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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

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

## Architectural requirements for visual surveillance

Recommendation ITU-T H.626

ITU-T H-SERIES RECOMMENDATIONS

**AUDIOVISUAL AND MULTIMEDIA SYSTEMS**

| | |
|---|---|
| CHARACTERISTICS OF VISUAL TELEPHONE SYSTEMS | H.100–H.199 |
| INFRASTRUCTURE OF AUDIOVISUAL SERVICES | |
| General | H.200–H.219 |
| Transmission multiplexing and synchronization | H.220–H.229 |
| Systems aspects | H.230–H.239 |
| Communication procedures | H.240–H.259 |
| Coding of moving video | H.260–H.279 |
| Related systems aspects | H.280–H.299 |
| Systems and terminal equipment for audiovisual services | H.300–H.349 |
| Directory services architecture for audiovisual and multimedia services | H.350–H.359 |
| Quality of service architecture for audiovisual and multimedia services | H.360–H.369 |
| Supplementary services for multimedia | H.450–H.499 |
| MOBILITY AND COLLABORATION PROCEDURES | |
| Overview of Mobility and Collaboration, definitions, protocols and procedures | H.500–H.509 |
| Mobility for H-Series multimedia systems and services | H.510–H.519 |
| Mobile multimedia collaboration applications and services | H.520–H.529 |
| Security for mobile multimedia systems and services | H.530–H.539 |
| Security for mobile multimedia collaboration applications and services | H.540–H.549 |
| Mobility interworking procedures | H.550–H.559 |
| Mobile multimedia collaboration inter-working procedures | H.560–H.569 |
| BROADBAND, TRIPLE-PLAY AND ADVANCED MULTIMEDIA SERVICES | |
| Broadband multimedia services over VDSL | H.610–H.619 |
| **Advanced multimedia services and applications** | **H.620–H.629** |
| IPTV MULTIMEDIA SERVICES AND APPLICATIONS FOR IPTV | |
| General aspects | H.700–H.719 |
| IPTV terminal devices | H.720–H.729 |
| IPTV middleware | H.730–H.739 |
| IPTV application event handling | H.740–H.749 |
| IPTV metadata | H.750–H.759 |
| IPTV multimedia application frameworks | H.760–H.769 |
| IPTV service discovery up to consumption | H.770–H.779 |

*For further details, please refer to the list of ITU-T Recommendations.*

# Recommendation ITU-T H.626

## Architectural requirements for visual surveillance


### Summary

The purpose of Recommendation ITU-T H.626 is to define a visual surveillance system based on IP networks. The visual surveillance system provides the display and storage of the multimedia (such as video, audio and image) captured by multiple remote cameras over an IP network for multiple users. It also provides other functionalities, such as remote control, alarm and linkage actions, recording and playback.

This Recommendation defines the functional requirements, model, architecture, entities, reference points and service-control flow of the visual surveillance. This document also describes the hierarchy model for deployment, the visual surveillance management system, and the interworking and service convergence between the visual surveillance system and other multimedia systems.



### History

| Edition | Recommendation | Approval | Study Group |
|---|---|---|---|
| 1.0 | ITU-T H.626 | 2011-05-14 | 16 |

### Keywords

Alarming, camera, IP network, PTZ control, recording and playback, visual surveillance.

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## Table of Contents

# Recommendation ITU-T H.626

## Architectural requirements for visual surveillance

### 1 Scope

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

The objective of this document is to describe the architectural requirements of the visual surveillance system, which satisfies the needs described in visual surveillance requirements [ITU-T F.743]. This document defines the functional requirements, model, architecture, entities, reference points and service-control flow of visual surveillance.

### 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 M.3320] Recommendation ITU-T M.3320 (1997), *Management requirements framework for the TMN X-Interface*.

[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*.

### 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** [b-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 electronic program guide (EPG)** [b-ITU-T J.200]: A program table that is presented electronically.

**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 implementation and between administrative domains.

NOTE 2 – The definition is not only applicable to NGNs, 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 quality of service (QoS)** [ITU-T Y.101]: The collective effect of service performances which determine the degree of satisfaction of a user of the service.

**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 structured set of capabilities intended to support applications.

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

**3.2.1 customer unit**: 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.

**3.2.2 premises unit**: 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.

**3.2.3 service platform**: A series of devices and subsystems located at the centred 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, and control and management functions.

**3.2.4 surveillant**: The individual performing surveillance.

**3.2.5 surveilled object**: The target (such as site, human, and related environment) on which surveillance is performed.

**3.2.6 visual surveillance**: 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 a managed broadband network with ensured quality, security and reliability.

## 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

| | |
|---|---|
| AAA | Authentication, Authorization and Accounting |
| AF | Application Function |
| ALA | Alarm and Linkage Action |
| BCVM | Bidirectional Voice Communication Mode |
| CDN | Content Delivery Network |
| CMU | Centre Management Unit |
| CPF | Content Provision Function |
| CU | Customer Unit |
| CUF | Customer Unit Function |
| EPG | Electronic Programme Guide |
| FCAPS | Fault, Configuration, Accounting, Performance and Security |
| FE | Functional Entity |
| HTTP | Hypertext Transfer Protocol |
| IIS | Instant Image Snapshot |
| IMS | IP Multimedia Subsystem |
| IPTV | Internet Protocol TeleVision |
| MCU | Multimedia Control Unit |
| MDU | Media Distribution Unit |
| MF | Management Function |
| MOC | Monitor Centre |
| MSCF | Media Switch and Control Function |
| MSU | Media Storage Unit |
| MZMU | Multi-Zones Management Unit |
| NGN | Next Generation Network |
| NTCF | Network Transport and Control Function |
| PC | Personal Computer |
| PTZ | Pan/Tilt/Zoom |
| PU | Premises Unit |
| PUF | Premises Unit Function |
| QoS | Quality of Service |
| RnP | Recording and Playback |

RTSP Real-Time Streaming Protocol

SCU Service Control Unit

SMS Short Message Service

STB Set Top Box

UVCM Unidirectional Voice Communication Mode

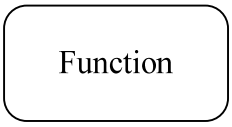
VAC Voice/Audio Communication

VCR Video Cassette Record

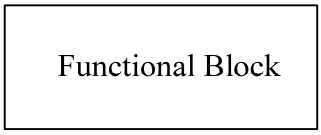
VS Visual Surveillance

## 5 Conventions

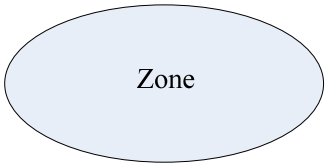
– Function: In the context of the visual surveillance architecture, a "function" is defined as a collection of functionalities. It is represented by the following symbol:




– Functional block: In the context of the visual surveillance architecture, a "functional block" is defined as a group of functionalities that has not been further subdivided at the level of detail described in this Recommendation. It is represented by the following symbol:




– Zone: In the context of the visual surveillance architecture, a "Zone" is defined as being composed of all the decomposed components which are managed by the same CMU. It is represented by the following symbol:




## 6 Roles and domains

This clause describes the roles and related domains which pertain to visual surveillance (VS).

