PCC.I/RES.99 (IX-06) [1]

ITU-T RECOMMENDATION J.122, "SECOND-GENERATION TRANSMISSION SYSTEMS FOR INTERACTIVE CABLE TELEVISION SERVICES – IP CABLE MODEMS"

The IX Meeting of the Permanent Consultative Committee I: Telecommunications,

CONSIDERING:

1. That there is a consensus that new forms of communication are fundamentally transforming the way in which people, communities, businesses and governments interact with each other;

2. That Resolution PCC.I/RES.4 (I-02) identifies broadband as a priority issue for examination by PCC.I;

3. That Resolution PCC.I/RES.21 (II-03) emphasizes the advantages of a prompt evolution towards a national broadband infrastructure in an environment of convergence, and

4. That Resolution PCC.I/RES. 86 (VII-05) creates a Technical Notebook on Broadband Access Technologies,

RECOGNIZING:

1. That the region's economy can be strengthened and its communities transformed by fostering the development of broadband Internet access throughout the Americas;

2. That today, the most advanced form of communications requires high bandwidth interconnection;

3. That ITU.T Recommendation J.122, "Second-generation transmission systems for interactive cable television services – IP cable modems" defines an access technology that exploits the existing infrastructure of copper wires that were originally deployed for television services;

4. That ITU-T Recommendation J.122., "Second-generation transmission systems for interactive cable television services – IP cable modems" allows operators to offer services such as high definition TV (HDTV), video-on-demand, videoconferencing, high speed Internet access and advanced voice services including VoIP, over a all-coaxial or hybrid-fiber/coax (HFC) cable network;

5. That the ITU-T Study Group 9 approved Recommendation G.993.2 in December 2002 and it is now in force,

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1 Document CCP.I-TEL/doc. 942/06

RESOLVES:

To endorse ITU.T Recommendation J.122., "Second-generation transmission systems for interactive cable television services – IP cable modems" with no deletions, additions or modifications; and

RECOMMENDS:

a) That the Rapporteur Group on Standards Coordination continues to monitor the cable modem work of ITU-T Study Group 9 and determines its applicability for the Americas as this work evolves; and

b) That the Rapporteur Group on Standards Coordination continues addressing the broadband access needs of the Americas and provides additional recommendations for endorsing standards that meet customer demands for ever higher bit rate data services, high-speed Internet access and other innovative services.

ANNEX TO RESOLUTION PCC.I/RES. 99 (IX-06)

STANDARDS COORDINATION DOCUMENT ON ITU-T RECOMMENDATION J.122, "SECOND-GENERATION TRANSMISSION SYSTEMS FOR INTERACTIVE CABLE TELEVISION SERVICES – IP CABLE MODEMS"

1. EXECUTIVE SUMMARY

The Working Group on Standards Coordination (WGSC) has addressed broadband access technologies as part of its studies of standards for Next Generation Networks (NGN), Services, Signaling, and Operations as they relate to the service access needs of the Americas. Part of this activity has included monitoring the work of the ITU-T. ITU-T Study Group 9 (Integrated broadband cable networks and television and sound transmission) has been designated as the Lead ITU-T Study Group integrated broadband cable and television networks. In this capacity, Study Group 9 approved, in December 2002, ITU-T Recommendation J.122, called "Second-generation transmission systems for interactive cable television services – IP cable modems".

Based on CableLabs[2] DOCSIS specifications, J.122 defines the second generation radio-frequency interface specifications for high-speed Data-Over-Cable systems. It belongs to the family of ITU-T Recommendation J.112, "Transmission systems for interactive cable television services". The main reason for the creation of J.122 was that, although high-speed data services on cable television systems have been widely deployed for sometime, there has been an increasing demand for higher upstream bandwidth, especially with the popularity of symmetric data applications. J.122 also allows for an improvement on noise immunity.

The second generation Data over cable system uses the same RF channel and its technology is backwards compatible with that of the first generation. It provides a significant increase in upstream channel capacity

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2 Cable Television Laboratories, Inc. (CableLabs®) is a non-profit research and development consortium that is dedicated to pursuing new cable telecommunications technologies and to helping its cable operator members integrate those technical advancements into their business objectives. It was founded in 1988 by members of the cable television industry.

with wider channels and better spectral efficiency. It provides for both Synchronous-CDMA[3] and Advanced-TDMA[4] coding.

The service will allow transparent bidirectional transfer of Internet Protocol (IP) traffic, between the cable system headend and customer locations, over an all-coaxial or hybrid-fiber/coax (HFC) cable network, as it can be seen in Fig 1-1/J.122 reproduced below for convenience.

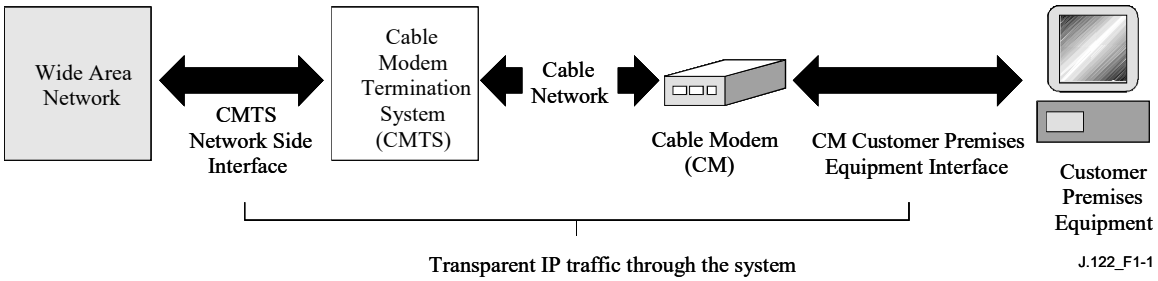

Figure 1-1/J.122 – Transparent IP traffic through the Data-Over-Cable system

Where:

Headend is the central location on the cable network that is responsible for injecting broadcast video and other signals in the downstream direction. CMTS is the Cable Modem Termination System located at the headend and CM is the Cable Modem located at the customer location.

