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Summary Report on the Workshop on Advanced Digital Video in the National Information Infrastructure

By C. Fenimore, B. Field, H. Frank, E. Georg, M. Papillo, G. Reitmeier, W. Stackhouse, and C. Van Degrift

The development of a National Information Infrastructure (NII) is a way of putting vast amounts of information at the fingertips of users in America and around the world. Digital video is likely to be the most technically demanding NII service. Recognizing this, several industrial and governmental organizations sponsored a recent workshop to define a vision of the role of digital video in the NII; identify the architectural, scaling, and performance issues in realizing this vision; and recommend the research, experiments, and other steps to be taken to resolve these issues. At the workshop, it was broadly agreed that the NII will be an amalgam of networks, information appliances, and services in which any company may provide any service to any user. This heterogeneous system will necessarily be modular, with an extensible architecture. The components of the NII will require publicly identified reference points and interfaces. The development of high-definition television (HDTV) will be a powerful force driving the development of NII applications. It was the sense of the participants in the workshop that the Grand Alliance proposal for HDTV is the best available alternative for terrestrial broadcast of HDTV in the U.S. Additional standards for advanced digital video will be required to meet the diverse needs of the NII.

A workshop was held May 10 to 11, 1994, in Washington, D.C., to highlight technical issues for industry and government decision makers with respect to advanced digital video (ADV) in the National Information Infrastructure (NII). The purpose of the workshop was to:

- Define a vision of the role of digital video within the NII.
- Identify the architectural, scaling, and performance issues in realizing this vision.
- Recommend the research, experiments, and steps to be taken to resolve these issues.

The workshop was sponsored by the following governmental agencies and industrial organizations:

- National Institute of Standards and Technology (NIST)
- Technology Policy Working Group in the Committee on Applications and Technology of the Information Infrastructure Task Force (TPWG)
- Electronics Industries Association (EIA)
- Institute of Electronics and Electrical Engineers (IEEE-USA)
- Society of Motion Picture and Television Engineers (SMPTE)
- Advanced Television Systems Committee (ATSC)
- Cross-Industry Working Team (XIWT)

It was attended by approximately 180 people from industry, government, and academia, and consisted of talks and discussions by experts in information services, broadcasting, computing, consumer electronics, and government policy. The discussions were facilitated by participants forming four breakout groups to focus on architectural considerations, modular decomposition and interoperability; display performance; image capture and display requirements; and digital delivery services. This summary of the full report[1] presents the main ideas expressed by the speakers and the conclusions reached by the breakout groups. Six recommendations emerged from the plenary discussions, and the concluding section briefly describes the efforts of various organizations which are pursuing these recommendations in public forums.

Key Concepts

Definition of the National Information Infrastructure

"A system to deliver to all Americans the information they need when they want it and where they want it — at an affordable price."

— Michael Nelson, OSTP

The NII will be an amalgam of information networks, appliances, and services. It will consist of thousands of interconnected, interoperable communication networks, including terrestrial and satellite broadcasting, cable television networks, wired and wireless telephone systems, commercial computer network services, and the Internet and its successor.[2] Computer systems, televisions, telephones, and other devices will all converge to serve as "information appliances" on the NII. Digital libraries, information services, and data bases will be needed to provide

A contribution received from Charles Fenimore, Chair, Program Committee of the Workshop on Advanced Digital Video in the National Information Infrastructure; he is with NIST, Gaithersburg, MD 20899. Co-authors and committee members Bruce F. Field and Craig Van Degrift are also with NIST; Howard Frank is with ARPA/ESTO, Arlington, VA 2203-1714; Elden Georg is with Space Applications Corp., Arlington, VA 22203; Michael Papillo is with Houston Associates, Arlington, VA 22203; Glenn Reitmeier is with David Sarnoff Research Center, Princeton, NJ 08540-6449; and Will Stackhouse is a consultant in Redondo Beach, CA 90278-4039. An earlier version appeared in *The Report on the Workshop on Advanced Digital Video in the National Information Infrastructure, NISTIR 5457*, pub. July 1994, U.S. Dept. of Commerce.

the NII information content; users will buy content, not technology.

