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Infrastructure of audiovisual services – Systems aspects

Multipoint control units for audiovisual systems using digital channels up to 1920 kbit/s

ITU-T Recommendation H.231

(Previously CCITT Recommendation)

ITU-T H-SERIES RECOMMENDATIONS

AUDIOVISUAL AND MULTIMEDIA SYSTEMS

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ITU-T RECOMMENDATION H.231

MULTIPOINT CONTROL UNITS FOR AUDIOVISUAL SYSTEMS USING DIGITAL CHANNELS UP TO 1920 kbit/s

Summary

This Recommendation specifies the means by which three or more audiovisual terminals conforming to Recommendation H.320 may communicate simultaneously over constant bit rate digital paths, such communication being designated a "multipoint call".

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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MULTIPOINT CONTROL UNITS FOR AUDIOVISUAL SYSTEMS USING DIGITAL CHANNELS UP TO 1920 kbit/s

(revised in 1997)

1   Scope

This Recommendation specifies the means by which three or more audiovisual terminals conforming to Recommendations H.320, H.221, H.242, H.261, H.262 and H.263 may communicate simultaneously over constant bit rate digital paths, such communication being designated a "multipoint call". The terminals should not need any modification for multipoint working, though some optional enhancements may require additional software; in particular, considerably enhanced functionality is attained via the use of T.120 protocols in the MLP channel. The interconnection is effected by one or more Multipoint Control Units (MCU) which may reside in the network or at one of the terminals.

This Recommendation covers both mandatory requirements and optional enhancements for multipoint working. The optional enhancements include:

- numbering of terminals;

- chair control;

- data broadcast;

- video mixing;

- cascading.

2   References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

–   CCITT Recommendation G.711 (1988), *Pulse Code Modulation (PCM) of voice frequencies*.

–   CCITT Recommendation G.722 (1988), *7 kHz Audio-coding within 64 kbit/s*.

–   CCITT Recommendation G.728 (1992), *Coding of speech at 16 kbit/s using low-delay code excited linear prediction*.

–   ITU-T Recommendation H.221 (1997), *Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices*.

–   ITU-T Recommendation H.230 (1997), *Frame synchronous control and indication signals for audiovisual systems*.

–   ITU-T Recommendation H.233 (1995), *Confidentiality system for audiovisual services*.

–   ITU-T Recommendation H.234 (1994), *Encryption key management and authentication system for audiovisual services*.

–   ITU-T Recommendation H.242 (1997), *System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s*.

–   ITU-T Recommendation H.243 (1997), *Procedures for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s*.

–   ITU-T Recommendation H.320 (1997), *Narrow-band visual telephone systems and terminal equipment*.

–   ITU-T Recommendation T.122 (1993), *Multipoint communication service for audiographics and audiovisual conferencing service definition.*

–   ITU-T Recommendation T.123 (1996), *Network specific data protocol stacks for multimedia conferencing Teleconference Applications*.

–   ITU-T Recommendation T.124 (1995), *Generic conference control*.

–   ITU-T Recommendation T.125 (1994), *Multipoint communication service protocol specification*.

–   ITU-T Recommendation H.224 (1995), *A real time control protocol for simplex applications using the H.221 LSD/HSD/MLP channels*.

–   ITU-T Recommendation H.261 (1993), *Video codec for audiovisual systems at $p \times 64$ kbit/s*.

–   ITU-T Recommendation H.262 (1995), *Generic coding of moving pictures and associated audio information: Video*.

–   ITU-T Recommendation H.263 (1996), *Video coding for low bit rate communication*.

3   Definitions

This Recommendation defines the following terms:

3.1   adding and dropping terminals from a conference: Refers to connection to the APU, VPU and DPU (see 5.2), not to network (dis-)connection which is outside the scope of this Recommendation.

3.2   chair-control terminal: An enhanced terminal possessing a token conveying a certain measure of authority over the operation of the MCU; the token may be assigned by rearrangement, by an operator, or by protocol during the call. The person controlling need not be the actual chairperson of the meeting.

3.3   chair-control port: That port of the MCU serving the terminal to which chair-control has been assigned (this port is not physically different from the others).

3.4   directly-connected terminal: Where reference is made to "directly" connected terminals, this should not be taken to mean that the terminal in question is collocated with the MCU, but rather that it is not connected to a different MCU.

3.5   local MCU: That to which the terminal in question is directly connected.

3.6   multipoint control unit (MCU): A multi-port device, by means of which two or more audiovisual terminals may intercommunicate in a conference call; a "listed MCU" has the properties defined in clause 8. Master and Slave MCUs: A "master MCU" has been assigned a superior controlling function in a call where two or more MCUs are interconnected, while the other MCUs in that call are termed "slave MCUs".

