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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Broadband, triple-play and advanced multimedia services – Advanced multimedia services and applications

Architecture for mobile visual surveillance

Recommendation ITU-T H.626.1

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Recommendation ITU-T H.626.1

Architecture for mobile visual surveillance

Summary

The purpose of Recommendation ITU-T H.626.1 is to define architecture, functional requirements, entities, reference points and service control flow for visual surveillance systems with mobile units. The mobile visual surveillance system provides the display and storage of multimedia, such as video, audio, and images, captured by multiple remote cameras over an IP network for consumption by mobile users. It also provides other functionalities such as remote control, alarming and linkage actions, recording and playback.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.626.1	2013-03-16	16

Keywords

Alarming, architecture, camera, mobile visual surveillance, PTZ control, recording and playback.

FOREWORD

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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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1 Scope

The visual surveillance (VS) service is a telecommunication service focusing on audio and video application technology that is used to remotely capture multimedia (such as video, image, audio and various alarm signals) and present them to the end user in a friendly manner, based on a managed broadband network with ensured quality, security and reliability.

This Recommendation focuses on the architecture of a visual surveillance system with mobile units, as well as on the service flow related to mobile units, such as a mobile customer unit (M_CU), accessing real-time video streams from a visual surveillance system. This Recommendation defines the architecture, functional requirements, model, entities and reference points of the mobile visual surveillance system, based on the architecture defined in [ITU-T H.626].

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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T F.743] Recommendation ITU-T F.743 (2009), *Requirements and service description for visual surveillance.*

[ITU-T H.626] Recommendation ITU-T H.626 (2011), *Architectural requirements for visual surveillance.*

[ITU-T H.627] Recommendation ITU-T H.627 (2012), *Signalling and protocols for visual surveillance*.

[ITU-T M.60] Recommendation ITU-T M.60 (1993), *Maintenance terminology and definitions.*

[ITU-T Y.101] Recommendation ITU-T Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions*.

[ITU-T Y.110] Recommendation ITU-T Y.110 (1998), *Global Information Infrastructure principles and framework architecture.*

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.

[IETF RFC 2326] IETF RFC 2326 (1998), *Real Time Streaming Protocol (RTSP)*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [ITU-T Y.101]: A structured set of capabilities, which provide value-added functionality supported by one or more services.

3.1.2 customer [ITU-T M.60]: An entity which receives services offered by a service provider based on a contractual relationship. It may include the role of a network user.

NOTE – In this Recommendation, Customer has the same meaning as End User.

3.1.3 customer unit [ITU-T H.626]: A device located at the customer part of a visual surveillance system and used to present multimedia information (such as audio, video, image, alarm signal, etc.) to the end user.

3.1.4 functional architecture [ITU-T Y.2012]: A set of functional entities and the reference points between them used to describe the structure of an NGN. These functional entities are separated by reference points, and thus they define the distribution of functions.

NOTE 1 – The functional entities can be used to describe a set of reference configurations. These reference configurations identify which reference points are visible at the boundaries of equipment implementations and between administrative domains.

NOTE 2 – The definition is not only applicable to NGN, but also to other IP packet switch-based networks.

3.1.5 functional entity [ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.6 interface [ITU-T Y.101]: A shared boundary between two functional units.

NOTE – An interface is defined by various characteristics pertaining to the functions, physical interconnections, signal exchanges and other characteristics as appropriate.

3.1.7 media [ITU-T Y.101]: Plural of medium.

3.1.8 medium [ITU-T Y.101]: a) Specific physical support for transmission or storage of information; b) Type of presentation of information (i.e., video, audio, text, etc.).

3.1.9 premises unit [ITU-T H.626]: A device located at the remote part of a visual surveillance system and used to capture multimedia information (such as audio, video, image, alarm signal, etc.) from a surveilled object.

3.1.10 reference point [ITU-T Y.2012]: A conceptual point at the conjunction of two non-overlapping functional entities that can be used to identify the type of information passing between these functional entities.

NOTE – A reference point may correspond to one or more physical interfaces between pieces of equipment.

3.1.11 role [ITU-T Y.110]: The role is a business activity which fits in a value chain. The role is constrained by the smallest scale of business activity which could exist independently in the industry and so a marketplace will exist for every relationship between roles.

3.1.12 service [ITU-T Y.101]: A structure set of capabilities intended to support applications.

3.1.13 service platform [ITU-T H.626]**:** A series of devices and subsystems located at the central part of a visual surveillance system. It is used to integrate all of the capabilities and provide visual surveillance services to customers. The main functions include service control function, media switching, distribution, storage, control and management functions.

3.1.14 surveillant [ITU-T H.626]: An individual performing surveillance.

3.1.15 surveilled object [ITU-T H.626]: The target (such as site, human, and related environment) on which surveillance is performed.