Content and useful applications will attract the usage necessary for NII success. The cultural industries, particularly motion pictures and television, can thus be seen as an essential part of the NII. It is critical that intellectual property rights associated with cultural items be protected by audit and control mechanisms at all service levels. Furthermore, the NII should be open to all information suppliers on an equitable basis.

NII applications will include distribution of entertainment programming, educational information, government data, manufacturing information, and access to health care. The production and distribution of entertainment programming today is a $37 billion information industry in the U.S. Digital program delivery over interactive networks will permit additional cost-effective services, such as video on demand and shopping at home. Electronic distribution of educational material will expose all students, even those in remote locations, to a high-quality education. Government, in part, is a vast information gathering and disbursing system. Electronic availability will facilitate access by business and the public to government reports, weather information, and other scientific data. Electronic "blueprints" and rapid communication between manufacturers and their suppliers are critical elements in improving manufacturing productivity. Health care may be improved by telemedicine and maintenance of on-line medical records. Telemedicine permits remote patient examination and diagnosis. Keeping appropriately protected medical records on line permits immediate medical review by specialists, allows simplified billing procedures, and provides more complete research material for population studies.[3]

The NII will be built, owned, and run by the private sector, with hundreds or thousands of companies providing services. The role of the government is to ensure that these systems and services are interconnected and interoperable in order to provide competition and choice for the customer.[4] The goal is to have a fully competitive marketplace in which any company may provide any service to any customer.

System Requirements of the NII

Interoperable, extensible systems are required so that television and communications can evolve along the technology curve.

Communications and video standards should describe an architecture that is flexible, extensible, and simple. A flexible architecture allows loose coupling between the components while focusing on key interworking points. If the architecture is structured correctly, its performance can be optimized by improved engineering while still retaining maximal backward compatibility. System developers must plan for continuous deployment and renewal; system heterogeneity and migration will be the steady-state condition.

"The goal is to have a fully competitive marketplace in which any company may provide any service to any customer."

In an NII environment of diverse heterogeneous networks, interconnected systems will need commonality among high-level functions such as addressing, device and environment description, service performance description, property-rights protection data, and transaction security. Lower level protocols of different individual network elements can be otherwise subjected to the standards of each industry, knowing that appropriate protocol conversions can be performed at network interconnect points. Two examples of these lower level protocols are the asynchronous transfer mode (ATM) protocol (an accepted world standard for telephony) and the MPEG systems layer (an accepted world standard for multiplexing video, audio, and data for digital television broadcasting).

Proposed technical approaches exist for efficiently mapping advanced digital video streams into ATM and handling the effect of "cell jitter" in applications where video and audio time synchronization are crucial, but industry agreements are still needed. Current video experiments are also being performed on the Internet to examine multicasting techniques and the use of multiple service classes to handle applications with different timing requirements. Further work remains to accommodate network diversity, to determine requirements for various applications of video, and to define network management policies that accommodate video requirements.

Efficient general-purpose networking involves a flexible, loose coupling of sources with destinations so that a variety of sources can be connected to a variety of destinations via a variety of transmission paths. This decoupling means, for example, that image timing and colorimetry information must be conveyed in a device-independent manner. Using digital converters between existing standards is likely to be more cost-effective than requiring uniform standards for all types of imagery in the system.

Despite many common characteristics, the NII information appliance may develop along two paths: task-oriented computer systems, and entertainment-oriented digital television. Entertainment systems require a bright, large-screen display for multiple viewers while computer systems usually have a geometrically accurate, small-screen display for a single viewer. This dual approach will provide NII services for different interests and needs, thus producing the quickest evolution of technology, services, and content. The architecture, however, must not force the technology along two paths, as applications may emerge to use the capabilities of both.

The Role of Video in the NII

An NII goal is to transmit images

and video as easily as a telephone transmits voice today.

