

Advanced Television For The United States: Status and Issues

Organizer:

Gary Demos, DemoGraFX

Panelists:

Alvy Ray Smith, Microsoft

Craig Birkmaier, Pcube Labs

Mark Richer, Advanced Television Systems Committee

Glenn Reitmeier, Sarnoff Labs

The Federal Communications Commission is about to select a standard for Advanced Television for the United States to replace our existing NTSC television system. An advisory commission on advanced television service, "ACATS," appointed by the FCC, is recommending that we deploy a new television system which includes interlace, 59.94 and 60 Hz, and non-square pixel spacing. These parameters are fundamentally incompatible with modern computer graphics displays, which do not use interlace and which operate at display rates exceeding 70 Hz.

Those involved in developing the ACATS do not feel a need to restrict their proposed formats to those that are compatible with computer displays. They further are asserting that the cost and quality loss associated with converting interlaced 60 Hz video to 70+ Hz non-interlaced (progressive scan) pictures is acceptable. However, under their scenario, responsibility to de-interlace and frame rate convert these proposed formats for every computer display would fall upon the computer industry.

Other problematic issues include interlace and 59.94/60Hz, lack of a robust data capacity, non-square pixel spacing in some formats, lack of defined overlay planes, a controversial "16:9" image aspect ratio, overscan issues, and limited colorimetry. It is also proposed that receiving devices decode each of 18 different image formats, spanning a 6:1 range in resolution and data rate.

ACATS proposes that format problems be solved by a later migration strategy away from admittedly obsolete techniques, such as interlaced scanning. However, no scenario is suggested for accomplishing this after deployment of a new television infrastructure, after which some it may be impossible to replace the interlaced portions of the system.

The deployment of a new national television infrastructure is an opportunity to leave behind the obsolete NTSC television system. Since the primary distribution media for computer graphics are film and video, the introduction of new video formats will affect the work of digital production facilities.

Gary Demos

ACATS claims that their proposal is an appropriate compromise, containing some non-interlaced, and some interlaced formats. ACATS is aware that the computer industry needs display rates exceeding 70 Hz for large and bright screens containing computer information. However, they assert that interlace and 59.94 and 60 Hz are needed more than non-interlace 70+ Hz by the existing NTSC broadcast infrastructure and by existing television manufacturers. This panel offers an opportunity to challenge these assertions.

Motion picture film runs at 24 frames per second. The display rate of 72 Hz is naturally suggested since 72 is three times 24. This would satisfy the need of computer displays to exceed 70 Hz. The frame rate of 36 would also form a new natural image motion rate for 72 Hz display.

Image layering represents a powerful alternative to the ACATS proposal. ACATS proposes selection among numerous widely-differing formats. Layering provides a single layered format providing multiple layers of quality in resolution and frame rate within a common data format that would be used by all. The data layer within the ACATS proposal is also not a true layer, since its error rate is not sufficient to carry the multitude of data and code types that will be useful.

ACATS proponents have asserted that 60 Hz and interlace are required because wide screen 72 Hz non-interlace images of a thousand lines cannot fit within the broadcast television channel's capacity of 19 mbits/second. ACATS has further asserted that resolution layering is not feasible. However, it has now been demonstrated that these assumptions are incorrect. Layered images running at 72 frames per second have been demonstrated at 2k x 1k for the highest resolution layer, and 1k x 512 for the base resolution layer, all fitting within 18.5 mbits/second. Movies at 24 frames per second can fit within even less data. The data layer could also be made to be sufficiently error-free to allow carriage of highly desirable multimedia code and data types.

It is therefore unnecessary to continue to debate obsolete image format parameters. The ACATS proposal, which includes interlace, 59.94 and 60 Hz should be rejected, and should be replaced by a layered system operating at 72 Hz. No new interlaced formats should be deployed, since the obsolete interlace technique forms a fundamental barrier of computer display incompatibility. Adoption of the ACATS proposal would most likely prevent the realization of a National Information Infrastructure.

Alvy Ray Smith

What if the Internet, a well-known digital communications channel, had been "standardized" five years ago to carry only video data in a compressed form that subsequently became obsolete due to technological advances. This example is not unlike the standardization of the digital broadcast spectrum that recently was proposed quite seriously. It is simply a digitization of old analog thought, rather than an exploitation of new digital concepts. The largest possible view of broadcast television is as a collection of digital channels that can carry any kind of digital information, not just video. Any standardization that prohibits the full ramifications of this view will appear ridiculous in a very few years.

The Internet is an example of a non-broadcast digital communications medium that was standardized at a very fundamental level only. Atop this minimum protocol standardization, free enterprise is busily constructing numerous useful and exciting businesses. I believe the digital broadcast television spectrum should likewise be minimally standardized, and then allowed to develop with full digital cleverness.

One goal is complete interoperability between broadcast TV and home computers. Digital technology is now sufficiently developed to actually implement the "digital convergence" between the two. There is no reason, other than insufficiently well thought-out infrastructure, for this not to happen now. Key to television and computer interoperability is data sharing, not merely display of television images on a computer screen.

