



INTERNATIONAL TELECOMMUNICATION UNION

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**H.281**

(11/94)

**TRANSMISSION OF NON-TELEPHONE SIGNALS**

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**A FAR END CAMERA CONTROL PROTOCOL  
FOR VIDEOCONFERENCES USING H.224**

**ITU-T Recommendation H.281**

(Previously "CCITT Recommendation")

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## FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation H.281 was prepared by ITU-T Study Group 15 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 1st of November 1994.

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## 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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## **SUMMARY**

The Recommendation describes how a far end camera control system for H.320 terminals can be operated based on H.224 running on LSD, HSD, or MLP as a lower layer for both point-to-point and multipoint operation.

## A FAR END CAMERA CONTROL PROTOCOL FOR VIDEOCONFERENCES USING H.224

(Geneva, 1994)

### 1 Scope

This Recommendation covers the elements of procedure and format of fields to support a Far End Camera Control (FECC) protocol layered over the Data Link protocol covered in Recommendation H.224. The FECC protocol is designed to operate in both point-to-point and multipoint simplex modes, using the H.224 link layer protocol. A major requirement of the Far End Camera Control application is for both minimum variation in delay as well as minimal absolute delay.

This FECC protocol, together with Recommendation H.224, allows each camera in a multipoint video conference to be individually controlled from any video terminal.

The FECC protocol shall require of the H.224 link layer that, if both the LSD and HSD channels are in use for H.224, all FECC data be transmitted on the LSD channel only. This will ensure that FECC data is received in the order in which it is transmitted.

### 2 Normative 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.

- ITU-T Recommendation H.224, *A Data Link Layer for simplex applications using the H.221 LSD/HSD/MLP channels*.
- ITU-T Recommendation H.261 (1993), *Video Codec for Audiovisual Services at  $p \times 64$  kbit/s*.
- CCITT Recommendation T.50 (1984), *International Alphabet No. 5*.

### 3 Definitions

For the purposes of this Recommendation, the following definitions apply:

**3.1 simplex protocol:** A communication protocol that is purely one-way, and where acknowledgements are not part of any application protocol. Error control is either not provided, or is accomplished via forward error correction.

**3.2 client:** An entity that uses the data transfer services of the Data Link layer. Far End Camera Control is an example of such a client.

**3.3 client management entity:** A data link client that uses Client ID  $0 \times 00$  to send a complete list of locally registered clients and their optional extra capabilities. See Recommendation H.224 for additional information.

**3.4 FECC commands:** Atomic requests to act on a remote camera. Examples of FECC Commands include: Start Camera Action, Continue Camera Action, Stop Camera Action and Select Video Source.

**3.5 PTZF:** Pan, Tilt, Zoom, and Focus – the four basic camera movements supported by this protocol.

**3.6 room preset:** Information that may be used to select a video source, and then control the video source to provide the desired view. Support for Room Presets is an extra capability and is announced in the extra capabilities message sent by the H.224 CME. The ability to provide presets is optional and may not be supported in all terminals.

**3.7 activate preset:** A command that requests a terminal switch to the video source specified by the room preset and position the video source to provide the view specified by the room preset. An Activate Preset command may be issued by a user local to a video teleconferencing terminal, or remotely by a user at another terminal. For the purposes of this Recommendation, we assume an Activate Preset is issued remotely.

**3.8 ASCII:** Characters coded as in International Alphabet No. 5 as defined in Recommendation T.50, with bit 8 set to zero.

**3.9 normal resolution still image:** A still image transmitted in the H.261 video stream encoded to the same resolution as the previous motion video (i.e. QCIF or FCIF). This mode uses bit 2 “Document Camera Indicator” as defined in 4.2.1.3/H.261.

**3.10 double resolution still image:** A still image transmitted in the H.261 video stream encoded to twice the horizontal and twice the vertical resolution as the previous motion video (i.e. FCIF or 4\*FCIF). This mode uses bit 5 “Hi\_Res” as defined in 4.2.1.3/H.261 and Annex D/H.261.

## 4 Abbreviations

CIF Common Intermediate Format. (See Recommendation H.261 for more information).

CME Client Management Entity.

FCIF Full CIF. (This is the same as CIF).

QCIF Quarter CIF. (See Recommendation H.261 for more information).

## 5 Elements of Procedure

The FECC protocol has the following basic messages types:

- START ACTION – Requests for each of the three camera axis of movement.
- CONTINUE ACTION – Requests for each of the three camera axis of movement.
- STOP ACTION – Requests for each of the three camera axis of movement.
- SELECT VIDEO SOURCE – Requests a switch to the indicated video source for encoding and transmission.
- STORE PRESET – Requests the current video source and its current spatial parameters are stored in the indicated preset number.
- ACTIVATE PRESET – Requests the indicated preset is used to select the video source and set its spatial coordinates.