### 6.1 Roles of visual surveillance

The roles of visual surveillance (VS) include those involved in business activities that fit into a value chain of VS. The roles of VS could be identified as follows:

– Third-party application provider: The provider of third-party applications, services or contents to be integrated by service providers.

– Customer: The individual or organization that consumes the media captured via the VS system (i.e., surveillant), the individual or organization that operates the VS system (i.e., operator) and the individual or organization that administers the VS system (i.e., administrator).

– Network provider: The organization that maintains and operates the network components required for VS functionality. A network provider can also act optionally as the service provider [ITU-T Q.1290], (1998). In this document, the term 'network provider' signifies the entity that provides the network infrastructure.

NOTE 1 – Although considered as two separate entities, the service provider and the network provider may in fact be one organizational entity.

– Service provider: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider can optionally be a customer of another service provider [ITU-T M.3320]. In this document, the term 'service provider' signifies the entity that provides services and/or service integration.

– Surveilled object: The target (such as site, human, and related environment) is surveilled.

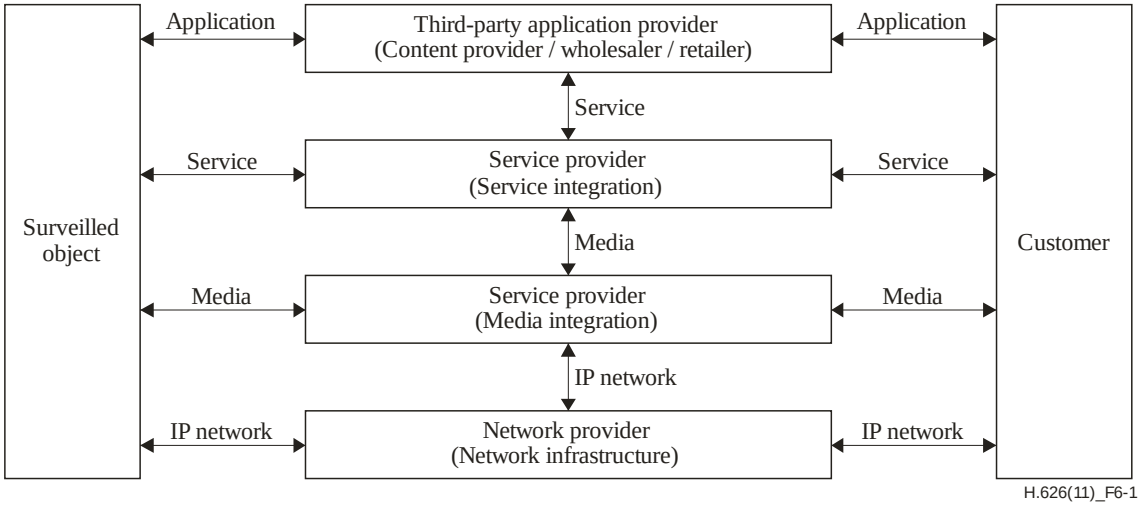



**Figure 6-1 – Roles and relationships of visual surveillance**

The relationships among the roles of the VS, illustrated in Figure 6-1, are:

– IP network relationship: Network provider provides network infrastructure to service provider, customer, and surveilled object.

– Media relationship: Service provider provides media to customer and surveilled object.

– Service relationship: Service provider provides service to customer and surveilled object, and also provides service support for third-party application provider.

– Application relationship: The third-party application provider provides application both to customer and surveilled object.

NOTE 2 – The third-party application provider may include content provider, wholesaler and/or retailer.

NOTE 3 – Content provider: The one who provides content and/or content integration.

## 6.2 Domains of visual surveillance

The domains of VS, illustrated in Figure 6-2, are:

– Customer domain: A collection of physical or functional entities, including terminal equipment and network resources under the control of a customer.

– Surveilled object domain: A collection of physical or functional entities, including premises equipment and network resources related to a surveilled object.

– Network provider domain: Domain of network providers and related network infrastructure.

– Service provider domain: Domain of service providers and related service platforms.

– Third-party application provider domain: Domain of third-party application providers and related applications.

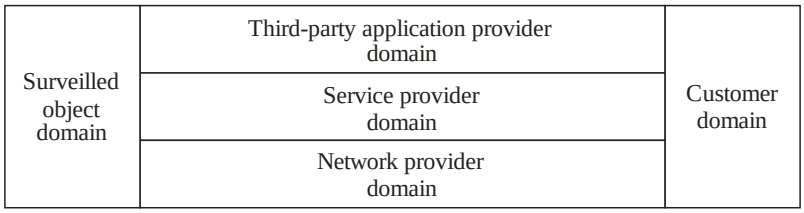



**Figure 6-2 – Domains of visual surveillance**

## 7 Functional requirements

This clause describes the functional requirements of services, control and management aspects which pertain to VS.

### 7.1 Functional requirements pertaining to basic services

According to the service requirements of [ITU-T F.743], the following are the basic services:

– Alarm and linkage action (ALA)
– Video/audio acquisition (VAA)
– Instant image snapshot (IIS)
– Recording and playback (RnP)

#### 7.1.1 Alarm and linkage action

**Functional description**

The alarm and linkage action function is one of the basic capabilities of VS. It is used to respond to an input alarm signal event by producing an output alarm activity that triggers the related linkage actions.

**Reference procedures**

The order of the reference procedure of the alarm and linkage action function is:

1. When the alarm input facilities of the PU detect input alarm events, an output alarm activity is triggered.
2. The PU sends alarm signals to the alarm centre and/or the CU, and may also trigger linkage actions, such as running the recording and instant image snapshot functions, calling the police, and/or sending out alarm messages through the SMS system.

**Trigger conditions**

The alarm and linkage action function may be triggered by the following alarm events (among others):

– On/Off switch
– Motion detection
– Image covering
– Image interruption
– Door control

**Operation constraints**

The alarm and linkage action function could be enabled and disabled by all kinds of customers, i.e., surveillant, operator and administrator.

### 7.1.2 Video/audio acquisition

**Functional description**

The real-time video/audio acquisition function is one of the basic capabilities of VS, and is used to acquire video and audio information from a surveilled object.

**Reference procedures**

The VS system is composed of CUs, PUs and the service platform. PUs capture and record the video/audio information, encode and transform it into a media stream, and send the media stream to the service platform. The service platform stores and distributes the media stream to a CU, which decodes and transforms the media stream into analogue media signal data, and then finally outputs to the display devices that have been assigned by the user.