Video applications will likely set the maximum bit-rate requirements of the NII. High-definition, "studio-quality" video will need to be sent point-to-point in real time between studios, editing facilities, and archive locations. This may set the maximum bit rate required by any individual transaction in NII. Similarly, compressed HDTV is likely to set the maximum bit-rate requirements of NII connections to the home.

The Grand Alliance HDTV System is an effective solution for delivering high-quality, high-definition pictures and sound over a wide service area by terrestrial broadcast. The FCC's mandate to simulcast HDTV within the existing frequency allocations for television service requires low interference with existing NTSC service. This provision forces difficult trade-offs among picture quality, sound quality, data rate, and HDTV coverage area, which must all be balanced in an overall HDTV system design.

Entertainment television service further requires strict synchronization of video, audio, and auxiliary data. The Grand Alliance system provides such capability and provides interoperability with other imaging media, e.g., motion-picture film, NTSC television, and still images. While the Grand Alliance HDTV system will be useful in many NII applications beyond entertainment, there will clearly be a need for other advanced video standards. Applications in video production, medical, industrial, space, scientific, and defense industries may require higher resolution, different frame rates, or a different level of compression to meet quality or data rate requirements.

Existing technologies, on which present compression techniques are based, will be satisfactory for many NII applications. However, additional engineering will be required to develop a family of compression techniques to meet a wider range of quality and compression level requirements. The MPEG-2 standard, adopted by the Grand Alliance, could be a starting point for such a family of standards. As technology evolves and new methods are developed, equipment upgrades will be needed and should be considered in information appliance design. Today, cost-sensitive applications (i.e., consumer electronics) use specialized hardware that is not easily modified. For future information appliances, careful consideration should be given to including capabilities and required protocols to enable the transparent upgrade of functions, such as decompression or display, by downloading new software.

Video standards on the NII should decouple programming, distribution, and appliances. Traditionally, each information supplier has had its own distribution system with appliances tailored to the medium. In the NII, digital video will be carried by a variety of distribution channels, and will be easily repackaged and stored. This permits video suppliers and users to use a common distribution infrastructure that provides competition across all markets. The distribution infrastructure must ride the technology curve, with continuous deployment and renewal. Video should be scalable and extensible, e.g., encoded in a multiresolution format that can be adapted to available resources. Achieving scalability without adversely affecting compression efficiency, however, represents an unsolved technical issue.

Compatibility and interconnectivity are of high priority in setting standards. Forcing premature obsolescence of consumer equipment should be avoided. Failure to do so may decrease the acceptability of the NII by consumers.

Breakout Group Summaries

Architectural Considerations, Modular Decomposition, and Interoperability

The architecture discussion focused on the identification of "key long-lived reference points" in the conceptualization of the network. The reference points identified were:

- Digital appliance reference points (physical point of attachment, logical point of attachment, status/remote-control management protocols).
- Channel/network reference points (channel end points, coding within channels, channel address space naming).
- Software/program object reference points (naming protocols for all items transmitted over the network, media-specific data formats).
- Reference points for third-party services supporting network management.

Rather than mandate a single standard at each reference point, industry should adopt a flexible architecture that assumes that the interfaces are constantly evolving and that most reference points will be realized by a variety of detailed standards. The principal requirement for NII interoperability is that a publicly documented interface be made available at each reference point. Market forces will then drive the implementation of converters and convergence of standards that facilitate the interoperability.

Display Performance

The Display Performance Group addressed a contentious issue: is it possible to reconcile the demands for interlaced image capture with the superiority of progressive scan for display? There was no consensus on this question. There was anxiety that interlaced scanning may corrupt the whole advanced digital video system. It was recognized that one way to lower this anxiety is to assure that all film-sourced material (initially 60 to 70% of HDTV prime-time material) be transmitted in progressive scan. (This approach is supported by the Grand Alliance.) An additional requirement is that all HDTV material be transmitted at the full resolution of its particular format; that is, any necessary filtering would be done at the receiver. Adopting these requirements would smooth the transition to higher quality systems.