## 5.1 Action messages

START ACTION messages have an associated action parameter and a time out value. The action parameter indicates what camera motion (from the set of PTZF) is desired, and which direction is desired. CONTINUE ACTION messages and STOP ACTION messages also have the same associated action parameter. A CONTINUE ACTION message with an action parameter matching the previous START ACTION shall restart the time out period. A STOP ACTION message with an action parameter matching the previous START ACTION causes the camera positioning to stop. (The minimum duration for the START ACTION command is left to the discretion of the manufacturer based on camera parameters. This minimum duration shall ensure that some motion does occur.) If the time out occurs, the receiving FECC client shall act as though a STOP ACTION message with the appropriate action parameter has been received. Any subsequent CONTINUE or STOP action messages shall be discarded until a new START ACTION message is received. The time out value sent in an initial START ACTION message protects against the possible loss of the final STOP ACTION request. Any CONTINUE ACTION message or STOP ACTION message with an action parameter that does not match the immediately preceding START ACTION message shall be discarded.

Continuous camera motion is achieved through use of an initial START ACTION message followed by a series of zero or more CONTINUE ACTION messages, and terminated by a STOP ACTION message. The time interval between transmission of any two consecutive messages in this sequence shall not exceed the time out value specified in the START ACTION message minus 200 milliseconds. If continuous motion is desired, the time out value must therefore be set to 250 milliseconds or greater.

The action parameter of a START ACTION message may indicate multiple motions in the same command (for example, Pan Right and Tilt Up). Any CONTINUE ACTION message or STOP ACTION message shall have an action parameter matching all the motion attributes of the preceding START ACTION message. After a valid START ACTION message has been received, and possibly followed by any number of matching CONTINUE ACTION messages, a new START ACTION message may be issued with a different action parameter. This new START ACTION message shall be interpreted as a valid STOP ACTION message for any motion that is no longer set, and shall be interpreted as a valid CONTINUE ACTION message for any motion that continues to be set, and shall be interpreted as a valid START ACTION message for any new motion that is indicated by the action parameter. Implementers shall ensure that once a terminal starts acting on camera commands from one remote terminal, camera commands from other remote terminals are discarded until motion from the first camera stops. The data link protocol (see Recommendation H.224) provides both source and destination addresses on messages to allow this interlocking.

## 5.2 Action message examples

An example of a valid camera sequence may help to illustrate the proper use of the protocol. A START ACTION message indicating Pan Right and Tilt Up may be issued, followed by any number of CONTINUE ACTION messages also specifying Pan Right and Tilt Up. These messages may be followed by another START ACTION message specifying Pan Right only. Any number of CONTINUE ACTION messages specifying Pan Right may then be issued. Another START ACTION message may then be sent specifying Pan Right and Tilt Down, which in turn is followed by any number of CONTINUE ACTION messages specifying Pan Right and Tilt Down. Finally a STOP ACTION message specifying Pan Right and Tilt Down is issued to terminate far end control of the camera. In this example the Pan Right action is continuous while the Tilt Up action is only valid for the first part of the camera control. Similarly, the Tilt Down action is only valid for the last part of the camera control. The use of multiple camera controls simultaneously is optional for terminals both sending and receiving FECC requests. Any terminal not equipped to handle simultaneous camera motion commands shall operate on one or more of the commands and disregard the others. The choice of axes in which to move is arbitrary. (The far end user will see one or more of the camera requests acted upon and then may send the other motion commands later.)

### **5.3 Select video source**

A SELECT VIDEO SOURCE message has an associated video source and video mode parameters. On receipt of the SELECT VIDEO SOURCE message the terminal shall check for the validity of the video source and for the validity of the video mode for this source. If either parameter is invalid, the receiving terminal shall discard the message without further action. If the parameters are valid and the chosen video mode is motion video, then the receiving terminal shall change its video selector so the requested video source is sent to the video encoder and transmitted. This selected video source and mode shall remain in effect until another valid SELECT VIDEO SOURCE message is received, or until a user changes the mode locally. If the parameters are valid and the mode requests a still image transmission (either using normal resolution or double resolution), the receiving terminal shall switch the video source and code a single still image frame for transmission in the H.261 video stream. After sending the single still image the video selector is switched back to the previously chosen video source for encoding and transmission.