NOTE – The physical realization of an MCU may be such that two or more independent conferences may be set up within the same unit; logically, however, there is no relationship between these conferences; the text herein refers to an MCU only as a logical entity pertinent to the particular call of concern.

3.7   primary and secondary ports: While all ports of an MCU may be physically the same, distinctions may be made by the internal software, on the basis of declared terminal capabilities, such that the ports are not all treated on an equal basis. In general, a multipoint call will involve two or more terminals intercommunicating on an equal basis, at their highest common capability; the MCU would designate as "primary" those ports to which these terminals are connected, and for simplicity these terminals can be referred to as "primary terminals" for the purposes of this one call. The selection of an appropriate common level for primary communication is described in Recommendation H.243.

One or more additional terminals may take part in the multipoint call, even though they do not have sufficient capability to communicate on an equal basis with primary terminals; these may be designated "secondary terminals", communicating with the others only by such compatible signals as can be made available (e.g. speech only), the MCU having designated the appropriate port accordingly. Note that if this provision were not made, then the addition of a telephony terminal to a videophone conference would cause all picture transmission to be discontinued.

It is not mandatory that an MCU be able to handle secondary terminals; in such a case, the MCU may either:

a)   disconnect a terminal not declaring capabilities adequate to participate as a primary; or

b)   lower its definition of "primary" to include the said terminal.

The provider of the MCU should make clear which procedure is followed.

4   Abbreviations

This Recommendation uses the following abbreviations:

APU   Audio Processing Unit

BAS   Bit-rate Allocation Signal

CIF   Common Intermediate Format

CPU   Control Processing Unit

DPU   Data Processing Unit

ECS   Encryption Control Signal

FAS   Frame Alignment Signal

FAW   Frame Alignment Word

GOB   Group of Blocks

H-MLP   High speed Multi-Layer Protocol

HSD   High Speed Data

LD-CELP   Low Delay – Code Excited Linear Prediction

LSB   Least Significant Bit

LSD   Low Speed Data

MB   H.261/H.262/H.263 Macroblock

MBE   Multi-Byte Extension

MCC   Multipoint Command Conference

MCN   Multipoint Command Negating

MCS   Multipoint Command Data Symmetrical Data-Transmission

MF   MultiFrame

MLP   Multi-Layer Protocol

MPI   Minimum Picture Interval

MSB   Most Significant Bit

NS   Non-Standard

PCM   Pulse Code Modulation

QCIF   Quarter Common Intermediate Format

SBE   Single Byte Extension

SC   Service Channel

SCM   Selected Communications Mode

SMF   Sub-MultiFrame

SP   Still Picture

VCF   Video Command "Freeze Picture Request"

VCU   Video Command "Fast Update Request"

VPU   Video Processing Unit

5 Functional representation

5.1 General representation

A multipoint call may be represented as in Figure 1, wherein are shown a number of terminals T, not necessarily identical, linked individually into a network by symmetrical bidirectional digital connections, not necessarily all of the same capacity. There is no particular limit set by the system to the number N of terminals connected in the call, though in practice, depending on implementation, the difficulties and cost will rise as N increases, while performance tends to fall.
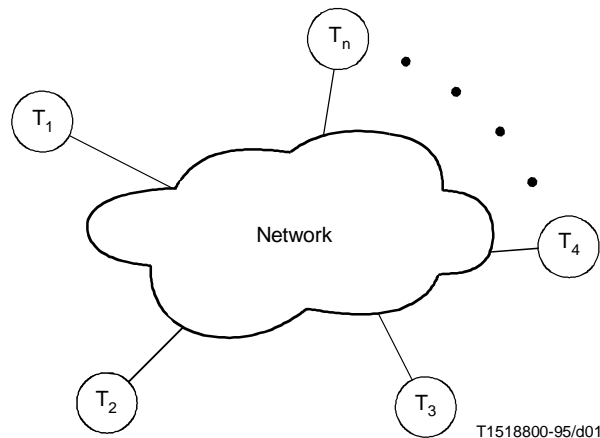

Figure 1/H.231 – Representation of a multipoint call

In the representation of Figure 1, the network need only be described by the signal flows at its ports, and their interdependencies. The hardware realization need not be of concern: there may be a single MCU at one location; alternatively the functions may be distributed to two or more locations, but in practical terms we then refer to a series of single MCUs linked together. In this Recommendation, the text applies in general to both single-location and distributed MCUs, and the linking of MCUs is only treated specifically where there is a particular need to do so.