The reference procedure of the real-time video/audio acquisition function is as follows:

– PUs capture the real-time video/audio information of surveilled objects, perform transcoding and encoding, and send the media stream to the service platform.

– Triggered by the operation command from end users, CUs send a request for real-time video/audio acquisition, with the channel information of requested Pus, to the service platform.

– The service platform receives and handles this request, then transfers the real-time media stream received from PUs to CUs.

– CUs receive the media stream, perform decoding and transcoding, and then finally output the analogue media signal data to the display devices that have been assigned by the user.

**Trigger conditions**

The real-time video/audio acquisition function could be triggered either by manual mode (according to the command of an administrator, operator and/or surveillant) or by automatic mode (according to preset configuration conditions, such as time, alarm and policy).

**Operation constraints**

The real-time video/audio acquisition function could be enabled and disabled by a given customer, i.e., administrator, operator or surveillant, according to the access control and security policies set for each of these entities.

### 7.1.3 Instant image snapshot (IIS)

**Functional description**

The instant image snapshot (IIS) function is one of the basic capabilities of VS, and is used to obtain instant image information based on the video of the surveilled object.

**Reference procedures**

The order of the reference procedure of the instant image snapshot function is:

1. Customer sends a request for an instant image snapshot from CU to PU.
2. PU receives this request for an instant image snapshot. It snapshots an image from the surveillance video and responds to CU with the image data.
3. CU receives PU's response and separates the image data and does further image processing.

**Trigger conditions**

The instant image snapshot function may be triggered either by manual mode (according to the command of administrator, operator and/or surveillant) or by automatic mode (according to preset configuration conditions, such as time, alarm and policy).

**Operation constraints**

The instant image snapshot function could be enabled and disabled by all kinds of customers, i.e., surveillant, operator and administrator.

### 7.1.4 Recording and playback

**Functional description**

The recording function is one of the basic capabilities of VS. It is used to record multimedia information (audio, image and video) from surveilled objects and to store it either in terminal devices or in the service platform.

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

NOTE – As a VS basic capability, the recording function is the precondition of playback, that is to say, the media needs to be recorded and stored before and/or during the operation of playback.

The operation of playback may include, among others, the following actions:

– Fast forward, fast rewind (backward), pause, play, stop
– Multiple speeds, such as 2X, 4 X, 8X, 16X, 32X
– Fraction speeds, such as 1/32X, 1/16X, 1/8X, 1/4X, 1/2X, 1X
– Position play, such as play from specified start time
– Frame forward, frame rewind (backward)

**Reference procedures**

The order of the reference procedure of the recording and playback function is:

1. When the recording action is triggered, the multimedia information is captured and recorded either in the PU or the CU.
2. The recorded media is stored in either the PU or the service platform (such as the media resource centre used to store media).
3. The stored media may be replayed and used with playback mode, at once or in the future.

**Trigger conditions**

The recording function could be triggered either by manual mode (on command of the administrator, operator and/or surveillant) or by automatic mode (according to preset configuration conditions, such as time, alarm and policy).

The playback function could be triggered by manual mode (according to the command of the administrator, operator and/or surveillant).

**Operation constraints**

The recording and playback function can be enabled or disabled by all kinds of customers, i.e., surveillant, operator or administrator. In some situations, recording on the customer side (i.e., via CU) could be determined by the surveillant. However, recording on the surveilled object side (i.e., via the PU), and on the service platform sides, are only determined by operator and administrator.

## 7.2 Functional requirements pertaining to supplementary services

According to the service requirements of VS in [ITU-T F.743], voice (audio) communication (VAC) is an advanced service which could be a supplementary service.

### 7.2.1 Functional description

The voice (audio) communication function is one of the advanced capabilities of VS, and is used for communication between the end user and the surveilled object (human beings).

There are two reference modes of the voice (audio) communication function:

– Unidirectional voice communication mode (UVCM): one-way communication from the customer/CU to the surveilled object/PU (e.g., speech/audio broadcasting).

– Bidirectional voice communication mode (BVCM): bidirectional, simultaneous communication both from the customer/CU to the surveilled object/PU, and from the surveilled object/PU to the customer/CU (e.g., talkback).

### 7.2.2 Reference procedures

**Reference procedures for UVCM**

The order of the reference procedure for UVCM is:

1. The CU gets the list of PUs from the service platform and selects and creates the group to which it intends to speak or broadcast.
2. The CU sends a request to broadcast to the service platform with the group that it had created earlier.
3. The service platform receives and handles this request, and distributes media broadcasting requests to the PUs in this group.
4. Every PU that receives the request creates a unidirectional media channel with the service platform. The service platform selects a media distribution unit and returns this response to the CU.
5. The CU creates a media channel with the MDU and sends a unidirectional audio stream to the MDU.
6. The MDU broadcasts the media stream to every PU through the channels created earlier.

**Reference procedures for BVCM**

The order of the reference procedure for BVCM is:

1. The CU sends a request for voice (audio) communication to the service platform. The SCU in the service platform determines if the voice channel of the target PU is available, and then transfers the request to the target PU.
2. The PU sends back a response to the SCU with the session information for voice (audio) communication which transfers this response to the initial CU.
3. The CU creates a bidirectional media channel with the MDU in the service platform.
4. The PU creates a bidirectional media channel with the MDU in the service platform.
5. The CU sends an audio media stream to the MDU, which transfers this stream to the PU.
6. The PU sends the audio media stream to the MDU, which transfers this stream to the CU.

### 7.2.3 Trigger conditions

The voice (audio) communication function may be triggered by manual mode (according to the command of administrator, operator and/or surveillant).

### 7.2.4 Operation constraints

The voice (audio) communication function could be enabled and disabled by a given customer, i.e., administrator, operator or surveillant, according to the access control and security policies set for each of these entities.

## 7.3 Functional requirements pertaining to control

According to the service requirements of VS in [ITU-T F.743], the PTZ control function is an advanced service pertaining to control.

### 7.3.1 Functional description

The PTZ control function is used to pan, tilt and zoom a video camera, switch auxiliary peripherals (such as flashlight, fan and rain brush), and preset the position of related physical devices.

The detailed PTZ control operation commands include, among others, the following actions:

– Pan left and pan right
– Tilt up and tilt down
– Zoom in and zoom out
– Camera on, camera off and camera auto-scan
– Iris (aperture) open and iris (aperture) close
– Focus near and focus far.

For PTZ control, the following operation rules need to be taken into consideration:

– Administrator has higher (i.e., pre-emptive) priority than other end users.
– When two or more surveillants attempt to access a PTZ system simultaneously, only one is allowed to control the system at any given time.
– Only one user can both pan the camera and access the output from it.
– Some PTZ control functions (such as public traffic conditions control) should be controlled only by the administrator.