3.1.16 visual surveillance [ITU-T H.626]: A telecommunication service focusing on video (but including audio) application technology, which is used to remotely capture multimedia (such as audio, video, image, alarm signal, etc.) and present them to the end user in a user friendly manner, based on managed broadband network with ensured quality, security and reliability.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 mobile customer unit (M_CU): Mobile client software installed in a customer's mobile devices. The M_CU is used to initiate the service and provide customers with video viewing.

3.2.2 mobile service portal (MSP): A series of devices and subsystems located at the central part of a mobile visual surveillance system. The MSP is the business application platform of the mobile visual surveillance system. Its main functions include a unified access entrance to the business entrance of user authentication and the display list of users' monitoring permissions. The MSP can carry out user authentication, query the list of monitoring permissions, synchronize user account information, and assist service management through the exchange of information with the centre managing unit (CMU).

3.2.3 packet-switched streaming service (PSS): A device located at the central part of a mobile visual surveillance system. The PSS is the stream media server that processes media stream distribution between the M_CU and the VAU. The main functions of the PSS include: responding to the service request message sent by the M_CU; receiving the real-time media stream from the VAU; and distributing the stream to multiple M_CUs.

3.2.4 video access unit (VAU): A device located at the central part of a mobile visual surveillance system. The VAU is used to implement communication between the mobile customer unit (M_CU) and the units defined in [ITU-T H.626]. The VAU's main functions include: requesting the CMU for scheduling information to be used to establish the media session between the media distribution unit (MDU) and the packet-switched streaming service (PSS); processing requests from the agent mobile customer unit for control of pan/tilt/zoom (PTZ); and distributing and transcoding multimedia data.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAA Authentication, Authorization and Accounting

CMU Centre Management Unit

CU Customer Unit

M_CU Mobile Customer Unit

MDU Media Distribution Unit

MSP Mobile Service Portal

MSU Media Storage Unit

PTZ Pan/Tilt/Zoom

PU Premises Unit

PSS Packet-switched Streaming Service

RTSP Real Time Streaming Protocol

SCU Service Control Unit

VAU Video Access Unit

VS Visual Surveillance

5 Functional requirements

There are new functional requirements in order to provide end users with the necessary functions to use mobile terminals to access visual surveillance systems.

5.1 Video/audio acquisition

A mobile terminal can view the list of authorized premises units (PUs) and status once it has registered its username and password with the mobile service portal (MSP).

The mobile customer unit (M_CU) then obtains the information about the video access unit (VAU) and receives the real-time video stream from the VAU. At the same time, the M_CU can perform operations of pause, resume and reload.

5.2 Instant image snapshot

The instant image snapshot function is one of the basic capabilities of VS. It is used to obtain instant image information based on video of the object under surveillance by the M_CU, when users are watching live surveillance video by the M_CU in a mobile terminal.

5.3 Recording and playback

The recording function is one of the basic capabilities of VS. It is used to record multimedia (such as video, audio and image) information about surveilled objects and store these multimedia files under user control in the mobile terminal.

The playback function is an operation mode of media play that is used to play video, audio and image recordings which have been stored according to previously entered customer favourites.

5.4 PTZ control

The PTZ control function is used to pan, tilt and zoom (PTZ) a video camera, switch auxiliary peripherals, such as flashlight, fan and rain brush, and preset the position of related physical devices. Authenticated users can operate PTZ functions via the M_CU in a mobile terminal.

5.5 Alarming and triggered action

The alarming and triggered action function is one of the basic capabilities of VS. It is used to respond to an input alarm signal event, give an output alarm activity and trigger the related actions. When the alarm event occurs, the VS system utilizes sound, image, or other ways to inform a mobile terminal.

5.6 Service management

5.6.1 User authentication

When a user visits an MSP via an M_CU, the MSP performs authentication according to user type, user ID and other information submitted by the M_CU. If the authentication succeeds, the M_CU will return the PU list; if authentication is unsuccessful, it will return error messages.

5.6.2 Management configuration

M_CU configuration information includes server address, customer domain name, connection point, storage path of the instant image snapshot and recorded video, PTZ control parameters, etc.

The M_CU can be updated to a new version automatically when the M_CU is registered in the service platform. Users can select to also download and install the new version M_CU.

5.6.3 Search for and obtain the PU list

After authorization, the M_CU registers to the service platform. It can request to search by key words and obtain the PU list information, and then show the list to end users. The information concerning PUs includes user information, static list information and dynamic list information.

5.6.4 Objects of interest

Objects of interest are used to save information about the PU list which has been selected by users. Users can view the PU list and modify it by adding or deleting one or multiple pieces of PU information.

6 Functional architecture

6.1 Functional architecture framework

The high-level functional components for a mobile visual surveillance system are described in Figure 6-1.