The MCU is represented in more detail in Figure 2.

Each port of the MCU has a network interface unit, with associated call control if appropriate; on the MCU side of the network interface unit, the signal flows are contained in one or more bidirectional channels normally of equal capacity, according to the transfer rates listed in Annex A/H.221. The incoming flow is passed to the demultiplexer, which extracts the several types of information (audio, video, data, and control) and passes them to their respective processors. The processors are controlled in such a way that an appropriate output from each is made available for transmission to every terminal; the latter are brought together in the multiplexer to be combined into the outgoing channels.

The "call-control" and "call-control processor" units are outside the scope of this Recommendation (see Recommendation H.200/AV.440); the other units are described in the following subclauses.

5.2 Description of functional units

5.2.1 Network interface unit

A physical entity that converts to/from line code the signals of 64 kbit/s (56 kbit/s) or multiples thereof which enter the demultiplexer and leave the multiplexer. Although in Figure 2 such a unit is shown for each multiplexer/demultiplexer pair, in practice a network interface might support a number of logical ports (see below).
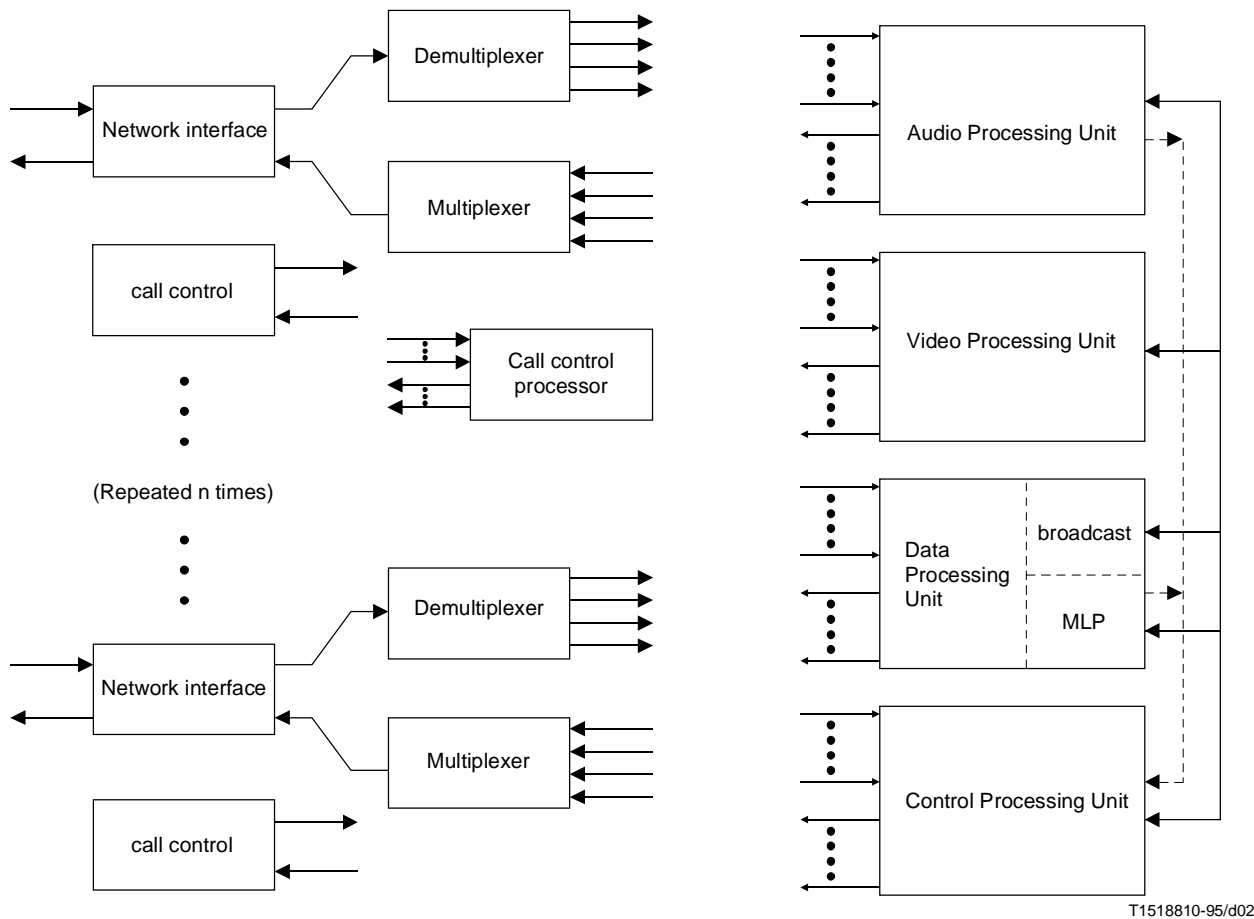
Figure 2/H.231 – Schematic of a multipoint control unit

5.2.2 Port

A port is a logical entity which may support one audio or audiovisual terminal; it is associated with a single multiplexer and demultiplexer.