There are four PTZ control operation modes:

– Pre-emptive mode: the priority of multiple users at the same level requesting PTZ control follows the 'first come, first served' rule. In this situation, it is recommended to apply a suitable policy to avoid someone's frequent and continuous occupation.
– Token ring mode: users who apply PTZ control are joined into a circle, and the one who receives the token will get PTZ control privilege. Once the user finishes or the token expires, the token will pass to the next user, and the next user will receive the PTZ control privilege.
– Overwhelming mode: the one who has higher-level priority will get the PTZ control privilege over the one who has lower-level priority.
– Hybrid mode: a combination of the three modes above.

### 7.3.2 Reference procedures

The order of the reference procedure of the PTZ control function is:

1. The customer sends the operation control commands from the CU to the service platform.
2. The service platform forwards these operation control commands to the PU.
3. The PU converts these operation control commands into instructions and passes them to the pan mechanism, camera and relevant auxiliary peripherals.
4. These instructions are then executed.

### 7.3.3 Trigger conditions

The PTZ control function may be triggered either by manual mode (according to the command of administrator, operator and/or surveillant) or by automatic mode (according to preset configuration conditions, such as time, alarm and policy) as an active intelligent action and a passive accompanying action for alarming, instant image snapshot, video acquisition, etc.

### 7.3.4 Operation constraints

The PTZ control function could be enabled and disabled by a given customer, i.e., administrator, operator or surveillant, according to the access control and security policies set for each of these entities. The operations of PTZ control must comply with the PTZ control operation rules and modes. PTZ control should be enabled in most situations, although it should be disabled for some kinds of customer. For example, during an emergency, PTZ control cannot be used by surveillants with a low-priority level.

## 7.4 Functional requirements pertaining to management

The management functions include terminal management, network management, media resource management, service operation management, and application management.

### 7.4.1 Network management

Network management is used to manage the VS network equipment (such as router, switch and various servers), and resources (such as bandwidth), from a fault, configuration, accounting, performance and security (FCAPS) perspective.

### 7.4.2 Media resource management

Media resource management is used to manage media distribution, media storage and media serving for the captured and recorded VS media.

Media management functions include, among others, the following aspects:

– Media session information statistics
– Media distribution information updating/publishing
– Media usage information statistics
– Media adding/updating
– Media storage/archiving
– Media indexing/search
– Media play/playback
– Media edition/modification
– Media copy/backup
– Media expiration/deletion

### 7.4.3 Service management

Service management is used to manage the service resource, signalling control and system running state diagnostics of VS from a FCAPS perspective. service management functions include, among others, the following aspects:

– Service resource control
– Service configuration
– Session status monitoring
– Signalling tracing
– System running status diagnostics and system optimization

### 7.4.4 Terminal management

Terminal management is used to manage the VS terminal devices (such as CU and PU) from a FCAPS perspective.

Terminal-management functions include, among others, the following aspects:

– Fault

– Diagnostics

– Version upgrade

– Grouping

## 8 Functional architecture

This clause describes the basic functional model, functional approaches, functional architecture framework, functional entities, reference points, decomposed components and service flows which pertain to VS.

### 8.1 Functional model

The basic functional model for VS consists of CUs, PUs and a service platform. The interface Pi is the interface between PUs and the service platform, and the interface Ci is the interface between CUs and the service platform. This is illustrated in Figure 8-1.

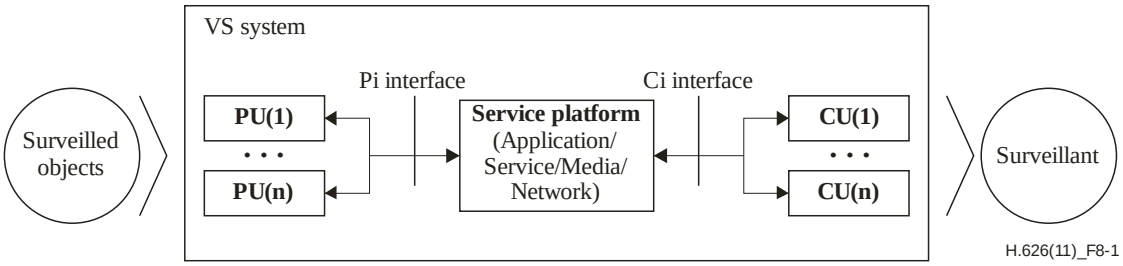



**Figure 8-1 – Functional model of visual surveillance**

### 8.2 Architecture approaches

In principle, three VS architecture approaches have been identified that enable service providers to deliver VS services:

– Non-NGN VS functional architecture (non-NGN VS): The non-NGN VS architecture, also called dedicated VS architecture, is based on existing network components, protocols and interfaces. The technology components, protocols and interfaces used in this VS architecture are already in use and hence this approach is a representation of typical existing networks providing VS services. This architectural approach can be used as the basis for evolution towards the other VS architectures listed below.

– NGN-based non-IMS VS functional architecture (NGN-non-IMS VS): The NGN-non-IMS VS architecture utilizes components of the NGN framework reference architecture as identified in [ITU-T Y.2012] to support the provision of VS services, in conjunction with other NGN services, as required.

– NGN IMS-based VS functional architecture (NGN-IMS VS): The NGN-IMS VS architecture utilizes components of the NGN architecture including the IMS component to support the provision of VS services, in conjunction with other IMS services, as required.

This Recommendation currently only addresses the non-NGN VS approach, as a basis for evolution towards the other two approaches. While NGN-non-IMS and/or NGN-IMS VS architectures are for further study, it is recommended to reuse the architectural concepts and the relevant functional entities, reference points and components found in this Recommendation.

## 8.3 Functional architecture framework

The VS functional architecture framework is illustrated in Figure 8-2.