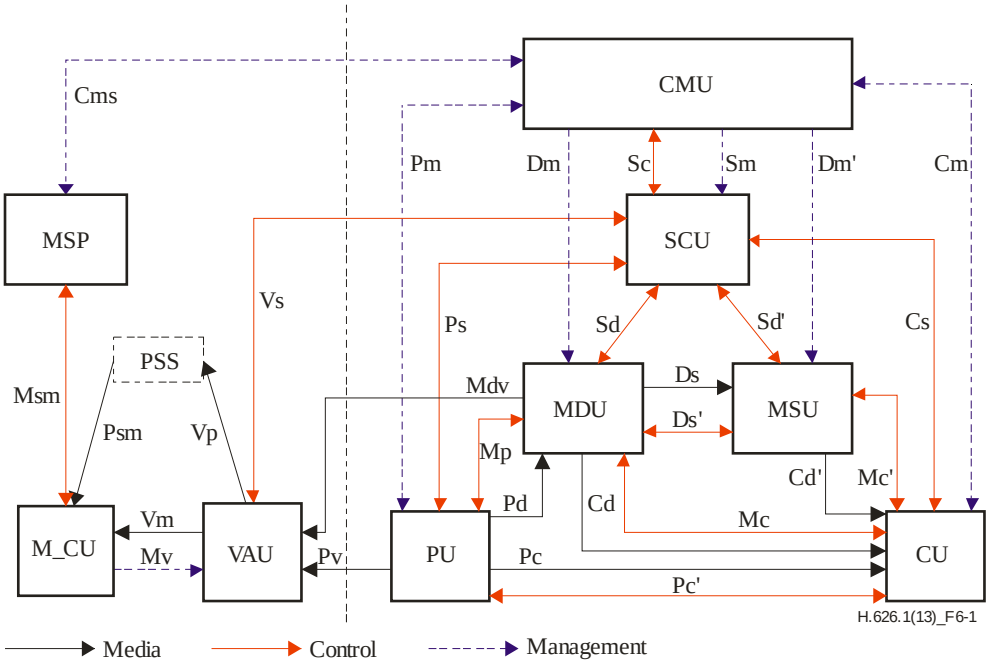

Figure 6-1 – Components for a mobile visual surveillance system

– M_CU: Mobile customer unit. The M_CU is a software client running on a mobile phone used by the visual surveillance end user.

– MSP: Mobile service portal. The MSP provides the whole access portal for mobile surveillance users, including the user authentication portal, the premises unit (PU) list portal, etc. The MSP provides service management functions for end users through communication with the service control unit (SCU), such as querying user authentication, information, programme for surveillance content, synchronization of information with the SCU, etc.

– VAU: Video access unit. The VAU is the key unit for implementing communication between the M_CU and the units defined in [ITU-T H.626]. The main functions of the VAU include: obtaining management information from the SCU; creating a connection with the media distribution unit (MDU) and/or the PU; distributing and transcoding multimedia data; transferring commands of PTZ control; and dynamically adjusting the media stream, etc.

– PSS: Packet-switched streaming service. The PSS is an optional unit between the M_CU and the VAU. It is the stream media server and processes the media stream distribution. The main functions of the PSS include: responding to the service request message sent by the M_CU; receiving the real-time media stream from the VAU and distributing the stream to multiple M_CUs.

6.2 Functional entities

6.2.1 Mobile service portal

The mobile service portal (MSP) is the application server for the mobile visual surveillance system.

The MSP is used to communicate with the SCU to provide service management for the M_CU, such as authentication, search for and obtaining the PU list, video data search and information synchronization with the SCU.

6.2.2 Video access unit

The video access unit (VAU) is the key unit to implementing control between mobile terminals and other units defined in [ITU-T H.626]. The main functions of the VAU are illustrated in Figure 6-2 and include the following functions: service control function, media control function (such as PTZ control command transmit), media processing function (such as multimedia transcoding) and configuration management function.

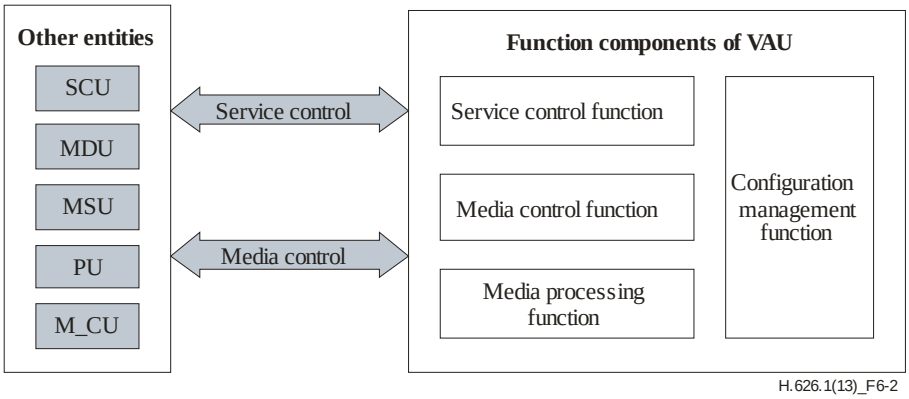

Figure 6-2 – Function components of the VAU

The VAU provides the media transcoding function for M_CUs located in different types of networks. The VAU acquires preconfiguration of transcoding parameters for various mobile networks from the SCU. The transcoding parameters include resolution, bit rate, encoding type and I-frames interval.