### **5.4 Select video source examples**

The use of SELECT VIDEO SOURCE may be best illustrated by examples. In the first example let us assume the main camera is sending motion video to the H.261 encoder for transmission. Receiving a SELECT VIDEO SOURCE message requesting a normal resolution still image from a 35 mm slide projector, would cause acquisition and H.261 encoding of that frame. Automatically the video selector would revert back to the main camera sending motion video when the still image coding and transmission is completed.

In the next example let us assume the main camera is sending motion video to the H.261 encoder for transmission. Receiving a SELECT VIDEO SOURCE message requesting motion video from a document camera would cause the video selector to choose the document camera for encoding and transmission. A subsequent SELECT VIDEO SOURCE command requesting a double resolution still image from the document camera would cause acquisition and H.261 encoding of that frame in the higher resolution mode. Automatically the video selector would revert back to the document camera sending motion video (as the last selected motion video source) when the still image coding and transmission is complete.

### **5.5 Store preset**

A STORE PRESET message has an associated preset number as a parameter. If this optional feature is provided, the receiving terminal is requested to store the current video source and information about its spatial coordinates (i.e. pan, tilt, zoom, and focus information) into the preset location indicated by the preset number. (We note that Recommendation H.224 does not guarantee delivery of messages. To help assure reliable message delivery, manufacturers may choose to repeat this message.)

### **5.6 Activate preset**

An ACTIVATE PRESET message has an associated preset number as a parameter. If this optional feature is provided, the receiving terminal positions the video source associated with the preset to the stored spatial coordinates (i.e. pan, tilt, zoom, and focus), and switches the video selector to choose this video source.

### **5.7 General**

It is recommended that FECC messages are sent as HIGH PRIORITY datagrams to the underlying Data Link layer.

All FECC messages are requests with no response required over the communication link. This allows for operation over a simplex transmission link. Visual feedback of the change in camera placement enables the FECC message sender to determine when to stop updating along any specific camera axis. Because visual feedback is used, timely delivery of messages is necessary for proper operation.



## 6 FECC message structure

START ACTION type messages (see Figure 1) have an associated time out value octet. A CONTINUE message matching the original START ACTION shall reset the time out period.

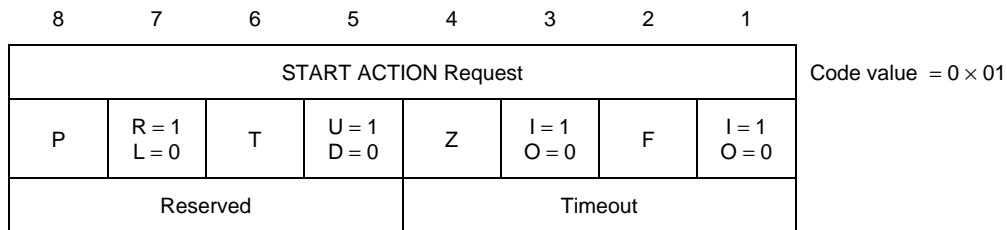


FIGURE 1/H.281

### START ACTION message

The arguments required for each command are detailed in the following paragraphs:

A Start Action command: axis to move and direction (i.e. Pan right/left, Tilt up/down or Zoom in/out; set PTZF bits to 1 to start motion on that axis). For example, a START ACTION message with P = 1/L = 0 T = 0/U = 0 Z = 0/I = 0 and F = 0/O = 0 (0 × 80) will cause the remote camera to begin panning to the left. As another example, a START ACTION message with P = 0/R = 0 T = 1/U = 1 Z = 0/I = 0 and F = 0/O = 0 (0 × 30) will cause the remote camera to begin tilting upward. Note that more than one action may be specified to occur at the same time. Note also that if the P/T/Z/F bits are not set, the direction bit is ignored. Thus, in the first example given, P = 1/L = 0 T = 0/U = 1 Z = 0/I = 1 and F = 0/O = 1 (0 × 95) would have the same effect as (0 × 80) since only the Pan(P) bit is evaluated.

Time out value is a 4-bit binary number expressed in 50 milliseconds intervals. For example, the binary pattern 1000 represents 400 milliseconds. A time out value of zero means 800 milliseconds.

A Continue Action command (see Figure 2): axis to move and direction.

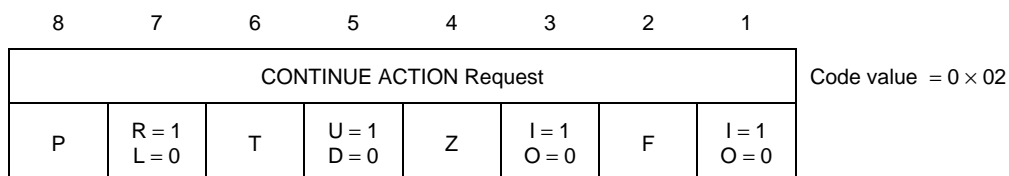


FIGURE 2/H.281

### CONTINUE ACTION message

A Stop Action command (see Figure 3): axis to move and direction.