5.2.3 Demultiplexer

The signal entering the demultiplexer is that transmitted by a terminal fully conforming to Recommendation H.221, so the operation is analogous to that of the receiving side of a terminal, namely:

– recovery of frame and multiframe alignment;

– buffering, synchronization and ordering of multiple channels if relevant;

– extraction of BAS codes and forwarding some of them to the control processor;

– extraction of encryption vectors and decryption if relevant;

– extraction of audio and forwarding to the audio processor;

– extraction of video and forwarding to the video processor;

– extraction of data and forwarding to the data processor.

Correct timing relationships must be maintained between mode-control BAS and the related audio, video and data.

5.2.4 Audio Processing Unit (APU)

The audio processor prepares N audio outputs r_j from N audio inputs s_i, by switching, mixing, or a combination of these. Mixing requires the addition of linear signals S_i obtained by decoding s_i to linear (PCM or analog), and the recoding of the responses R_j to appropriate transmission formats r_j.

An audio-mixing MCU generally results in sending to each terminal the sum of the signals from all other terminals. However, as the number of audio signals involved in the summation increases, there can be an accumulation of unwanted signals (e.g. acoustic returns and noise) which eventually result in unacceptable degradation of the service to the user if additional precautions are not taken. The methods of dealing with these problems are for further study.

Some MCUs may allow terminals to be removed from the mixing function and interconnected separately, for private consultation.

If in either of the above cases the number N is limited to one, the MCU becomes audio-switching instead of audio-mixing. The audio unit may also contain a voice synthesizer or recorded message store, able to be connected into the mixing unit or separately to any terminal.

If the video signal is switched while the audio is mixed, the audio may be delayed relative to the video: to remedy this, the video should be buffered to reduce this delay to less than 30 ms.

NOTE – All MCUs shall, in conformance with 5.1/H.242, be able to receive PCM audio.

If the video signal is mixed as well as the audio signal, the video may be delayed relative to the audio signal. To remedy this, the MCU should buffer the audio to reduce this delay to less than 30 ms.

5.2.5 Video Processing Unit (VPU)

The video processor can operate in ways entirely analogous to those described above for the audio processor: to each terminal may be transmitted a single video signal from another terminal, selected at a video switch; or a "mix" of some or all of the other video signals may be transmitted. In this case "mixing" takes the form of spatially multiplexing the images into a single composite image in one of many possible formats described in Recommendation H.243. Since the video mixing function is a complex process, the alternative of video switching may be preferred. As for audio switching, the choice of video may be automatic, such that the current speaker (largest value of s_i) receives the picture of the previous speaker, while all other terminals receive the picture of the current speaker; a time delay is incorporated into the switching (typical value 2 s) to avoid excessively frequent image changes, caused by spurious sounds such as coughing, knocking a microphone, and so on.

The video switching may also be controlled directly by the chairperson, if any, who makes the decision as to which picture is most appropriate. The symbol MCV (see Recommendation H.230) may be sent from a terminal to force an MCU to broadcast its video signal, overriding the automatic mechanism until "cancel-MCV" is sent; the T.120-Series Recommendations provide for more complex control procedures.

See Note in 5.2.4 above concerning differential delay.

5.2.6 Data Processing Unit (DPU)

This unit is optional; when present, it contains one or both of the functions depicted as "broadcast" and "MLP" in Figure 2 and further explained below.

5.2.6.1 Data broadcast function

In this case, only one LSD and/or one HSD input can be accepted at any one time, any data subsequently arriving at another input being ignored. The data is broadcast to other outputs as determined by the control processor, according to the capability of the connected terminals to receive such data (see Recommendation H.243). Data is not echoed to the transmitter.

5.2.6.2 MLP data handling function

In this case, the data processor is equipped to process the multilayer protocol defined in the T.120-Series Recommendations and performs one or more of the following functions (see Recommendations T.122, T.123, T.125, T.124, etc.):

– handling of telematic information according to Recommendations T.122/T.125;

– transmission of conference control signals (request/grant floor, chair control, audio/video switching, etc.) according to Recommendations T.124 and T.128 (T.AVC).