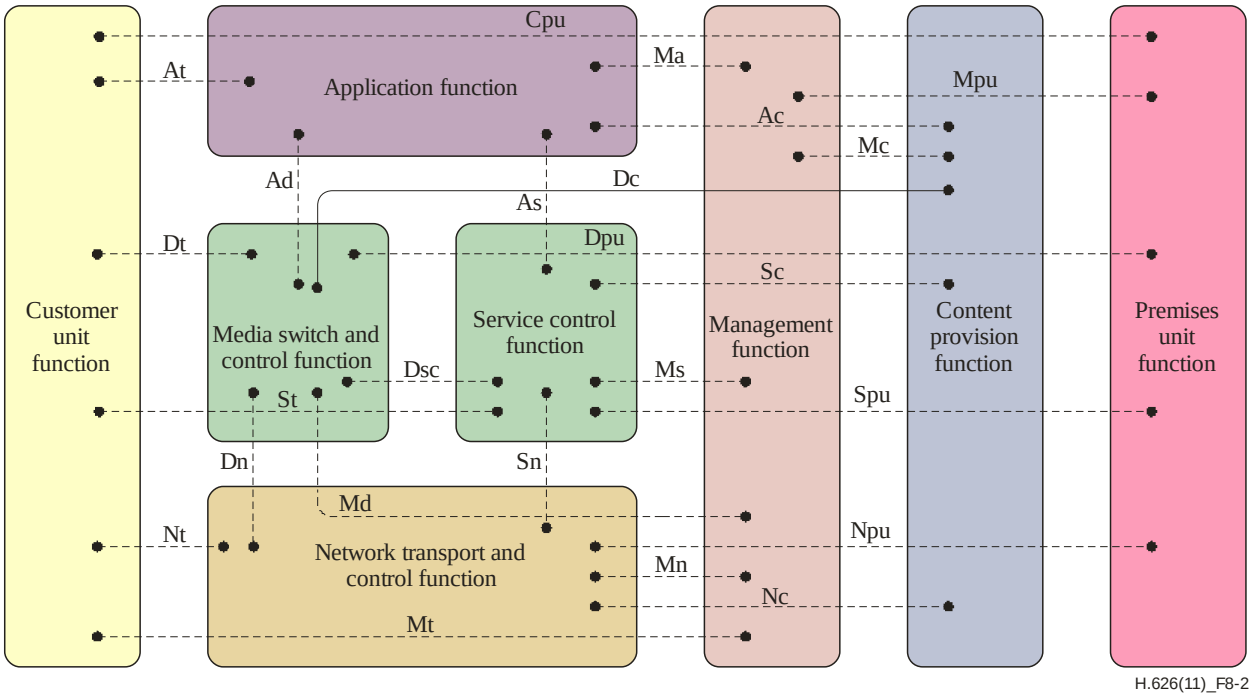



**Figure 8-2 – Functional architecture framework of VS**

The VS functional architecture framework addresses the functional architecture from the perspective of application, service, and network strata; it conforms to the principle of separation of control planes, data (user) planes and management planes. The main functions comprising the functional architecture of VS are:

– Application function
– Content provision function
– Service-control function
– Media switch and control function
– Network transport and control function
– Premises unit function
– Customer unit function
– Management function

For the detailed functions, refer to clause 8.4 and, for the detailed reference points, refer to clause 8.5.

### 8.4 Functional entities

This clause defines the VS functional entities.

#### 8.4.1 Application function – AF

The application function (AF) is the functional entity of application aspects.

The main AF tasks are application selection, application operation, application presentation and remote PTZ control by the end user.

#### 8.4.2 Content provision function – CPF

The main tasks of the content provision function (CPF) are content preparation (editing and composing), content storage and content offering.

#### 8.4.3 Service-control function – SCF

The service-control function (SCF) is the functional entity for service-control aspects.

The main tasks of the SCF are service control, service management and subscriber management.

#### 8.4.4 Media switch and control function – MSCF

The media switch and control function (MSCF) is the functional entity for media switch and control aspects.

The main tasks of the MSCF are to distribute, deliver and store media.

It may comprise the media distribution function, and the media storage and serving function.

#### 8.4.5 Network transport and control function – NTCF

The network transport and control function (NTCF) is the functional entity for network transport and control aspects.

The main tasks of NTCF are to transport IP data and to control the access and use of network resources.

It may comprise the access network, the convergence/concentration network, and the core network in practical network environments.

#### 8.4.6 Premises unit function

The premises unit function (PUF) is the functional entity for PU aspects.

The main tasks of the PUF are to capture information, convert it into IP packet-based digital media, and send it to the MSCF.

#### 8.4.7 Customer unit function – CUF

The customer unit function (CUF) is the functional entity for CU aspects.

The main tasks of the CUF are to receive IP packet-based media, play the media, pick the useful information and trigger the related actions.

#### 8.4.8 Management function – MF

The management function (MF) is the functional entity for management aspects.

The main tasks of the MF are to manage terminal devices (such as CU and PU), networks, services, media resource and applications based on the consideration of FCAPS aspects.

It may comprise the terminal devices management function, the network management function, the service management function, the media resource management function and the application management function.

## 8.5 Reference points

This clause defines reference points.

### 8.5.1 Reference point Ac: AF-CPF

Reference point Ac lies between the application function and the content provision function.

It is used for media selection, media operation and media presentation with a third-party or an external system:

– Selecting media from a third-party or other external media provision system (such as IPTV system) via GUI

– Operating media (media recording, media searching, media deleting, media playing) from a third-party or other external media provision system (such as IPTV system) via GUI

– Presenting media from a third-party or other external media provision system (such as an IPTV system) to the end user via GUI

### 8.5.2 Reference point Ad: AF-MSCF

Reference point Ad lies between the application function and the media switch and control function.

This reference point is used for the media selection, media operation and media presentation within the VS system:

– Selecting media from the media switch function of the VS system via GUI.

– Operating media (media recording, media searching, media deleting, media playing) from the media switch function of a VS system via GUI.

– Presenting media from the media switch function of the VS system to the end user via GUI.

### 8.5.3 Reference point At: AF-CUF

Reference point At lies between the application function and the CU function. It is used by the customer to select, search, play, download and install applications, and operate and control PTZ via the human-machine command interface.

### 8.5.4 Reference point As: AF-SCF

Reference point As lies between the application function and the service-control function. It is used to select, search, and interact applications with a third party or value-added service system.

### 8.5.5 Reference point Cpu: CUF-PUF

Reference point Cpu lies between the customer unit functions and the premises unit functions. It is used to deliver interaction signals directly between the CUF and the PUF (such as an RTSP request or response), as well as to directly deliver media streams from PUF to CUF.

### 8.5.6 Reference point Dc: MSCF-CPF

Reference point Dc lies between the media switch and control function and the service-control function. It is used for media insertion and media publishing from or to a third party or external system:

– Inserting media from a third party or other external media provision system (such as IPTV system) into the VS system

– Publishing media from the VS system to a third party or other external media distribution system (such as IPTV)

### 8.5.7 Reference point Dn: MSCF-NTCF

Reference point Dn lies between the media switch and control function and the network transport and control function.

This reference point is used by the NTCF to transport media from MSCF using unicast or multicast IP traffic mode.

### 8.5.8 Reference point Dpu: MSCF-PUF

Reference point Dpu lies between the media switch and control function and the PU function.

It is used by the MSCF to distribute and store media from the PUF using file and streaming methods.

### 8.5.9 Reference point Dsc: MSCF-SCF

Reference point Dsc lies between the media switch, the control function and the service-control function. It is used by the SCF to control the MSCF for media distribution, media selection and media location.

