SPECS News From CableLabs

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Cable Industry Issues Specification for High-speed Data Delivery

The Data Over Cable System Interface Specification working group has developed a set of specifications aimed at gaining interoperable high-speed cable modems.

"This is a major accomplishment for the cable television industry," said Dr. John C. Malone, chairman of CableLabs' Board of Directors and TCI Chairman, President and CEO. "We said last year at the Western Show we would do this as quickly as we could and here we are one year later at the Western Show announcing our success," Malone said.

"In the meantime, we continue to deploy early versions of these modems and our customers are delighted at the high speed and convenience these modems afford by not requiring customers to tie up a phone line each time they wish to connect to the Internet," Malone added.

The set of specifications includes a radio frequency (RF) interface specification which was released December 5 to the 95 vendors that have signed the Data Over Cable System Interface Specification Access Agreement.

Modems compliant with the specification will be capable of delivering data to users at a minimum rate of 27 million bits per second (Mbps). So far, suppliers Hewlett-Packard, Bay Networks' LANcity Cable Modem Division, General Instrument and Com21 have indicated an interest in building interoperable modems that comply with this specification.

This unprecedented effort by the cable industry was headed by the Data Over Cable System Interface Specification working group, which is comprised of cable operators Comcast Cable Communications, Cox Communications, Tele-Communications Inc. (TCI), Time Warner Cable, Continental Cablevision, Rogers Cablesystems Limited and the research and development consortium, Cable Television Laboratories Inc. (CableLabs).

The interface specifications benefit consumers and cable operators by providing multiple sources of interoperable modems, thereby encouraging marketplace competition and enabling economies of scale.

Multiple suppliers building to the industry specification, but adding unique capabilities, will give consumers a wide selection of products from which to choose. Manufacturers will benefit by the reduction of development risk afforded by building to an industry supported, well-known specification.

The set of documents, put together by the Data Over Cable Service Interface Specification working group, describe internal and external cable network interfaces. "The process has defined a system that allows for transparent, two-way transfer of data using Internet Protocols between cable headends and cable customers with telephone return or RF return on the cable system," said Stephen Dukes, vice president technology, TCI Technology Ventures.

Alex Best, senior vice president engineering at Cox Communications, Inc., said: "This interface specification represents a major vic tory for all parties involved. This includes cable operators, modem suppliers, and most of all our customers. The on-ramp to the infor mation highway just took a giant step forward... and at high speeds.

Because "time to market" was a primary driver, cable operators selected technology that was based on existing hardware and software "Care was taken to ensure that the technology choices would anticipa the evolving market needs over th next three to five years," said Jame A. Chiddix, Time Warner Cable chief technical officer.

"I want to commend the team people who worked tirelessly to arrive at a specification that offers reasonable balance between differe technical solutions while meeting our needs to get compatible modems to market quickly," said Mark Coblitz, vice president of strategic planning for Comcast.

In addition, the specification includes ways to incorporate new technologies as they become available, said Michelle Kuska, data modem specification project mana er and a director of network technology with TCI Technology Ven tures. Kuska managed the project on behalf of the Multimedia Cable Network System (MCNS), which made up of TCI, Time Warner

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Cable, Cox and Comcast.

MCNS plans to grant non-exclusive licenses to vendors wanting to manufacture to these specifications. The MCNS license grant is conditioned upon a manufacturer's agreement to contribute freely, or on a reciprocal, no-cost basis, any crucial intellectual property required to implement a compliant modem.

Vendors unwilling to contribute critical technology to the royalty-free intellectual property pool associated with the specification would be able to obtain required intellectual property through conventional licensing arrangements made directly with the property holders. Manufacturers with no crucial intellectual property would also be eligible for an MCNS royalty-free license to obtain technology required to produce compliant cable modems.

Following is the executive summary of the Radio Frequency Interface Specification that was distributed to vendors. This summary provides an overview of the RF specification.

Executive Summary - Radio Frequency Interface Specification

High speed delivery of data is now available in select cable systems using first generation hardware from several manufacturers. Early experience reveals two important facts: 1) The technology works very well, and 2) Customers are surprised and delighted by the high speed and the convenience of connectionless service.

While short-term deployment will continue using the proprietary and non-interoperable modems available today, the timely availability of product conforming to widely adopted industry specifications for interoperability will provide powerful advantages for cable operators, consumers, and manufacturers. The advantages include:

■ Operators may purchase interoperable equipment from multiple manufacturers, thus promoting competition and subsequent price reductions that benefit both the operator and consumer.

■ The interoperability specification provides a basic transport scheme that will allow early modems developed to the specification to continue to work on cable systems even though more advanced service capabilities may be added to future modems. As a result, investment in the early interoperable modems will not be stranded when more advanced modems are brought to the marketplace.

■ Cable modems that will work on a data-enabled cable system may be purchased by the consumer from a retail outlet.

■ Economies of scale advantages will be realized for key components of the cable modem system.

■ Manufacturers can reduce risk by developing to a well known specification.