Note that as described in Recommendation H.243, the MLP data processor may also be capable of processing the simplex data protocol described in Recommendation H.224. If this is the case, appropriate capability codes shall be present in the conference SCM.

5.2.7 Control processing unit

The control processor is responsible for determining the correct routing, mixing/switching, format and timing of the audio, video, data and control signals passed to each multiplexer for outward transmission; it also deals with the processing of conference-control functions.

5.2.7.1 Incoming BAS commands

According to the incoming BAS commands the CPU ensures the correct distribution of bits to the audio, video and data processors; it also ensures that the correct audio decoding algorithm is used on each input to the audio mixer and that any incoming data is sent to the broadcast unit or MLP processor as appropriate.

5.2.7.2 Outgoing BAS commands

The CPU ensures that the correct audio encoding algorithm is used on each output from the audio mixer, that the desired switching or summation has been performed in each case and that the desired switching (or mixing of video signals) has been made to each output of the VPU. It transmits VCF (see Recommendation H.230) to all relevant terminals at a set time before switching the video sent to them, and transmits VCU to a terminal whose video is about to be sent to another terminal; the procedure for this is set out in Recommendation H.243.

The CPU switches mode on outgoing streams to accommodate the appropriate combination of audio, video, and data, according to the declared capabilities of the connected terminals (see Recommendation H.243). Commands MCC, MCS, MCN are transmitted to effect the appropriate mode transmissions from connected primary terminals, so that audio, video and data occupy the same capacity on all primary ports. See also Recommendation H.243.

5.2.7.3 Incoming BAS capabilities

The capability codes from all N terminals are stored; whenever a new set is sent by a terminal, it replaces completely the previous set (exception: as a protective measure, encryption capability cannot be negated by sending a new capset with that value omitted).

5.2.7.4 Outgoing BAS capabilities

The values to be sent to each of the N ports are determined according to Recommendations H.243 and H.242.

5.2.7.5 Conference control processing

The conference control functions include selection of video signals to be transmitted (other than by voice-activation), selection of audio likewise, management of data tokens and the data transmission, assignment of terminal and MCU numbers, management of identity information, adding and dropping of terminals, and so on.

5.2.8 Multiplexer

The multiplexer sets up a frame structure on the outgoing channel(s) according to Recommendation H.221, and loads into this the BAS values from the CPU and the outputs of the APU, VPU and DPU.

6 Multipoint configurations

Star: All terminals connected to a single MCU; all primary terminals are connected at the same effective bit rate, being 64 kbit/s or a multiple up to 1920 kbit/s (rates defined in Annex A/H.221); secondary terminals may be connected at a lower rate.

Dumb-bell: Terminals are connected to one of two MCUs, which are themselves interconnected at the same effective rate as the primary terminals.

MCU star: Three or more MCUs may be connected in star configuration with terminals connected to each, the MCUs being interconnected at such a bit rate that the transfer rate can be at the same level as that between each MCU and the primary terminals. A chain of three MCUs is a degenerate case of the MCU star, and so is included in the definition thereof.

Hierarchical configurations: The MCU star is a second-order hierarchy; higher-order configurations may be formed by adding more MCUs at the periphery of the star, as exemplified in Figure 3.