### 8.5.10 Reference point Dt: MSCF-CUF

Reference point Dt lies between the media switch and control function and the CU function. It is used by MSCF to distribute, store and deliver media to, or from, the CUF, using file and streaming methods

### 8.5.11 Reference point Ma: MF-AF

Reference point Ma lies between the management function and the application function. It is used to manage and log the information on application selection, operation and presentation.

### 8.5.12 Reference point Mc: MF-CPF

Reference point Mc lies between the management function and the content provision function.

This reference point is used by the media resource function to manage third-party and other external systems (such as an IPTV system) media resources, especially those used for media insertion, media publishing and related media operations.

### 8.5.13 Reference point Md: MF-MSCF

Reference point Md lies between the management function and the media switch and control function. It is used by the media management function to manage the media distribution, media storage and media serving, and related media operations.

### 8.5.14 Reference point Mn: MF-NTCF

Reference point Mn lies between the management function and the transport network and control function.

It is used by the network management function to manage network equipment, network resources (such as IP address, bandwidth allocation, network traffic, network performance, and QoS related parameters), their usage and their running status.

### 8.5.15 Reference point Ms: MF-SCF

Reference point Ms lies between the management function and the service-control function. It is used by the service management function to manage service resource, session status, signal tracing, and system running status diagnostics.

### 8.5.16 Reference point Mt: MF-CUF

Reference point Mt lies between the management function and the customer unit function.

It is used by the terminal device management function to manage end-user devices (such as dedicated CU devices) and related home-network devices (such as home gateway and various home devices), and the usage status of applications via CU.

### 8.5.17 Reference point Mpu: MF-PUF

Reference point Mpu lies between the management function and the premises unit function.

It is used to manage the PU device, to query the running status of devices, to configure parameters and to upgrade the software version.

### 8.5.18 Reference point Nt: NTCF-CUF

Reference point Nt lies between the network transport and control function and the customer unit function.

This reference point is used for IP address configuration, network access control, network resource allocation, QoS related admission control by the NTCF at the request of the CUF, and IP traffic transport between them.

### 8.5.19 Reference point Npu: NTCF-PUF

Reference point Npu lies between the network transport and control function and the premises unit function.

It is used for IP address configuration, network access control, network resource allocation, QoS-related admission control by the NTCF at the request of the PUF, and IP traffic transport between them.

### 8.5.20 Reference point Nc: NTCF-CPF

Reference point Nc lies between the network transport and control function and the content provision function.

This reference point is used for IP address configuration, network access control, network resource allocation, QoS related admission control by the NTCF at the request of third-party and other external systems (such as an IPTV system) for IP traffic transport, especially for media insertion and media publishing.

### 8.5.21 Reference point Sc: SCF-CPF

Reference point Sc lies between the service-control function and the content provision function.

It is used by the service-control function to control and monitor the service interaction between VS and third-party and other external systems (such as an IPTV system), especially for service control of media insertion and media publishing.

### 8.5.22 Reference point Sn: SCF-NTCF

Reference point Sn lies between the service-control function and the network transport and control function.

This reference point is used to request network resource allocation, enquire about the network running status, and instruct QoS-related admission control and enforcement policy by the service-control function to the network transport and control function.

### 8.5.23 Reference point Spu: SCF-PUF

Reference point Spu lies between the service-control function and the premises unit function.

It is used by the service-control function to control PU registration, access authentication, authorization, accounting, and monitoring of the status of the PU (such as online/offline status, active/inactive), and to control PTZ by forwarding PTZ control operation commands from the CU.

### 8.5.24 Reference point St: SCF-CUF

Reference point St lies between the service-control function and the customer unit function and it is used by the service-control function to control CU registration, access authentication, authorization, accounting, monitoring of the CU status (such as online/offline status, active/inactive), and receiving the PTZ control operation commands from the CU.

## 8.6 Decomposed components

This clause provides the decomposed components of the VS general architecture.

The decomposed components could be based on different network infrastructures, such as dedicated IP network architecture and NGN-based IP network architecture. At this stage, this Recommendation only addresses dedicated IP network architecture environments. NGN-based VS decomposed components could be discussed further. However, it is recommended that components mentioned herein should be reused.

The decomposed components focus mainly on service platform functions, which include the service-control function, media switch and control function, the network transport and control function and the application function. This document focuses on the VS service logic and gives more concise and compact concepts for VS architecture, which will decrease the binding between service and network. However, it is recommended that these aspects should be taken into consideration during implementation.

### 8.6.1 Overview of decomposed components

According to the VS functional model and the VS functional architecture framework, the terminal devices and service platform should be taken into consideration within the scope of service logic, and the relevant components could be decomposed into six units:

– Centre management unit (CMU)
– Service-control unit (SCU)
– Media storage unit (MSU)
– Media distribution unit (MDU)
– Premises unit (PU)
– Customer unit (CU)

The relationship and interfaces of the six decomposed components are illustrated in Figure 8-3.

The mapping relation between architectural functions and decomposed components is described in Table 8-1, and the mapping relation between reference points of architectural functions and interfaces of decomposed components is described in Table 8-2.

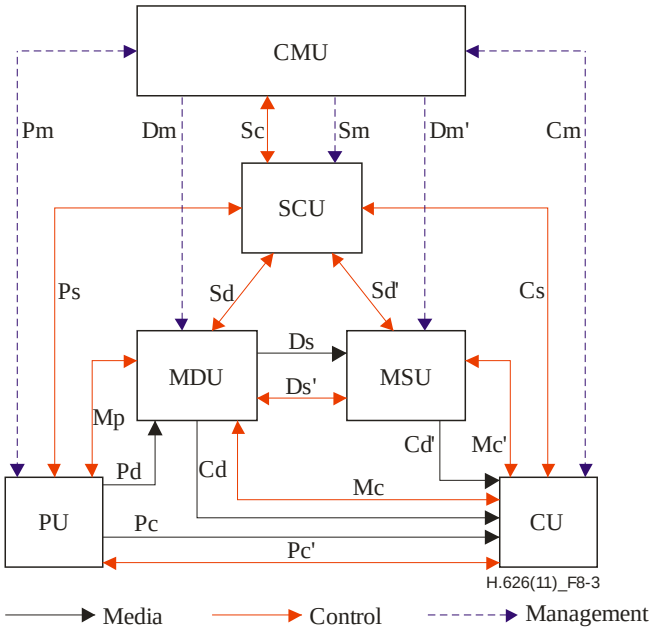



**Figure 8-3 – Decomposed components of VS**

**Table 8-1 – Mapping relation between architectural functions and decomposed components**

| No. | Architectural functions | Decomposed components | Notes |
|---|---|---|---|
| 1 | AF | – | N/A |
| 2 | MF | CMU | |
| 3 | SCF | SCU | |
| 4 | MSCF | MDU | |
| 5 | | MSU | |
| 6 | PUF | PU | |
| 7 | CUF | CU | |
| 8 | CPF | – | N/A |
| 9 | NTCF | – | N/A |