Service control function:

– initiates, maintains and releases the connection with the SCU;

– processes service requests from the M_CU, forwards them to the SCU and responds to the M_CU;

– acquires the media stream from the MDU and/or the PU.

Media control function:

– receives the media stream from the MDU and/or the PU according to the M_CU's request;

– transmits or forwards the media stream to the M_CU;

– processes control and reports indications from the M_CU.

Media processing function:

– transcodes the media stream before transferring the stream from the MDU and/or the PU to the M_CU according to the ability of the M_CU;

– adjusts the key-frame interval and bitrate of the media stream according to the packet loss rate reported by the M_CU before the VAU transfers the stream from the MDU and/or the PU to the M_CU (in addition, the VAU decreases the key-frame interval and bitrate when the packet loss rate increases, and increases the key-frame interval and bitrate when the packet loss decreases).

Configuration management function:

– manages the overall configuration in the VAU, including transmission, decoding, transcoding and other controls of the stream.

6.2.3 M_CU

The M_CU is the functional entity within the mobile VS system. It is a software client running on a mobile phone used by the visual surveillance end user. It is used to present multimedia information (such as video, image, audio, alarm signal, etc.) to the end user. It implements the following functions:

– requests the media stream from the VAU, based on the network types in which the M_CU is located;

– receives, decodes and plays back the media stream. The media stream packet loss rate is periodically reported to the VAU;

– displays the PU list and presents real-time image/video;

– provides a console interface for the end user to operate the VS system (such as PTZ control).

6.2.4 PSS

The PSS is the optional unit between the M_CU and the VAU. It is the stream media server, and processes the media stream distribution.

The main functions of PSS include:

– responding to the service request message sent by the M_CU;

– acquiring the real-time media stream from the VAU and distributing the stream to multiple M_CUs.

6.3 Reference points

6.3.1 Reference point Cms: CMU-MSP

The reference point **Cms** is located between the CMU and the MSP. It is used for the following functions:

– to deliver registration and to access authentication, authorization and accounting (AAA) signals between the MSP and the CMU, following the user's first visit to the MSP;

– to return to the MSP the user surveillance lists created by the CMU;

– to inquire with the CMU about the media address of the surveillance point visited by the MSP.

6.3.2 Reference point Msm: MSP-M_CU

The reference point **Msm** is located between the Msp and the M_CU. It is used for the following functions:

– to deliver registration and to access AAA signals between the M_CU and the MSP, following the user's first visit to the MSP;
– to return to the M_CU the user surveillance lists created by the MSP;
– to return to the M_CU the media address of the surveillance point visited by the MSP, following the user's selecting media from the M_CU via a graphical user interface.

6.3.3 Reference point Mv: M_CU-VAU

The reference point **Mv** is located between the M_CU and the VAU, where related media operations between the M_CU and the VAU are delivered. It is used for the following functions:

– to send media requests and receive responses sent by the M_CU to the VAU;
– to deliver instructions for control of PTZ and receive response sent by the M_CU to the VAU;
– to report periodically to the VAU on the media stream packet loss rate.

6.3.4 Reference point Vm: VAU-M_CU

The reference point **Vm** is located between the VAU and the M_CU. It is used by the VAU to distribute and deliver media to the M_CU using streaming methods.

6.3.5 Reference point Vs: VAU-SCU

The reference point **Vs** is located between the VAU and the SCU. It is used by the SCU to control VAU registration and access authentication, authorization and accounting. It is used for the following functions:

– to transfer the PTZ control operation commands from the M_CU via the VAU to the SCU;
– to deliver control signals between the VAU and the SCU in order to create a media session between the PSS and the MDU;
– to query the transcoding parameters from the SCU according to the network type in which the M_CU is located.

6.3.6 Reference point Mdv: MDU-VAU

The reference point **Mdv** is located between the MDU and the VAU. It is used by the MDU to distribute, store and deliver media to the VAU using streaming methods.

6.3.7 Reference point Pv: PU-VAU

The reference point **Pv** is located between the PU and the VAU. It is used to deliver interactive signals, such as RTSP request or response, directly between the VAU and the PU. It is also used to deliver the media stream directly from the PU to the VAU.

6.3.8 Reference point Vp: VAU-PSS

The reference point **Vp** is located between the VAU and the PSS. It is used to deliver interactive signals, such as an RTSP request or response, between the PSS and the VAU. It is also used to deliver media stream from the VAU to the PSS.

The PSS is used to receive the multimedia stream from the VAU, store multimedia data, distribute the multimedia stream to the M_CU and provide other streaming server services.