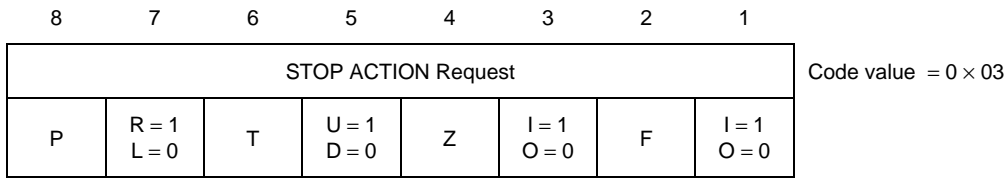


FIGURE 3/H.281

**STOP ACTION  
message**

Note that the direction bits (R/L, U/D, I/O, I/O) immediately following the action bits (P/T/Z/F) are ignored in the Stop Action command.

A Select Video Source command (see Figure 4): the number of the video source to use for encoding and transmission.

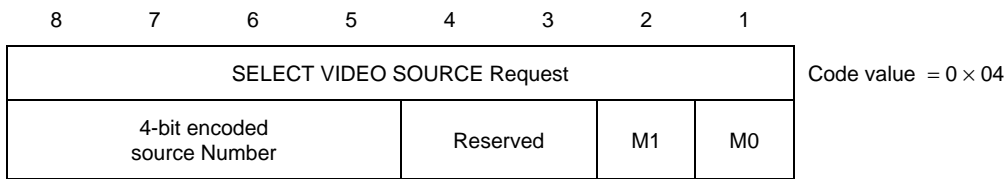


FIGURE 4/H.281

**SELECT VIDEO SOURCE  
message**

M1 and M0 convey the binary coding for the mode to be used on activation of the video source (M1 = 0, M0 = 0 for motion video; M1 = 1, M0 = 0 for normal resolution still image; and M1 = 1, M0 = 1 for double resolution still image).

Optionally a terminal may broadcast that it has switched its video source (see Figure 5), if it has declared that it will do so in the initial FECC capability.

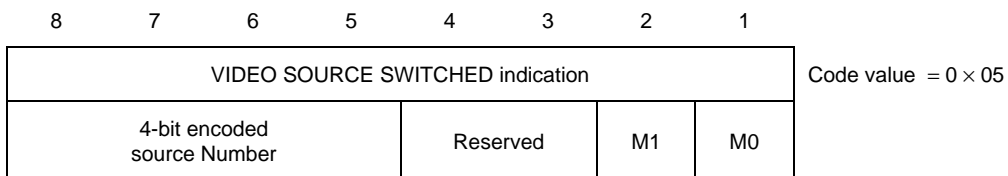


FIGURE 5/H.281

**VIDEO SOURCE  
SWITCHED message**

A Store Preset command (see Figure 6): preset number to hold the video source number and its current spatial coordinates

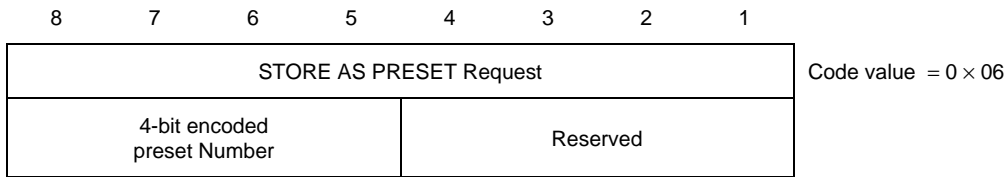


FIGURE 6/H.281

**STORE AS PRESET message**

Activate Preset command (see Figure 7): preset number used to select the video source and to change its spatial coordinates