**Table 8-2 – Mapping relation between reference points and interfaces**

| No. | Reference points | Interfaces | Notes |
|---|---|---|---|
| 1 | At | – | N/A |
| 2 | Ac | – | N/A |
| 3 | Ad | – | N/A |
| 4 | As | – | N/A |
| 5 | Dc | – | N/A |
| 6 | Dn | – | External interface, for further study |
| 7 | Dpu | Pd/Mp | External interface, open |
| 8 | Dsc | Sd/Sd' | Internal interface, open |
| 9 | Dt | Cd/Cd'/Mc/Mc' | External interface, open |
| 10 | Ma | – | N/A |

**Table 8-2 – Mapping relation between reference points and interfaces**

| No. | Reference points | Interfaces | Notes |
|---|---|---|---|
| 11 | Mc | – | N/A |
| 12 | Md | Dm | Internal interface, proprietary |
| 13 | Mn | – | External interface, for further study |
| 14 | Ms | Sm | Internal interface, proprietary |
| 15 | Mt | Cm | External interface, open |
| 16 | Mpu | Pm | External interface, open |
| 17 | Sc | – | N/A |
| 18 | Sn | – | External interface, for further study |
| 19 | Spu | Ps | External interface, open |
| 20 | St | Cs | External interface, open |
| 21 | Cpu | Pc/Pc' | External interface, open |
| 22 | N/A | Ds/Ds' | Internal interface, proprietary |

### 8.6.2 CMU: centre management unit

The centre management unit (CMU) is used for centralized system management, service operation management, etc.

Accordingly, CMU main functions include management, authorization, accounting and charging, location and presence. The detailed functional features are:

– Management: managing content, service, network, terminal devices, etc.

– Authorization: authorizing access right.

– Accounting and charging: providing CDR and charging policy, etc.

– Location and presence: locating the PU, and presenting PU and CU online/offline status.

### 8.6.3 SCU: service-control unit

The service-control unit (SCU) is used to access service control and signal call control between the PU and the CU.

Accordingly, SCU main functions include access registration, access authentication, identification, authorization, call control, location, presence, and target media serving function selection. The detailed functional features are:

– Access registration: receiving the access registration request from the CU and the PU, and registering them with the registration management server.

– Access authentication: receiving the access authentication request from the CU and the PU, and as an authentication server function, forward (proxy) authentication signals between the AAA servers.

– Identification: identifying the CU and the PU, and comparing identities with subscriber data and terminal data to determine matching results.

– Authorization: authorize CU and PU access rights.

– Call control: mediate the call control session with the PU and the CU, establish and maintain media transport path information (media routing table, i.e., MRT). The related session methods could include setup, tear down, update, modify and keep live, in order to access, route and relay.

– Location: if required, providing the placement information of the PU and the CU.

– Presence: presenting the status of the CU and the PU, such as on-line, offline, active, inactive, etc.

– Clock synchronization: providing unified time criteria and clock synchronization control.

– Media serving function selection: selecting one media serving function unit (i.e., media distribution unit and related media storage unit) when one SCU controls multiple media serving function units.

### 8.6.4 MDU: media distribution unit

The media distribution unit (MDU) is an instance of the MSCF. The MDU is used to transport media from the PU to the CU.

Accordingly, the main MDU functions include media receiving, media processing, media routing, media transmission, media forwarding, media replication, etc. The detailed functional features are:

– Media receiving: receiving media (stream and files) from the PU.

– Media processing: muxing/demuxing, decoding/encoding and transcoding media that is received by the MDU, as required.

– Media routing: seeking media routing information between the PU and the CU in the media routing table (MRT) in order to decide on the media transport path and destination routing port.

– Media transmission: transmitting media to a CU or multiple CUs on request, according to media routing information (Note – Transmission from one PU to multiple CUs requires conversion from a unicast media channel to a multicast media channel).

– Media forwarding: forwarding media from the current MDU (Domain A) to another MDU (Domain B), in order to access the remote CU (Domain B) under the control of the SCU.

– Media replication: replicating media for point-to-multipoint transmission, if required.

NOTE – The alternative approach is to convert the unicast media channel to a multicast media channel. For this situation, the media replication is not needed.

The MDU internal process is illustrated in Figure 8-4 and the VS end-to-end media transport process is illustrated in Figure 8-5.

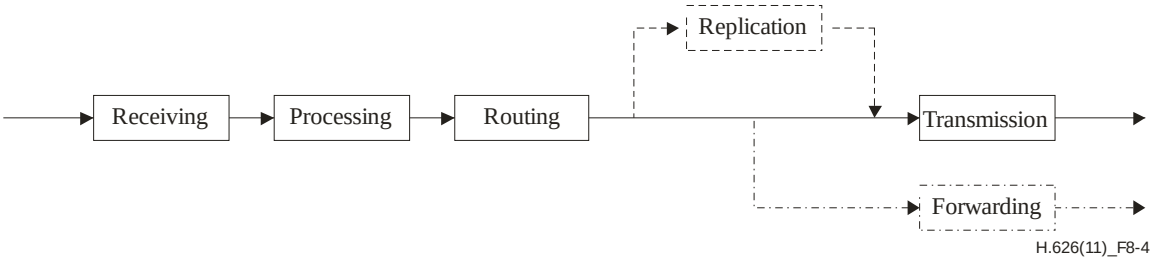



**Figure 8-4 – MDU internal process**

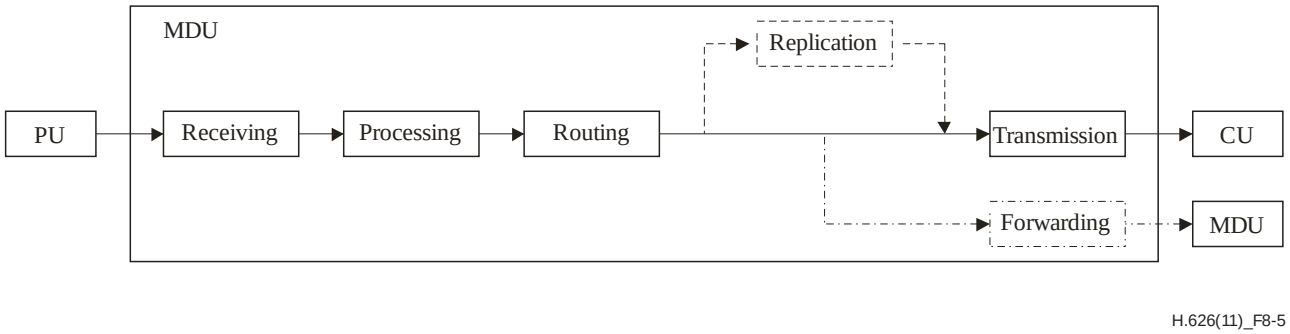



**Figure 8-5 – VS E2E Media-transport process**

The four media transport modes among PU, CU and MDU are:

– Type A: Conversation mode (point-to-point), see Figure 8-6.