T1518820-95/d03

MCU

Terminal
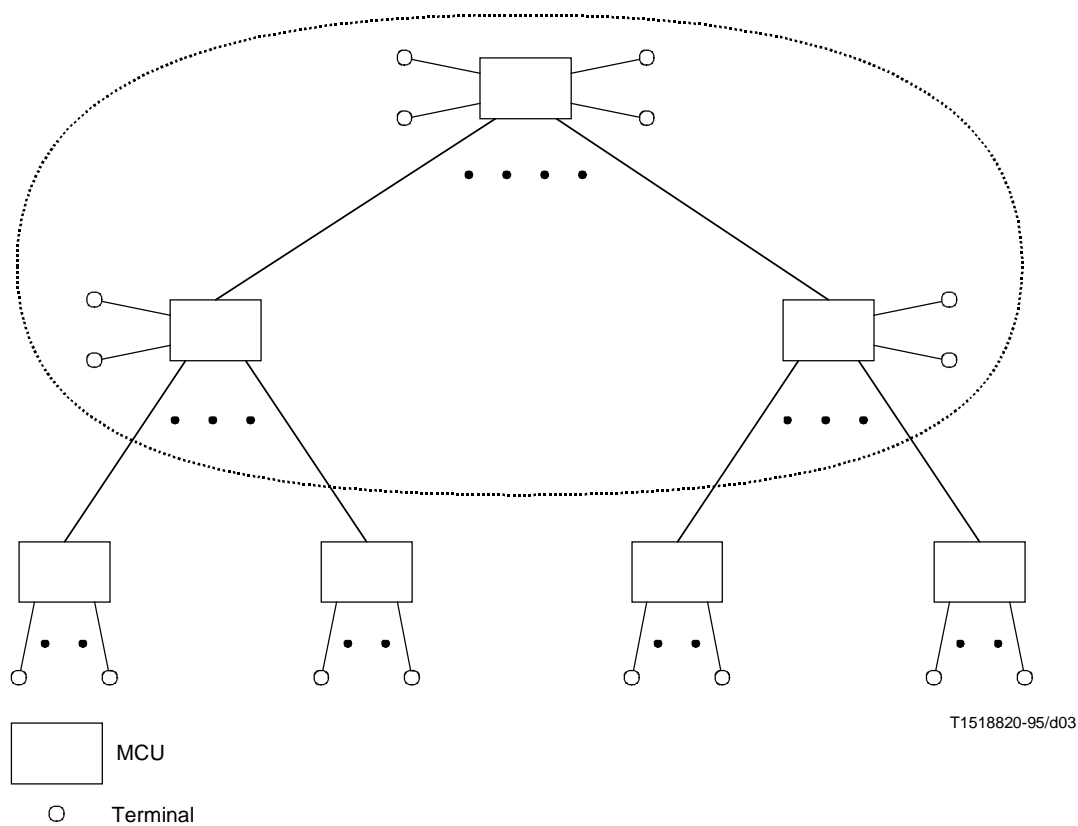
Figure 3/H.231 – MCU hierarchical configuration

Each link of a multipoint call is set up using the standardized point-to-point procedures of Recommendation H.320. Additional in-band provisions are described in Recommendation H.243.

7 Multipoint control unit characteristics and classification

7.1 Conformance

MCUs intended for use with terminals conforming with Recommendations H.221/230/242 must themselves conform to these Recommendations, and with the procedures set out in Recommendation H.243.

7.2   Classification of MCUs

A wide variety of MCUs can be envisaged, according to the many different options available within the provisions of this Recommendation. Table 1 lists the various attributes and parameters which an MCU may possess, and by means of which it may be classified; the manufacturer should specify all of the properties which the unit possesses and the conditions under which they may be activated. Most of the attribute values are not themselves mandatory, but where they are provided it is mandatory that the procedures of Recommendation H.243 be adhered to. These attributes, numbered in the left-hand column of Table 1, are elaborated in 7.3 and 7.4 below, cross-referenced as [1], etc. The MCU attributes must be such as to handle the signals of the terminals with which it is intended to be used.

7.3   Summary of MCU BAS capabilities

NOTE 1 – This subclause is concerned with the internal capabilities of the MCU (the BAS-capabilities declared at any time towards a particular terminal should normally take into account those of the terminals connected – see Recommendation H.243); these are a function of the physical properties of the MCU and any software selections (made automatically or by human intervention).

a)   Audio: An audio-mixing MCU intended for inter-regional operation must be able to encode and decode G.711 A-law and μ-law, and may also optionally handle other audio modes from A.5/H.221. An audio-switching MCU does not decode any audio signals; internally generated messages may be transmitted as G.711 or by other audio algorithms if appropriate [6, 6.1, 6.2].

NOTE 2 – If an MCU is not equipped with both A- and μ-law decoding it may be impossible for terminals in another region to access it.

b)   Video: An MCU may or may not be able to handle video. If it does so by switching, the different video capabilities defined in Recommendation H.221 declared by the terminals must be taken into account in determining those to be declared by the MCU, though it may have inherent video-mode capabilities of its own. Various video algorithms such as H.261, H.262, and H.263 may appear in the MCU capability set, either because terminals with such capabilities are in the conference, or because a video-mixing MCU supports these algorithms. An MCU shall support video algorithms according to the hierarchy of H.242, but need not support this hierarchy at all times. For example, an MCU may put H.263 in the conference SCM and make H.261-only terminals secondary for a particular conference, but the MCU shall support H.261 for other conferences. If an MCU supports video mixing, it may operationally put only a single video capability in the SCM, but shall still support the video algorithm hierarchy of H.242 [7, 7.1].

c)   Transfer rate: An MCU may have any of the capability values defined in Recommendation H.221 [5].

d)   Restricted-network capability: An MCU connected to a network whose B-channels are effectively restricted to $p \times 56$ kbit/s (p = 1 to 24), or whose channels at 128 or higher are restricted by ones-density considerations, must declare capabilities as given in Recommendation H.221 and Recommendation H.242. All MCUs intended for interworking with terminals or MCUs on such restricted networks must have the capability to respond to appropriate restrict commands and capabilities according to Recommendations H.221 and H.242 [4.2].