Of the several strictly technical issues concerning the use of the digital spectrum for video data, the most important is this: Interlaced scanning should no longer be supported. If video were being created today, interlace would not be suggested as a new standard. There are far superior ways available to utilize the same bandwidth. We fully expect there to be even better ways in the future. Furthermore, a frame rate of at least 70 Hz should be supported, non-square pixel spacing should be disallowed, an aspect ratio amenable to film should be used, and a true family of resolutions should be defined. All of these issues, however, pale in comparison to the overriding importance of the definition of a digital broadcast data transmission standard.

Craig Birkmaier

A properly conceived digital television system for local, regional, national, and international distribution of digital media will provide a solid foundation for the distribution of all forms of digital media.

The digital television system proposed by the Grand Alliance and the Advanced Television Systems Committee (ATSC) was conceived as a higher resolution "clone" of our existing television system. It carries significant excess baggage for compatibility with existing broadcast practices. This shortsighted approach will limit the opportunity for broadcasters to compete with every other infrastructure provider and programming service.

Nearly a year ago, I submitted the following observations to the ATSC.

The Challenge

1. To develop enabling standards for a digital television system interoperable with all digital communications infrastructures, backward compatibility with existing analog and digital video program archives, and a migration strategy which allows digital television to be delivered using existing NTSC and ITU-Rec-601 acquisition and receiver infrastructures.
2. To stimulate a rapid migration to artifact-free high-resolution video acquisition and display systems, and rapid voluntary replacement of analog NTSC receivers.

The Opportunity

1. To influence and manage the evolution of digital communications systems.
2. To provide a framework within which all effected industries and stakeholders can participate in rapidly developing digital communication system standards and extending them in the future.
3. To ensure that these standards be developed by industry-led initiatives, rather than by government-imposed standards.
4. To ensure the ability to interoperate and rapidly evolve with underlying technology.

The Solution

1. Develop enabling standards for digital television based on a layered, open architecture, which will provide artifact free imagery at multiple quality of service (QOS) levels, to interoperable information appliances.
2. Establish minimum and maximum performance limits for each QOS level rather than rigid point standards.
3. Establish a modular framework.
4. Allow the marketplace to drive the evolution process.
5. The process of maintaining and extending DTV standards and recommended practices should rest with national and international standards organizations.

Mark Richer

The ATSC Digital Television Standard is the result of an eight year long open process. Hundreds of people contributed thousands of hours of effort to create a digital television standard for the United States. The result of this process is a system that utilizes a layered architecture and is compliant with the MPEG-2 international standard for video compression and transport. The ATSC standard provides a flexible system that offers the user a variety of options. The system includes multiple options for video input and compression. The two HDTV formats (1920 x 1080 and 1280 x 720) result in square pixels. The system supports use of both progressive and interlaced scan.

The issue of interoperability is one that has been central in the choice of ATV system parameters. The goal was to provide interoperability with a variety of media including existing NTSC program material and consumer receivers, film, existing HDTV production formats, and computers. There is no consensus on a single approach to achieve interoperability across all media. However, the inherent flexibility of the technology provides options to both service providers and consumers:

- The choice of progressive or interlace scan source material will be made by the program producer.
- The choice of progressive or interlace for transmission will be made by the program service provider.
- The choice of progressive or interlace scan display is an independent choice that will be made by the consumer.

The ATSC digital television standard is the only existing standard in the world that offers the option of progressive scan and square pixels for both standard definition and high definition television. On the other hand, the DBS and cable industries are in the midst of rapidly deploying digital systems that do not incorporate progressive scan and square pixels. For this reason, the ATSC Digital Television Standard should be adopted immediately.

Glenn Reitmeier

The adoption of the Advanced Television Systems Committee's Digital Television Standard and the recommendation of the Advisory Committee on Advanced Television Service that the FCC approve it as a national standard for terrestrial HDTV broadcasting are landmark developments in the convergence of computing and television.

The ATSC Advanced Television (ATV) standard is the most flexible, most computer friendly, most broadly interoperable television system ever developed. It provides powerful interoperability by using:

- A layered digital system architecture that conforms to international data communications models
- Header/descriptors that allow a flexible system today and extensibility for future improvements
- Multiple video formats and frame rates with a heavy emphasis on progressive scan and square pixel formats that facilitate easy computer interoperability
- MPEG-2 video compression that conforms to draft international standards, and that will likely form the basis for most computer multimedia use of motion video
- MPEG-2 transport (packet) format that meets the needs of broadcasting while being designed to be easily interoperable with ATM networks.

In developing the technical basis for the ATSC standard, the Grand Alliance carefully balanced diverse and often conflicting needs from film and television post-production (including computer generated images), broadcasting, cable television, consumer electronics, computing and telecommunications industries. Of course, interoperability must be balanced against other design goals such as HDTV picture quality, restricted-power simulcasting and low cost. Because no rigid single approach could simultaneously meet such a broad spectrum of needs, the result is a standard that is flexible and inclusive.

The ATV standard recommended to the FCC represents the consensus of over 100 companies that participated in the open ACATS process over an eight-year period. Delay in idealistic pursuit of perfection by an interest group can only result in the destruction of consensus and a giant step backwards for television and computer interoperability. After huge investments, failure to promptly commercialize ATV technology will result in the only option being a European or Japanese system - one that has ONLY interlaced scanning and non-square pixels.