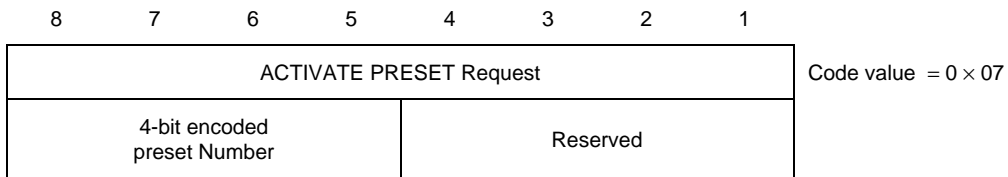


FIGURE 7/H.281

**ACTIVATE PRESET message**

**6.1 FECC capabilities fields**

The FECC Client capabilities are sent by the H.224 Client Management Entity in the form of a CME Extra Capabilities message. The FECC client at time of registration with the H.224 layer shall submit a data block encoded as per the following field formats. The first field is an octet indicating the number of presets supported by this terminal. This is followed by a description of the capabilities of each camera present at this site. The fields required to describe basic camera capabilities are Camera number, indication of the ability to send motion video using this camera, and indication of the ability to send normal resolution still images using this camera, an indication of the ability to send double resolution still images with this camera, the ability to Pan, the ability to Tilt, the ability to Zoom, and the ability to Focus this camera. Any video source omitted from the capabilities set shall be assumed to not be present.

Video Sources 0 through 5 are preassigned to the following devices:

- 0 Default – Current Video Source;
- 1 Main Camera;
- 2 Auxiliary Camera;
- 3 Document Camera;
- 4 Auxiliary Document Camera;
- 5 Video Playback Source (such as a Video Cassette Recorder).

The first octet (see Figure 8) describes the number of presets supported.

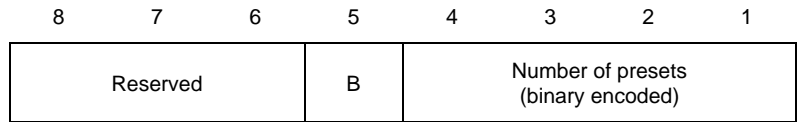


FIGURE 8/H.281

**Number of presets octet**

B bit is set to logic 1 if terminal will broadcast that it has switched video sources.

To describe these standard video sources in the capabilities message, only the Video Source number and its capabilities need to be specified (see Figure 9). The capabilities that may be specified are motion video, normal resolution still images, double resolution still images, Pan, Tilt, Zoom, Focus, and the number of presets associated with this video source. A 1 in any of these bit positions indicates the camera has this capability. A 0 indicates the camera does not have this capability.

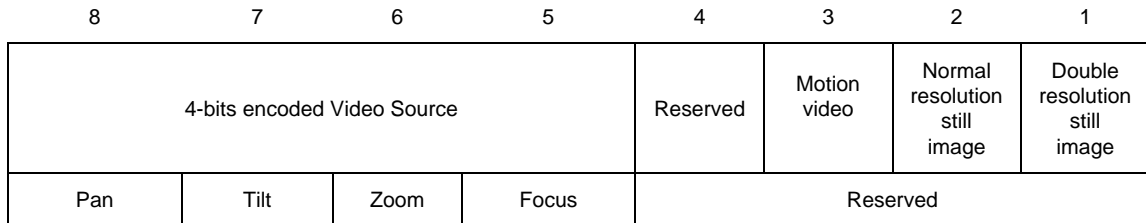


FIGURE 9/H.281

**Standard video source capabilities**

Video Sources 6 through 15 may be assigned to other devices. To describe these devices using the capabilities field requires specifying the number of the video source, followed by a variable length ASCII string (with a maximum length of 16 characters) identifying the type of camera (the ASCII string is terminated with all zeros byte), followed by a list of the capabilities (see Figure 10). The capabilities that may be specified are motion video, normal resolution still images, double resolution still images, Pan, Tilt, Zoom, Focus, and the number of presets associated with this video source.

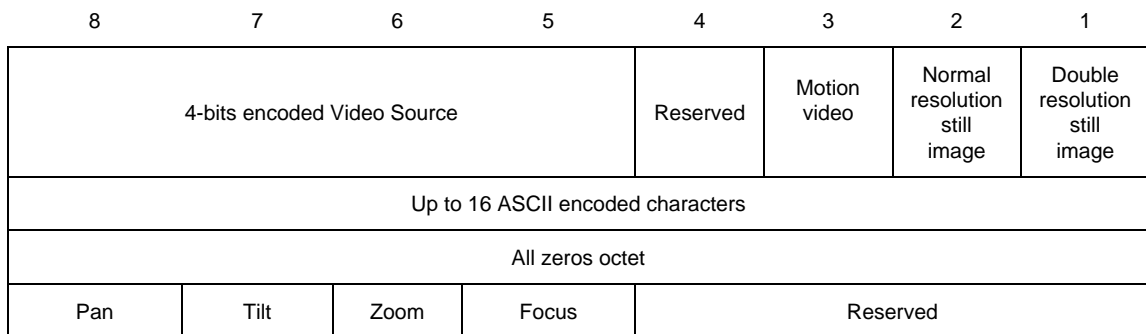


FIGURE 10/H.281

**Capabilities for video sources 6 through 15**