e)   Data (except MLP): The MCU may or may not be capable of broadcasting data at rates up to the highest transfer rate, and may so indicate by means of the appropriate capability codes defined in Recommendation H.221 [8.1].

f)   MLP: The MCU may or may not be capable of handling MLP at rates up to the highest transfer rate, and may so indicate by means of the appropriate capability codes defined in Recommendation H.221 [8.2, 13.2].

g)   Encryption: See Recommendations H.233/H.234 [9].

h)   MBE capability: This is required for some multipoint functions (see Recommendation H.243) [16].

i)   Non-T.120 chair-control capability: The MCU may or may not be able to provide terminal numbering and the means for one terminal to control video switching, connection-dropping, etc. (see Recommendation H.243) [13.1].

Examples:

i)   A simple ISDN MCU might well possess the following capabilities:

[H.261, G.722-48 + G.728, switched video, Transfer-rate 1B and 2B and 128, LSD up to 6.4 kbit/s].

ii)   An audiographic MCU might be: [G.722-48, Transfer-rate 1B, LSD up to 14.4 kbit/s, MLP, MBE].

iii) A videoconference MCU might be: [H.261, H.263, G.722-48, switched video, Transfer-rate 2B and H0, HSD 64 kbit/s].

7.4   Other attributes

a)   Ports and configurability: A physical MCU equipment may be capable of handling several simultaneous independent conferences, with limitations as to number of possible connections to terminals and to other MCUs [1, 2, 3].

b)   Network aspects: An MCU may be designed for connection to various types of digital networks, with various call-control arrangements, including the possibility of using the same network address for all incoming connections to a given conference [4.1, 13].

c)   Communication mode selection: Various possibilities exist for the method of selection of "Selected Communication Mode" (see Recommendation H.243) and the resultant treatment of connected terminals as "primary" or "secondary" [10, 11].

d)   Terminal identification: An MCU may or may not be able to request, accept and process alphanumeric strings from connected terminals for identification purposes (see Recommendation H.243) [15].

e)   Cascading: An MCU may be capable of operating with another MCU to provide "cascaded" operation. Cascading may be limited to two MCUs per conference, or may extend to a "star" configuration, and finally to a multi-level hierarchy. Two mechanisms for cascading exist:

i)   fixed rates ("simple") [14.1];

ii)   master/slave operation, required for many features such as terminal numbering [14.2].

8   "Listed" multipoint control units

Table 1 lists the present set of attributes, as well as possible values for certain attributes, that can be associated with a multipoint control unit. Table 1 is meant to act as a guide to users to determine what attributes an MCU could possess and is not exhaustive.

Given the very wide range of possible MCU properties and capabilities, it is appropriate to identify a rather narrower range which can be referred to for clarity and convenience, without any implication that other conformant MCUs are in any way non-standard. This narrower range is more exactly defined and understood, and applicable to fairly common service implementations using terminals which may be widely available and not highly specialized. The listed MCUs are presented in Table 2.

The listed MCUs have relatively few options. Manufacturers may include in a given product one (or more) of the listed types, thus assuring a customer of a known range of behaviour when used with equipment from other manufacturers; "enhancements" of various types could also be included and would themselves be in conformance with available Recommendations, but the behaviour when used with other equipment might be less predictable or give problems of complexity at the human-machine interface.

9 Terminal requirements and options

All terminals must conform to the provisions of Recommendations H.221, H.230 and H.242.

A terminal intended for chair-control operation (see Recommendation H.243) must be able to transmit BAS codes and provide other functions as described in 9.1/H.243.