Both, CMTS and CM, realize the transmission path over the cable system. At the headend (or hub), the interface to the Data-Over-Cable system is called the Cable Modem Termination System-Network Side Interface (CMTS-NSI). At the customer locations, the interface is called the cable-modem-to-customer-premises-equipment interface (CMCI). The intent is for operators to transparently transfer IP traffic between these interfaces.

2. BACKGROUND

Cable Modems

Digital data signals are transmitted over radio frequency (RF) carrier signals on a cable system. In order to get bi-directional communication, there is one carrier signal that carries data in the "downstream" direction (from the cable network to the customer), and another that carries data in the "upstream" direction (from the customer to the cable network). Cable modems (CM) are devices at the subscriber premises that convert digital information into a modulated RF signal in the upstream direction, and convert the RF signals to digital information in the downstream direction. Cable modem termination systems (CMTS), perform the converse operation for multiple subscribers at the cable operator's headend.

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3 CDMA stands for ***C**ode-**D**ivision **M**ultiple **A**ccess*, which is a digital cellular technology that uses spread-spectrum techniques. In CDMA every channel uses the full available frequency spectrum instead of assigning a specific frequency to each user. Individual conversations are encoded with a pseudo-random digital sequence. CDMA is the common platform on which 3G technologies are built.

4 TDMA stands for ***T**ime **D**ivision **M**ultiple **A**ccess,* which is a technology for delivering digital wireless service using time division multiplexing (TDM). TDMA works by dividing a radio frequency into time slots and then allocating slots to multiple calls. I.e. a single frequency can support multiple, simultaneous data channels. TDMA is used by the GSM digital cellular system.

First Generation Transmission systems for interactive cable television services
In March 1998, ITU-T SG 9 approved Recommendation J.112, "Transmission systems for interactive cable television services" based on a series of Data Over Cable Service Interface specifications developed by CableLabs, called DOCSIS 1.0 and 1.1. DOCSIS defines interface requirements for cable modems involved in high-speed data distribution over cable television system networks. DOCSIS-compliant cable modems are at present the most successful and cost-effective method for providing high-speed data services, being now in competition with DSL technologies.

In DOCSIS 1.0 and 1.1 the downstream channel is 6 MHz and occupies the space of a single television transmission. It is compatible with digital set-top MPEG[5] transport stream modulation, and can provide up to 40 Mbps. The upstream channels, shared by several hundred users, can be up to 3.2 MHz wide, and it can deliver up to 10 Mbps-per-channel.

Second Generation Transmission systems for interactive cable television services
J.122 allows for a higher upstream bandwidth than J.112. In J.122, upstream channels that can be up to 6.4 MHz, can deliver up to 30 Mbps. A media access control (MAC) layer coordinates shared access to the upstream bandwidth.

Since the sharing of the channels could offer a threat to the security and privacy of data, J.112 and J.122 technologies use encryption and security mechanisms for the operator to prevent theft of service.

Physical Layer Options in J.122
As different networks in the world adopt different cable spectrum, J.122 defines three possible options for the physical layer technology. These three options have equal priority and are not required to be interoperable. They are:

1) Based on the downstream multi-program television distribution that is deployed using 6 MHz channeling, this option supports upstream transmission in the 5-42 MHz region.

2) Based on a multi-program television distribution using 8 MHz channel spacing, this option supports upstream transmission in the 5-65 MHz region.

3) The third technology option is based on 6 MHz channel spacing and supports upstream in the 10-55 MHz region.

To be compliant with J.122, implementations must be compliant only with one of the three options and it is not required for equipment built according to one option, to interoperate with equipment built according to another option. However, all optional physical-layer technologies are required to be backwards compatible with the earlier versions of those options.

J.122 refers to the first technology option in its main body and the second and third options are referred to in Annexes F and J respectively. It also assumes that the access network is coaxial-based broadband, understanding that coaxial-based may be either an all-coax or a hybrid fiber/coax (HFC) network. In any of these cases, the network is referred to as a "cable network"

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5 MPEG here refers to the family of digital video compression standards and file formats developed by the ISO Moving Picture Experts Group. MPEG achieves high compression rate by storing only the changes from one frame to another, instead of each entire frame.

A cable network uses a shared-medium, tree-and-branch architecture with analogue transmission. The key functional characteristics assumed are:

1) two-way transmission;
2) a maximum optical/electrical spacing between the CMTS and the most distant CM of 100 miles, although typical maximum separation may be 10-15 miles;
3) a maximum differential optical/electrical spacing between the CMTS and the closest and most distant modems of 100 miles, although this would typically be limited to 15 miles.

3. CONCLUSIONS

The Working Group on Technology recommends that CITEL PCC.I endorse ITU-T Recommendation J.122, "Second-generation transmission systems for interactive cable television services – IP cable modems" with no deletions, additions or modifications.

4. FUTURE WORK

The Rapporteur Group on Standards Coordination should continue to monitor the evolution of cable service specifications in ITU-T, (especially Study Group 9), and other relevant standards groups that address the broadband needs of the Americas. As appropriate, the RGSC will recommend endorsement of additional standards that serve to enhance broadband access technologies in the Americas.

5. RESOURCE DOCUMENTS

[1] ITU-T Recommendation J.122, "Second-generation transmission systems for interactive cable television services – IP cable modems".