6.3.9 Reference point Psm: PSS-M_CU

The reference point **Psm** is located between the PSS and the M_CU. It is used to create a media session and deliver interactive signals, such as an RTSP request or response, between the M_CU and the PSS. It is also used to deliver the media stream from the PSS to the M_CU.

6.4 Service control flow and signalling

6.4.1 Real-time video/audio acquisition

When a user wants to view real-time video/audio surveillance by the mobile terminal, the M_CU initiates a request to the VAU for real-time video/audio streams once the MSP has performed authentication and returned VAU information to the M_CU.

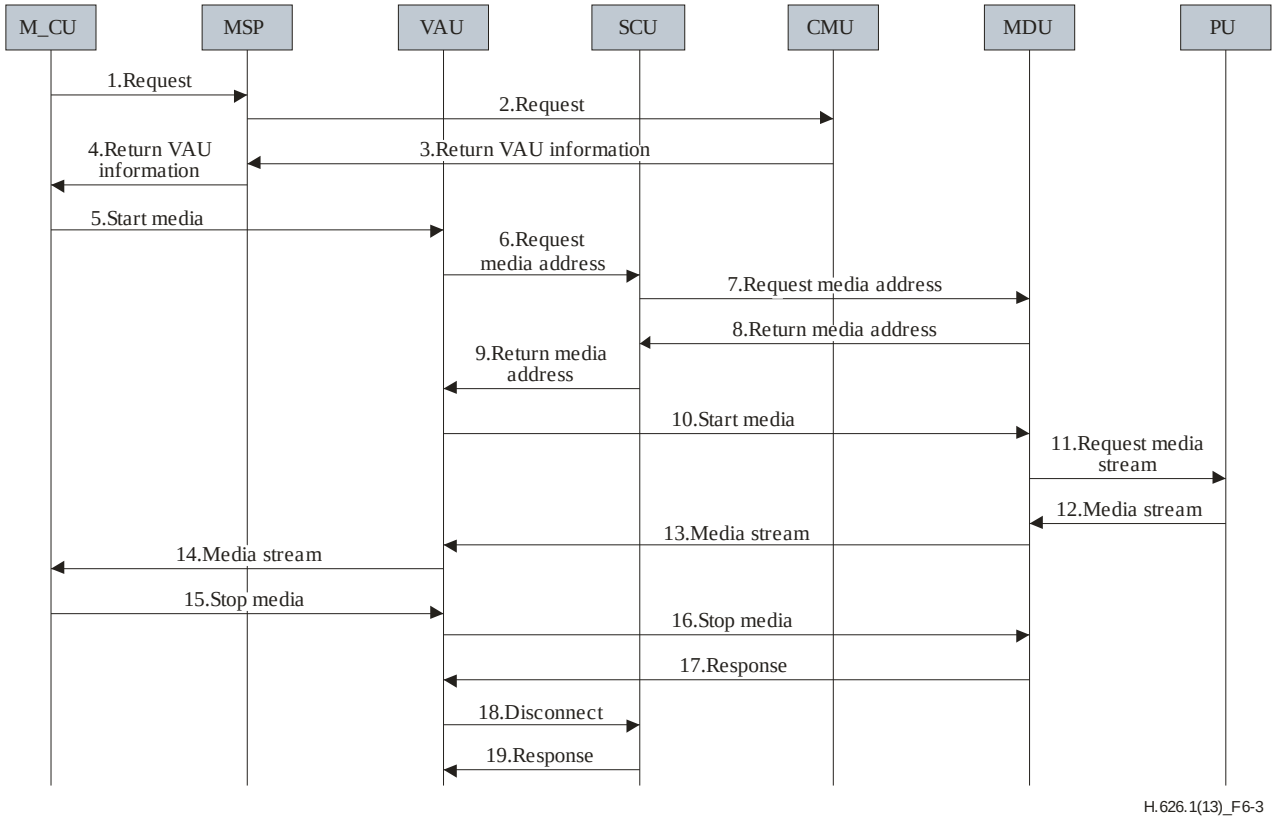

Figure 6-3 – High-level procedural flows for real-time media acquisition

Figure 6-3 shows the procedural flows of a single M_CU for real-time media acquisition:

1) First, the M_CU initiates a request and creates a connection with the MSP.
2) The MSP then initiates a request and creates a connection with the CMU.
3) The CMU then returns the VAU information.
4) The MSP then receives the request and returns the VAU information to the M_CU.
5) When the M_CU receives the VAU information, it requests the VAU for the real-time media address with the information about the network type in which the M_CU is located.
6) The VAU receives this request and requests the SCU for the media address. At the same time, the VAU addresses a query to the SCU about the corresponding transcoding parameters.
7) The SCU transfers this request to the MDU.
8) After receiving messages, the MDU returns the real-time media address to the SCU.
9) The SCU returns the real-time media address to the VAU.
10) After receiving the real-time media address, the VAU requests the MDU to start transmitting the media stream.
11) The MDU sends the PU a request for initiating a media flow.
12) The PU creates a media channel with the MDU and sends media flow to the MDU.