Display performance associated

with various technologies was felt to be properly handled by market competition. Government can accelerate the rate of innovation by facilitating interface standards, funding pilot programs using video in education and health care, and establishing regulations and policy in such areas as the protection of intellectual property rights.

Image Capture and Display Requirements

This breakout group focused on identifying image capture and display requirements for various ADV/NII applications, and the implications of decoupling capture and display devices from each other. Image capture devices were generally considered to be less of a gating technology for most applications than displays. The financial impact of conversions at the capture device is likely to be less significant than that at the receiving end.

Several video applications need display capabilities beyond that required for entertainment. Home shopping, medical imagery, and viewing of fine art require stringent color or detail fidelity. The decoupling of capture and display devices forces the use of a device-independent format for color information.

Point-to-point connectivity should allow video display devices and applications that use them to follow the technology curve. Nevertheless, the large installed base of standard NTSC television equipment must also be accommodated and will initially be the only video link to the NII for a large class of consumers.

Advanced Delivery of Digital Video Services

The Advanced Delivery of Digital Video Services breakout group addressed the requirements for delivering video services in the NII. The Internet was considered as a model for the delivery of NII services. It is ubiquitous in the U.S., has low barriers of entry for information users and providers, and is beginning to provide flexible search functionality. The Internet is not well suited as a channel for digital video, since it is bandwidth limited. It is also generally limited by an absence of network tools for traffic control, guaranteed delivery, privacy, security, and accountability.

Despite these limitations, the Internet serves as a model for the growth and evolution of digital services. It was suggested that government/industry cooperation can set goals for the NII, develop a minimal set of services now, and plan for the staged entry of added functionality.

"In the NII, digital video will be carried by a variety of distribution channels, and will be easily repackaged and stored. This permits video suppliers and users to use a common distribution infrastructure that provides competition across all markets."

Government can also assist industry in developing network protocols. Government information services may catalyze the development of ADV-capable networks. Finally, the 1996 Olympic Games were identified as an opportunity for a demonstration project of HDTV and NII services that contain educational, health care, and entertainment elements, but copyright issues were cited as a serious barrier.

Panel Discussion

The Evolution of Standards: Is a New Approach Necessary?

The standards panel viewed de facto standards as contradictory to the goal of interoperability. De facto standards lead to market fragmentation, higher cost to the end user, and confusion in the industry. There can be a financial reward for the originators of de facto standards because the traditional standards process often lags too far behind technological innovation. Also, the traditional standards process is slowed by a tendency to overspecify, a lack of focus on issues crucial to interoperability, and by the proliferation of standards organizations. In addition, those working on standards are usually volunteers whose time is shared with other "higher priority" tasks.

For the process of generating NII standards to be successful, the traditional standards process must be improved. It must be tightly focused on the network itself and how to assure the interoperability of its applications and transmission links. Critical interfaces must be identified and the resulting architecture must be "open." Those working on the process must be able to give it their primary attention and must be accountable to an agreed upon schedule. Government regulation should be applied only when it is in the public interest, e.g., to guarantee universal access.

Recommendations

The following recommendations, while not the result of a formal decision process, nevertheless represent statements that were strongly supported in the plenary and breakout group discussions.

- The U.S. should move forward on HDTV as quickly as possible, as it can be a powerful driving force for the development of NII applications. The Grand Alliance Proposal for HDTV is the best available alternative and is superior to any system that involves digitizing NTSC signals. Digital NTSC systems would propagate interlaced transmission and continue the division between entertainment television and the computer/communications technologies.
- There will be continued controversy and disagreement over the desirability of an interlaced video format within the Grand Alliance System. Some believe that an all-progressive system is the only acceptable

choice. The anxiety level would be reduced if the major broadcasting networks commit to broadcasting film-sourced material in unfiltered, progressive format. This approach is supported by the Grand Alliance, and there is an informal understanding that at least four networks (ABC, NBC, CBS, and PBS) are planning to broadcast film in progressive formats.