Table 1/H.231 – MCU attributes

		Attribute	Possible values
1		Maximum number of terminals that can be connected to a single MCU	3, 4, 5 ...
2		Maximum number of concurrent (independent) conferences that can be supported in a single MCU	1, 2, 3 ...
3		Maximum number of ports that can be connected to other MCUs [if non-zero state whether item (1) is dependent]	0, 1, 2 ...
4.1		Network interfaces at each port (if not all the same, give details)	BRI, PRI, E1/T1/J1, ATM, other
4.2		Restricted network capability	Restrict_Required, Restrict_P, Restrict_L,No_Restrict
5		Transfer rates available at each port (if not all identical, give details)	Any capability values from Rec. H.221
6		Audio processor	Mandatory
6.1		Mixed/switched (give details)	Mixed; auto- or user-switched (see [13.2])
		Noise/echo suppression on "silent" ports	Give details
6.2		audio algorithm at each port Rec. G.711 Rec. G.728 Rec. G.722	 Yes/No Yes/No Yes/No
7		Video processor (moving pictures)	No/Yes (details below)
7.1		Switched/mixed (give details)	Switched automatically (speech power basis)/user-control (see [13.2]), mixed
7.2		Video algorithm at each port Rec. H.261 Rec. H.262 Rec. H.263	 Yes/No Yes/No Yes/No
8		Data processor	
8.1		Data broadcast facility, LSD	No/Yes + rates from Rec. H.221
		Data broadcast facility, HSD	No/Yes + rates from Rec. H.221
8.2		MLP processor	No/Yes + rates from Rec. H.221
9		Encryption	Not supported, supported (details, algorithm, etc.)
10		Method of choosing Selected Communications Mode (SCM)	Preset by manufacturer (give values) Set by operator input (give range) Set by user (give range) (see [13.2]) Auto-set according to conn. terminals (details)

Table 1/H.231 – MCU attributes *(concluded)*

	Attribute	Possible values
11	Can deal with secondary terminals	Yes/No + details
12	Call set-up provision(s)	Non-reservation/reservation (+ details) Auto-answer at all ports (give numbering system) Operator set-up Dial out
13	Control capabilities	
13.1	Numbering of terminals Simple chair control using BAS	Yes/No Yes/No
13.2	MLP facilities [refer to ITU-T T-series]	No/Yes
13.3	H.224 (simplex data)	H.224_LSD, H.224_HSD, H.224_MLP, H.224_sim
14	Cascading	Yes/No
14.1	Fixed rates ("simple")	Yes/No
14.2	Master/slave	Yes/No
15	Terminal identification	No/TCI/TCS
16	MBE capability	Yes/No

Table 2/H.231 – Listed MCUs

	Attribute	MCU Type and values						
		A	**B(d)**	**C**	**C2**	**C(d)**	**D**	**D(d)**
1	Maximum number of terminals that can be connected to a single MCU							
2	Maximum number of concurrent (independent) conferences that can be supported in a single MCU							
3	Maximum number of ports that can be connected to other MCUs [if non-zero, state whether item [1] above is dependent]							
4.1	Network interfaces at each port (if not all the same, give details)							
4.2	Restricted network capability							
5	Transfer rates available at each port	64k	64k	2B	2B	2B	H0	H0
6	Audio processor							
6.1	Mixed/switched (give details) Noise/echo suppression on "silent" ports	switched	switched	switched	switched	switched	switched	switched
6.2	Audio algorithm at each port	G.728 + G.711	G.722 + G.711	G.722 + G.728 + G.711	G.728 + G.711	G.722 + G.728 + G.711	G.722 + G.711	G.722 + G.711
7	Video processor (moving pictures)	Yes	a)	Yes	Yes	Yes	Yes	Yes
7.1	Switched/mixed (give details)	switch	a)	switch	switch	switch	switch	switch
7.2	Video algorithm at each port	H.261	a)	H.261	H.261	H.261	H.261	H.261
8	Data processor	a)	Yes	a)	a)	Yes	a)	Yes
8.1	Data broadcast facility, LSD Data broadcast facility, HSD		up to 14.4k a)			up to 14.4k a)		b) b)
8.2	MLP Processor	a)	a)	a)	a)	a)	a)	a)
9	Encryption	a)	a)	a)	a)	a)	a)	a)
10	Method of choosing Selected Communications Mode (SCM)							

Table 2/H.231 – Listed MCUs *(concluded)*

	Attribute	MCU Type and values						
		A	**B(d)**	**C**	**C2**	**C(d)**	**D**	**D(d)**
11	Can deal with secondary terminals as audio only	Yes	Yes	Yes	Yes	Yes	Yes?	Yes?
12	Call set-up provision(s)							
13	Control capabilities							
13.1	Numbering of terminals	a)	a)	a)	a)	a)	a)	a)
	Simple chair control using BAS	a)	a)	a)	a)	a)	a)	a)
13.2	MLP facilities	a)	a)	a)	a)	a)	a)	a)
13.3	H.224 (simplex data)	a)	a)	a)	a)	a)	a)	a)
14	Cascading	a)	a)	a)	a)	a)	a)	a)
15	Terminal identification	a)	a)	a)	a)	a)	a)	a)
16	MBE capability	a)	a)	a)	a)	a)	a)	a)

a) Means that when set to work as the listed type, such facilities, if present, are disabled. Where there is no entry, implementers are free to use appropriate options.

b) LSD and HSD maximum rates are for further study.

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