Advanced Television may ultimately be viewed on large screen (>35") television, present display technology still has a way to go in terms of brightness, resolution, viewing angle and cost to realize these benefits. Even with technical advances in this area, it is unlikely that the shape and size of the conventional consumer's living room will change dramatically in the next 10-20 years to take full advantage of Advanced Television receivers.

Complicating the problem of determining a viewing room size is that motion artifact processing will be a key evaluation parameter when the various ATV systems are compared. Supported by psycho-visual research, most ATV systems improve resolution of a static scene at the expense of moving scenes, resulting in reduced resolution during motion, and potential motion artifacts. At close distances (1-2 picture heights), motion artifacts and reduced resolution become more apparent. Further away (beyond about 4 picture heights), they are not as apparent, but unfortunately, neither are the benefits of ATV when compared to NTSC!

Putting all this together yields some minimum and maximum viewing distance requirements for the controlled viewing area. Accommodating

a 20" ATV receiver at 1x's picture height yields a 1 foot minimum distance requirement, whereas a 70" ATV receiver viewable at 5x's picture height yields a 17.5 foot maximum distance requirement. Nominal viewing testing would probably be done at 3-4x's picture height, which, assuming a 35" entry level ATV set, would be 5-7 ft, consistent with a typical living room. The viewing angle should be kept within a +/- 30 degree offset from the center line to ensure that adequate detail is available to all the subjects taking part in the viewing testing.

AUDIO ASPECTS

In some respects, the audio aspects of the facility design are more demanding than video, and require even greater attention to detail to minimize the background noise during subjective evaluations. Potential sources of background noise include ventilation, heating and cooling systems, aircraft and environmental noise, power system hum, test equipment residual noise, and good old "people noise". Minimum background noise requirements are highlighted in IEC standard, NC-20.

Beyond background noise, it is also important to minimize distraction to other adjacent test areas during actual subjective audio testing of ATV systems. Fortunately, minimizing background noise into the subjective area also generally minimizes test noise out of the subjective area into adjacent test areas.

Noise is contained through a variety of design techniques, such as floating floor construction, minimizing heating/cooling airhandlers noise, soundproofing of walls, ceilings, and ductwork, isolating access ways into the facility, and reducing transformer AC noise. These concepts are based on sound acoustical practices, and are supported by qualified architectural design.

An optimum reverberation time of .3-.4 sec, 500 HZ octave band is also preferred in the IEC specification. Although specific characteristics can be custom tailored to particular preferences and "listening environments," a more preferred approach would be that which simulates the home environment.

VENTILATION/POWERING REQUIREMENTS

Given the powering (and therefore heat generating) requirements of the ATV hardware to be used during evaluation, obtaining adequate powering and ventilation cannot be overlooked.

While final ATV hardware may someday be "C-MOS custom IC based", the available test and evaluation hardware for the next several years will be anything but! With limited ATV hardware information presently available, an approximate rule of thumb would be to allow provisions for powering and ventilation requirements consistent with 10-15 Kwatt of power dissipation for proponent hardware, plus evaluation and test equipment hardware. Wherever possible, uninterruptable surge protected power supplies should also be considered to reduce down time and equipment damage.

Adequate ventilation in the viewing area is also important for several reasons, primarily to prevent distraction of the viewing subjects during testing. A "comfortable" level of temperature and humidity must be maintained during testing in a smoke free environment. Ventilation must also conform to minimum noise requirements, as discussed in the audio section.

ADEQUATE ISOLATION

In addition to sound isolation mentioned previously, provisions for RF, cable and AC power isolation must be maintained. RF isolation is important to prevent off air interference from either local broadcast channels or spurious interference. Cable shielding becomes essential when routing control and signal cables in and out of the facility, particularly the subjective area. AC power isolation is important to reduce 60 cycle hum and ground loops. All can be minimized with prudent engineering shielding and grounding techniques during the design and construction phase.

ACCESS AND SECURITY PROVISIONS

People access to the test facility must be carefully controlled to prevent unauthorized equipment removal and traffic into the facility. This is particularly important given the high capital expense of the equipment required to support ATV testing. This includes not only equipment provided by the test facility, but also on loan by the proponents.

Doorway access is also important, given the large size of the decoder and test hardware presently available. A

minimum door width of 42 inches between critical areas and outside doors is necessary to transport the required equipment in to the test facility. This width should also accommodate shipping containers necessary for transporting the required proponent and test hardware.

Security of the facility is also critical from the standpoint of access to proprietary information, some of which may not be intended for public distribution. "Off hours" tampering could also be a concern, and must be controlled. Given the high stakes involved in the future of Advanced Television, this item must not be treated lightly in the design.

SUMMARY

The design of an Advanced Television Test Facility can be achieved, that will support objective, subjective, and consumer preference testing. Careful attention to detail is, however, required to insure that key aspects of the design are considered beforehand. Successful completion of the facility will provide the foundation for thorough, impartial evaluation of Advanced Television Systems.

REFERENCES

1. CCIR Recommendation 500-3

2. IEC Standard NC-20