This draft specification defines the radio frequency interface and is part of the set of data-over-cable interface specification documents being developed by the Multimedia Cable Network System (MCNS) consortium. MCNS is comprised of Comcast Cable Communications, Inc., Cox Communications, Tele-Communications, Inc., and Time Warner Cable. MCNS along with Continental Cablevision, Inc., Rogers Cablesystems Limited, and Cable Television Laboratories, Inc. (on behalf of the CableLabs member companies) make up the MCNS consortium. This draft specification is being issued to solicit comments and submissions from manufacturers on the functionality, clarity, and precision of the described interfaces.

Goals of the Specification

The data-over-cable service interface documents describe the internal and external network interfaces for a system that allows transparent bi-directional transfer of Internet Protocol (IP) traffic, between the cable system headend and customer premises, over a cable television system.

Because low risk and rapid time-to-market were critical drivers, this specification development effort incorporated contributions from manufacturers that were based on working hardware. Care was taken to ensure that the technology choices meet the market needs for the first 3-5 years of service. In addition, because the technology is evolving, hooks were incorporated to facilitate the introduction of new technology as it becomes available. However, it should be noted that it was not a goal of this specification to incur excessive risk or delays by pushing the limits of technology and performance. Instead, this specification development effort involved a deliberate series of prudent tradeoffs. In the order of most important first, the selection criteria that was used is listed below:

1. Meets basic performance, feature and cost needs for the first 3-5 years of service--These requirements require Internet Protocol transparency and support for multiple grades of service.

2. Offered for use without intellectual property rights encumbrances; minimizes intellectual property issues and cost, thereby facilitating manufacture of compatible equipment by multiple vendors on a non-discriminatory royalty-free basis.

3. Technology has been implemented and tested--Timely availability of both prototypes for testing as well as volume field-deployable equipment was considered in all

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CableLabs is a non-profit, research & development consortium founded in 1988 to enable the cable television industry to use technology to improve its business. CableLabs members serve more than 85% of U.S. cable subscribers, more than 70% of Canadian cable subscribers and 10% of the subscribers in Mexico.

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technology choices. The desired schedule is to have hardware conforming to this specification available from at least one vendor as early as possible in 1997, and from multiple manufacturers by year-end 1997.

4. Support for the evolutionary aspects of the architecture--The protocols are layered so as to be decoupled and include the ability to support future upgrades and changes by negotiation of the physical and higher-layer protocols at session establishment.

5. Provides technology-based performance or feature benefits--Support is provided for additional vendor-specific features that add value.

SPECIFICATION OVERVIEW

Figure I depicts a high level block diagram of the data-over-cable system. The system consists of the Cable Modem Termination System (CMTS), cable network, and Cable Modems (CMs). The CMTS is located at the headend and the cable modems are located at customer premises. This document defines both the characteristics of the radio frequency interface on the cable system and the message sets and signaling sequences between the headend and modems that are necessary to achieve interoperability.

To enable transparent transfer of Internet Protocol messages across a cable system the Network Layer, Data Link Layer and Physical Layer protocols and sublayers are defined. These are briefly summarized below.

The Network Layer is IP.

The Data Link Layer is comprised of three sublayers:

- A Logical Link Control (LLC) Sublayer, which conforms to Ethernet standards.
- A link-security sublayer that supports the basic needs of privacy, authorization, and authentication.
- A Media Access Control (MAC) Sublayer, suitable for cable system operation, that supports variable-length protocol data units (PDU).

The main features of the MAC protocol defined in this document are:

a) Headend (CMTS) controlled mix of contention and reservation transmission opportunities;

b) A stream of mini-slots in the return, or upstream communications channel;

c) Bandwidth efficiency through support of variable-length packets;

d) Extensions provided for future support of Asynchronous Transfer Mode (ATM) or other PDU;

e) Support for multiple grades of service; and

f) Support for a wide range of data rates.

In the downstream direction, the Physical (PHY) Layer is based on North American digital video transmission specifications (i.e., ITU-T Recommendation J.83 Annex B) and includes these features:

- 64 level and 256 level Quadrature Amplitude Modulation (64-QAM and 256-QAM) modulation formats;
- Concatenation of Reed-Solomon and Trellis forward error correcting codes supports operation in a higher percentage of North American cable plants;
- Variable-depth interleaving su ports both latency-sensitive and latency-insensitive data; and
- Contiguous serial bit-stream (input and output) with no implied framing provides complete Physical Layer and MAC sublayer decouplin

The cable modem's upstream transmission Physical Layer charac teristics, under headend control, include:

- Quadrature Phase Shift Keyin (QPSK) and 16-QAM modulation formats
- Multiple symbol rates
- Frequency agility
- Time-division multiple access
- Support of both fixed-frame and variable-length PDU formats
- Programmable Reed-Solomor block coding
- Programmable preambles
- Minimal coupling between physical and higher layers accomm dates future Physical Layer technologies