13) The MDU transfers the media flow to the VAU. The VAU performs transcoding according to the transcoding parameters.

14) The transcoded media flow is transferred from the VAU to the M_CU. The M_CU decodes and plays the received media flow.

15) When the M_CU stops the real-time media acquisition, it sends a stop-media request to the VAU.

16) The VAU stops transcoding after it receives the request. The VAU stops sending the media stream to the MDU.

17) The MDU sends a response to the VAU requesting that the media flow stop.

18) The VAU requests the SCU to disconnect. The SCU then returns a response to the VAU.

19) The VAU then ends this real-time media acquisition and sends a response to the SCU.

6.4.2 Playback function

The playback function is used to play video and audio media which have been previously recorded and stored.

There are three locations in which recorded media are stored: in the platform, in the PU and in the M_CU. With media stored in the M_CU, the playback function plays the recorded media just like playing any local media file. As additional interaction with other parts of the VS system is not needed, the following procedural flows will not include this simple method.

6.4.2.1 Playback in platform

When users want to play back the surveillance point using mobile phones, they must log into the MSP via the M_CU. The MSP performs authentication and returned the playback surveillance list.

After the users choose one surveillance point name, the M_CU sends a request for this surveillance video to the VAU, and then the VAU returns the media stream to the M_CU to play.

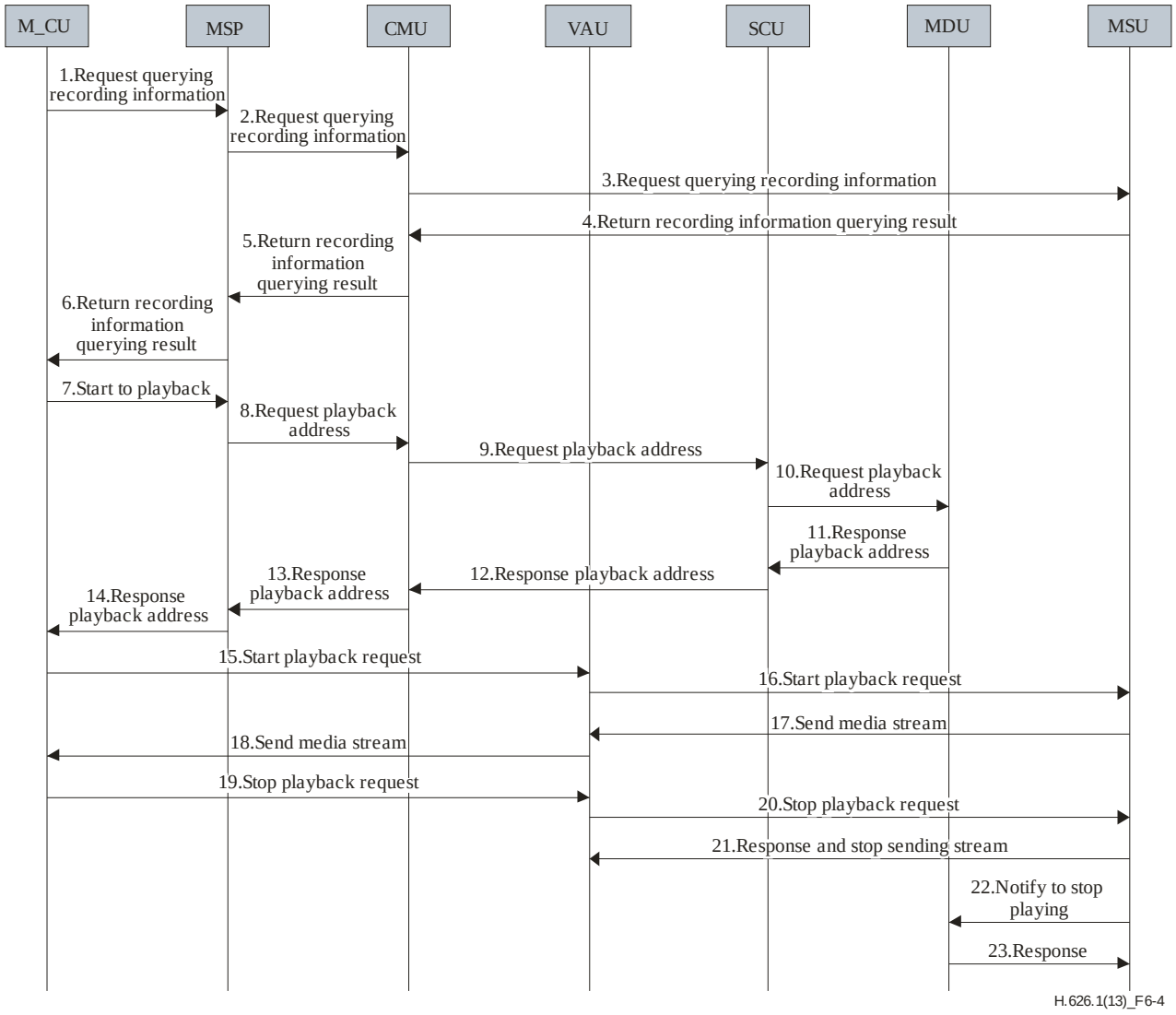

Figure 6-4 – High-level procedural flows for playback in platform

Figure 6-4 shows the procedural flows for playback in platform:

1) The M_CU sends the MSP a request querying recording information.
2) The MSP sends the CMU a request querying recording information.
3) The CMU sends the MSU a request querying recording information.
4) The MSU returns the querying result to the CMU.
5) When the CMU receives the result, it transfers the result to the MSP.
6) When the MSP receives the result, it transfers the result to the M_CU.
7) The M_CU selects one playback point and starts a request to playback.
8) The MSP sends the CMU a request for the playback address.
9) The request is transferred from the CMU to the SCU.
10) The request is transferred from the SCU to the MDU.
11) The MDU responds to the request and sends the playback address back to the SCU.
12) The playback address is sent from the SCU to the CMU.
13) The CMU sends the playback address to the MSP.
14) The playback address is sent from the MSP to the M_CU.

15) The M_CU starts a playback request for the VAU with the playback address and the network type.

16) The VAU starts a playback request for the MSU with the playback address. At the same time, the VAU queries the corresponding transcoding parameters from the SCU based on the network types.

17) The MSU returns a response to the VAU and sends the media stream to the VAU.

18) Once the VAU receives the media stream, it performs transcoding according to the transcoding parameters and then transfers the transformed stream to the M_CU.

19) The M_CU responds to the VAU and sends a stop playback request. The VAU stops transcoding after receiving the request.

20) The VAU sends a stop playback request to the MSU.

21) In response, the MSU stops sending the stream.

22) At the same time, the MSU notifies the MDU to stop playing.

23) The MDU returns a response to the MSU.