• There is a need for a long-term program involving government and industry to facilitate interface standards; address intellectual property rights and information protection; fund research and development in interoperable systems; and establish pilot programs to apply advanced video technology in education, health care, and other areas of national importance.

• To serve the diverse needs of the NII, additional advanced digital video standards must be developed that complement the U.S. HDTV transmission standard. These should take into account and be interoperable with the U.S. HDTV standard.

• Standards should include both one- and two-way communications, provision for multicast video services, and internetworking cable, satellite, broadcast, common carrier, and packaged media. They should address the interconnection and interoperability of digital appliances and devices, digital networks and channels, software and programs, and third-party services. This will require identifying reference points (physical, management, and logical) and interfaces. Minimum service levels and staged criteria for interoperability and functionality should also be defined.

• Industry is encouraged to demonstrate a comprehensive "multimedia" event with integration of transport modes (e.g., ATM and broadcast), the use of multiple delivery networks (including the Internet), and the integration of text, graphics, and video. The Grand Alliance is encouraged to provide coverage, transmission, and display of both live and filmed programs so that both progressive and interlaced modes will be demonstrated.

Conclusion

The development of a National Information Infrastructure (NII) is a way of putting vast amounts of information at the fingertips of users in America and around the world. The NII will be an amalgam of networks, information appliances, and services, and there are many players involved in developing the standards and technology that will be needed to create an interoperable system. The following organizations have public, active efforts along these lines.

• The Information Infrastructure Task Force (IITF) has a Committee on Applications and Technology, within which the Technology Policy Working Group has focused on digital video issues. IITF documents are available on the World Wide Web at *http://iitf.doc.gov/.**

• NIST has several technical programs related to video technology, particularly to quality measurements for video systems, displays, and interfaces. The Advanced Technology Program has recently announced a focused program entitled "Digital Video in Information Networks." Detailed information is available by Internet at the Universal Resource Locator (URL), at *http://www.nist.gov/.**

• The SMPTE has a Digital Image Architecture Task Force, which is charged to define a digital video architecture. For information contact (Chair) Peter Symes by e-mail, at symes@am.gvg.tek.com.

• The IEEE-USA Committee on Communications and Information Policy has sponsored a variety of information exchanges on digital video and on the NII. SMPTE President Stan Baron is a member of the Committee. He may be contacted at NBC, 30 Rockefeller Plaza, New York, NY 10112.

• The Grand Alliance proposal for digital, terrestrial broadcast of HDTV incorporates several features to achieve interoperablity with NII-type services. The evaluation of the proposal is being conducted by the Advisory Committee on Advanced Television Service of the FCC.

• The Cross-Industry Working Team is an industrial membership organization which is working with the IITF to develop technological and architectural approaches that bridge industry gaps in information technology while providing for interoperability and other NII needs. XIWT has a home page at *http://www.cnri.reston.va.us:3000/XIWT/public.html.**

• The American National Standards Institute has convened an Information Infrastructure Standards Panel to accelerate the development of standards required by the national information infrastructure. For information on the panel contact R. M. Hayden, e-mail chick.hayden@t1.org. Information is also available on the Internet at URL, *http://dsys.ncsl.nist.gov/pub/iisp/iisp.html.**

*This universal resource locator (URL) provides access to information on the World Wide Web, using an Internet browsing tool such as Mosaic.

References

1. C. Fenimore, B. Field, H. Frank, et al., eds. *Report on the Workshop on Advanced Digital Video in the National Information Infrastructure, NISTIR 5457.* Gaithersburg, Md., July 1994. The report, exclusive of speakers' visuals, is also available on the Internet at URL, *http://www.eeel.nist.gov/advnii/.**
2. Computer Science and Telecommunications Board, *Realizing the Information Future.* NSF Computer Systems Project. National Research Council Press, 1994.
3. Committee on Applications and Technology, *Putting the Information Infrastructure to Work,* NIST Special Pub. 857, May 1994.
4. Committee on Applications and Technology, *The Information Infrastructure: Reaching Society's Goals,* NIST Special Pub. 868, Sept. 1994.