## SYSTEM RATIONALE (OR ADTV DEVELOPMENT HISTORY)

*Why digital?*

- It is the consensus within ATRC that a well designed digital ATV for terrestrial broadcast offers significant performance advantages over analog approaches. Digital techniques have the well-known property of being impervious to moderate levels of channel impairment, and avoid accumulation of noise and other artifacts when passed through a series of processing and transmission stages. Digital technology is cheaper to implement in receivers and transmitters, and is consistent with the accelerating technological trend towards intergrated digital processing, storage and transmission of voice/video/data environment. In the long term, the universality of digital technology will lead to novel combinations of applications now considered separate, along with greater compatibility between different types of consumer electronic, telecommunication and computing equipment.

*Why MPEG (and not other proprietary compression?)*

- Extensive study and evaluation of several state-of-the-art compression techniques conducted within ATRC showed that the emerging MPEG standard provides an image quality better than or equal to other non-standard algorithms. MPEG outperforms most custom approaches because it incorporates results filtered from a great deal of image coding research conducted all over the world during the last few years. The outstanding image quality vs. bit-rate results demonstrated by the MPEG committee have motivated the technical community to consider MPEG as the likely basis for an extended standard (MPEG-II) for a universal high-quality image coding algorithm that spans applications ranging from multimedia to broadcast TV.

- Faster introduction of HDTV at lower cost to the public. MPEG is a mature algorithm that will not require a long period of feasibility demonstration and testing. VLSI development for MPEG is already under way, and should thus help to shorten ATV product development time.

- The use of MPEG as the core media-independent compression technique for HDTV improves the likelihood for industry consensus. This standard based approach provides a common platform for previously diverse communities, such as the broadcast industry, the consumer electronics industry, the office equipment manufacturing industry, the IC industry, the computer industry, and the telecommunication industry.

- The high cost of bringing HDTV to the American viewing public can be shared by these non-TV industries. At the same time, these industries in turns reap the benefits of lower cost and higher volumes (i.e., wider markets for their products).

*Why MPEG+:*

- MPEG+ used in ADTV is achieved by adding a separable terrestrial channel specific video compression layer to the standard algorithm. This provides protection against unavoidable and unpredictable channel impairments in the terrestrial broadcast channel. The decision to engineer robustness as an additive separable layer in encoding system was based on the the desire to maintain MPEG bit-stream compatibility at some level of the ADTV system, while also making provision for media specific robustness.

*Why cell-relay based layered data transport format?*

- Cell relay based packet transport used at the link-level of ADTV conforms to general technological trends in telecommunications, while achieving necessary technical objectives of ADTV. Specifically, similar cell relay techniques are being standardized for broadband ISDN/ATM, providing another industry standard anchor for the ATRC system.

- The use of a standards orienteded data format means that the ADTV system will provide a flexible high-speed data channel to the home (albeit one-way) well in advance of broadband ISDN, and should therefore be beneficial to the U.S. public.

- Cell relay provides rugged logical synchronization for reliable delivery of variable length coded compressed video in presence of errors

- ADTV's asynchronous time divsion multiplexed link level offers the advantage of flexible multiplexing of audio, data and video with bit-rates that do not need to be specified in advanced. It is noted that this data format offers the B-ISDN-like feature of address-based delivery of video, potentially permitting delivery of alternative commercials to different groups of households, etc.

- Fixed size packets in ATM-type cell relay can be handled with simpler high-speed processing hardware than required in systems with variable length data formats.

- The MPEG+ specific adaptation layer data format used in ADTV provides segmentation and chaining facilities for efficient packing of link-level cells with variable length video

data. In addition the adaptation level supports logical recovery from errors in the ADTV receiver.

- The adaptation layer of the data format adopted for ADTV handles multiple priority classes required for robust delivery of video. This feature is needed to suppport the prioritization layering carried out in the upper MPEG+ layer of the video compression algorithm.

*Why twin QAM:*

- The Twin-QAM modem used in the ADTV system was developed specifically for the terrestrial simulcast application with the joint design goals of achieving high spectral efficiency (i.e., bit-rate as high as 25-30 Mbps), along with NTSC-robust/NTSC-friendly operation. The modem emits a signal whose spectrum has been specifically shaped to avoid mutual interference with co-channel NTSC carriers, providing significantly better simulcast properties than standard wideband QAM.

- Twin QAM is specifically designed to support (at the physical level) the multi-tier service required by the prioritized MPEG++ and transport approach adopted with the objective of achieving graceful image quality degradation.