6.4.2.2 Playback in the PU

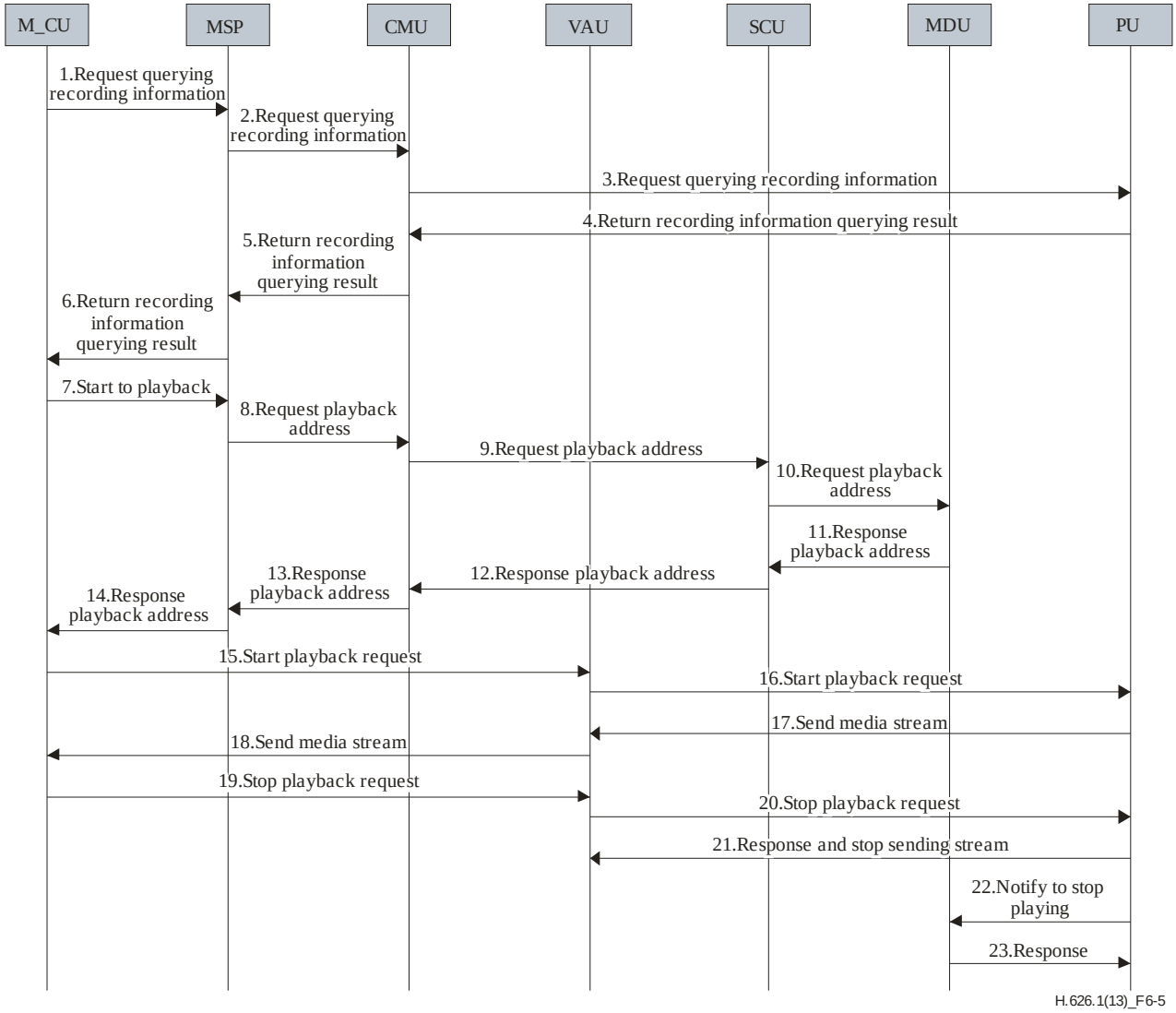

Figure 6-5 – High level procedural flows for playback in the PU

Figure 6-5 shows the procedural flows for playback in the PU:

1) The M_CU sends the MSP a request querying recording information.
2) The MSP sends the CMU a request querying recording information.
3) The CMU sends the PU a request querying recording information.
4) The PU returns the querying result to the CMU.
5) When the CMU receives the result, it transfers the result to the MSP.
6) When the MSP receives the result, it transfers the result to the M_CU.
7) The M_CU selects one playback point and starts a request to play back.
8) The MSP sends a request for the playback address to the CMU.
9) The request is transferred from the CMU to the SCU.
10) The request is transferred from the SCU to the MDU.
11) The MDU responds to the request and sends the playback address back to the SCU.
12) The playback address is sent from the SCU to the CMU.
13) The CMU sends the playback address to the MSP.
14) The playback address is sent from the MSP to the M_CU.
15) The M_CU starts a playback request for the VAU, with the playback address and network type.
16) The VAU starts a playback request for the PU, with the playback address. At the same time, the VAU queries the corresponding transcoding parameters from the SCU based on the network types.
17) The PU returns a response to the VAU and sends the media stream to the VAU.
18) Once the VAU receives the media stream, it performs transcoding based on the transcoding parameters and then transfers the transformed stream to the M_CU.
19) The M_CU returns a response to the VAU and sends a stop playback request. The VAU stops transcoding after receiving the request.
20) The VAU sends a stop playback request to the PU.
21) In response, the PU stops sending the stream.
22) At the same time, the PU notifies the MDU to stop playing.
23) The MDU returns a response to the PU.

6.4.3 PTZ control

The VAU receives a PTZ control request from the M_CU, parses and transfers this request to the SCU. After authentication, the SCU transfers this request to the PU to perform the PTZ operation.

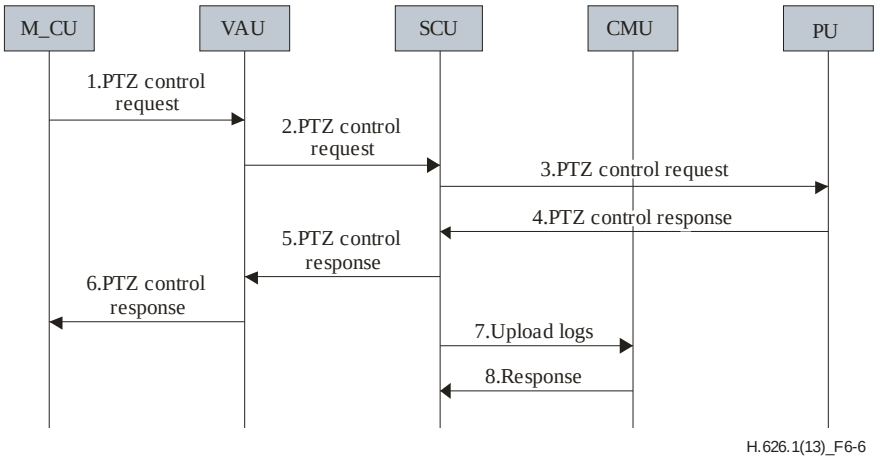

Figure 6-6 – High-level procedural flows for PTZ control

Figure 6-6 shows the procedural flows for PTZ control:

1) The M_CU sends a PTZ control request to the VAU.
2) The VAU transfers this request to the SCU.
3) After authentication, the SCU transfers this request to the PU.
4) The PU parses this request and transfers PTZ control commands to related physical devices. The devices then perform PTZ operations and the PU returns a response to the SCU.
5) The SCU transfers this response to the VAU.
6) The VAU returns this response to the M_CU.
7) The SCU writes logs about this PTZ control event, such as operation time and operation type, then uploads the logs to the CMU.
8) The CMU returns a response to the SCU to complete log uploading.

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