The specification identifies mea by which cable modems can "self-discover" the appropriate cable sys tem frequencies for reception and transmission, bit rates, modulation formats, error correction, and pow levels. To protect service to other users, and to ensure network reliability, cable modems are allowed t transmit after downstream synchro nization and receipt of the approp ate type of transmission grants. Additional channels in both the upstream and downstream directio can be provisioned as necessary to optimize traffic loading based on

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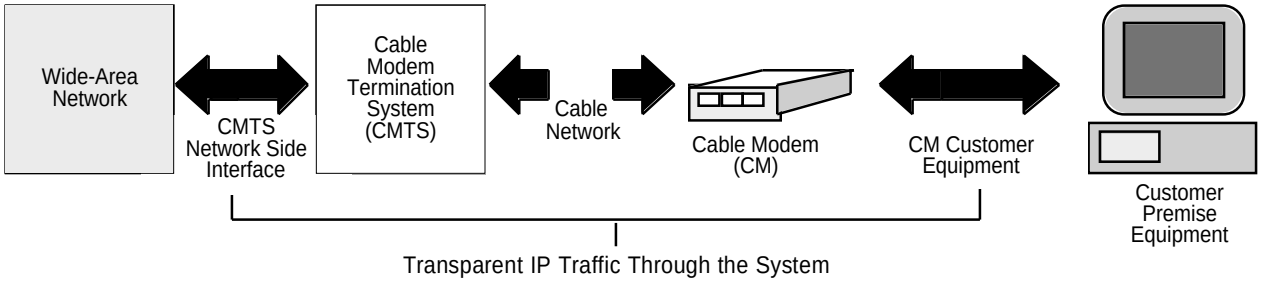

Figure I: Data-Over-Cable System Block Diagram

Cable Industry Fares Well in Standards Process

The North American cable television industry's pursuit of standards made significant gains on national and international fronts within the past month, according to CableLabs Chief Technical Officer Dr. Richard Prodan.

Various bodies, including the IEEE (Institute of Electrical and Electronics Engineers) 802.14 Committee and the International Telecommunications Union (ITU) Study Group 9, Working Party 1 (SG1) agreed with the cable industry's technical and commercial arguments and included CableLabs' proposals in their standards, Prodan said.

"These last few weeks have been a whirlwind of standards achievement for the cable industry in its pursuit of a goal to deploy interoperable, multi-vendor equipment for new digital services," Prodan indicated.

First, the Society of Cable Telecommunications Engineers (SCTE) Digital Video Subcommittee approved the quadrature amplitude modulation (QAM) transmission standard for downstream digital video delivery. The SCTE standard extends the current international QAM transmission standard, ITU-T J.83 Annex B. This standard contains compatible options for data networking, telephony, and interactive video.

Then the IEEE 802.14, a cable data modem standards setting group, adopted the downstream transmission standard by including the extended J.83 Annex B in its Physical Layer (PHY) specification. This is added to the existing downstream transmission format, J.83 Annex A, which is based on a European cable standard.

And in mid-November, in a meeting hosted by CableLabs in Boulder, Colo., the ITU SG 9/1 accepted the extensions embraced by IEEE and SCTE. Balloting now will be conducted with formal adoption of the extended as an international standard anticipated in April 1997. ▼

Time Warner's Vaughan to Head New CableLabs Subcommittee

CableLabs has created a new subcommittee to focus on issues associated with helping the cable industry derive ad sales revenues from digital programming.

Jay Vaughan, director of engineering and technology with Time Warner Cable, will chair the new group. Carol Derr, director of advertising technology with TCI Technology Ventures, Inc., also will play a key role in the group, which is a subcommittee of the CableLabs Technical Advisory Committee (TAC). The CableLabs TAC is made up of technical executives and business strategists from CableLabs member companies.

CableLabs' Engineering and Digital Network Technologies departments will work with the subcommittee on hardware, software and digital systems integration issues connected with local advertising and substitute video insertion and program generation.

Today ad insertion companies are providing digitally stored ads for conversion and inclusion in analog programming. But, Vaughan said, the subcommittee will also focus on the practice of digital ad insertion into digital video programs. This insertion of digital ads into digital programming has a different set of issues, such as bit rate differences, compression formats, cueing, buffering and statistical multiplexing, Vaughan said.

"By starting now, we hope to be in a much better position on digital ad insertion next year when cable's delivery of digital video services really takes off," Vaughan said. The work of this group may lead to issuance of requests for information and requests for proposal in this area, Vaughan said, as well as CableLabs issuance of recommended practices. All parties interested in this effort should contact Rhonda Hilton at CableLabs, 303/661-9100. ▼

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cable system topology, service penetration, and usage levels.

Support of Future New Cable Modem Capabilities

The specification strives to facilitate the introduction of modems in the future that will leverage technology advances and enable additional services that are not well defined or obvious today. These enhancements may include new Physical Layer modulation techniques, or different data transport structures optimized for differing traffic flows and classes of services (e.g., for synchronous transfer mode telephony).

Moderate "future proofing" is provided by the protocols defined in the specification. Standard headends will be able to activate new modems for enhanced communications options at the time of setup. In addition, the means for updating modem software via the cable network have been included in the specification. ▼