– Type B: Distribution mode (point-to-multipoint), see Figure 8-7.

– Type C: Collecting mode (multipoint-to-point), see Figure 8-8.

– Type D: Conferencing mode (multipoint-to-multipoint), see Figure 8-9.

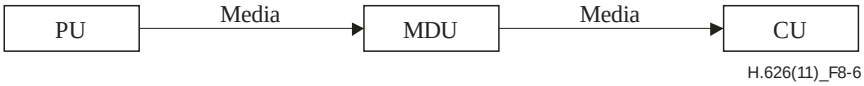



**Figure 8-6 – Type A media transport mode (point-to-point mode)**

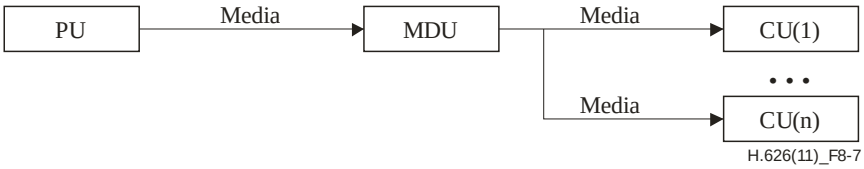



**Figure 8-7 – Type B media transport mode (point-to-multipoint mode)**

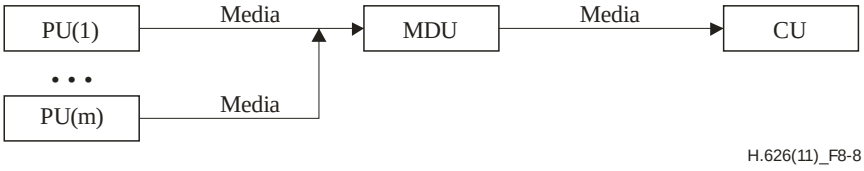



**Figure 8-8 – Type C media transport mode (multipoint-to-point mode)**

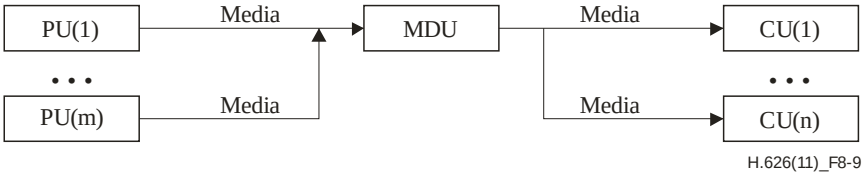



**Figure 8-9 – Type D media transport mode (multipoint-to-multipoint mode)**

### 8.6.5 MSU: media storage unit

The media storage unit (MSU) is an instance of the MSCF. The MSU is used to retrieve, store media and provide a streaming media serving capability.

Accordingly, MSU main functions include media storage, media serving, media indexing, media downloading, etc. The detailed functional features are:

– Media retrieval: retrieving audio and/or video media streams (such as using RTSP protocol) and image files (such as using HTTP protocol) from PU and/or MDU (such as using RTSP protocol).

– Media storage: storing recorded audio, video and image files from PU and/or MDU.

NOTE 1 – The images from the PU can be stored directly in the MSU, without the control of the MDU.

NOTE 2 – Alternatively, images can be stored by the independent image file storage server (IFSS), which is out of the scope of the MSU. For this situation, IFSS could not be controlled by the MDU.

– Media serving: serving audio and video to one CU or multiple CUs with media streaming (such as using RTSP protocol) on request of playback service.

– Media indexing: indexing audio, video and images files when stored for further media searching on request.

The MSU internal process is illustrated in Figure 8-10.

The VS end-to-end media storage and serving process is illustrated in Figure 8-11.

The media transport mode for playback service among MDU, MSU and CU is illustrated in Figure 8-12.

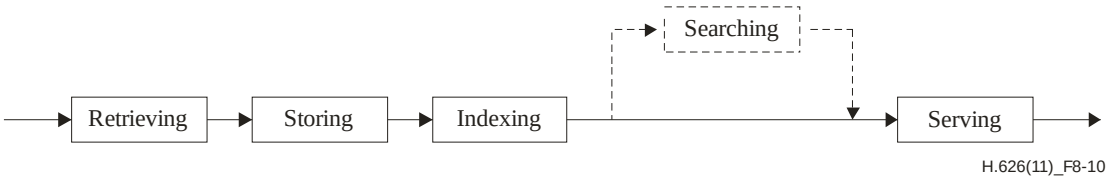



**Figure 8-10 – MSU internal process**

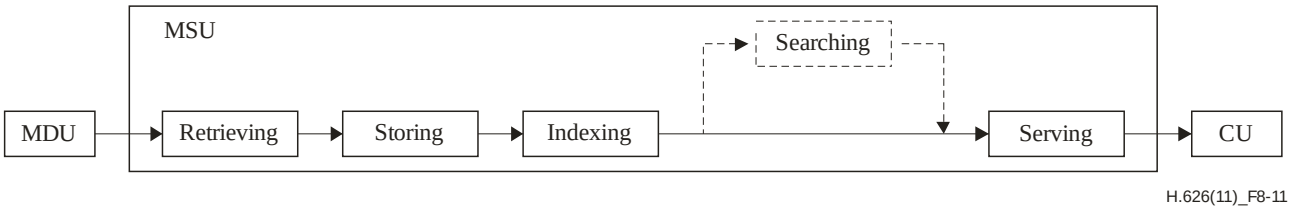



**Figure 8-11 – VS end-to-end media storage and serving process**

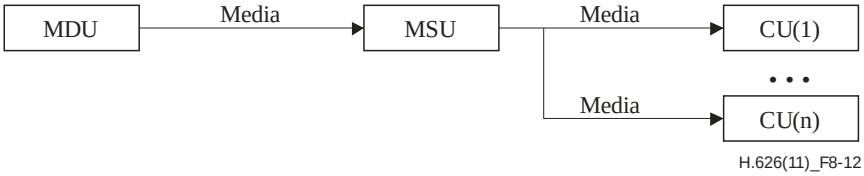



**Figure 8-12 – Media transport mode – playback service**

### 8.6.6 PU: premises unit

PU refers to the premise subsystem within the VS system. It implements the following functions:

– Captures multimedia information (such as audio, video, image, alarm signals, etc.) from the surveilled object

– Encodes multimedia (audio, video, image)

– Outputs alarm signal to external linkage device

– Parses PTZ command codes and transmit them to the devices in order to control pan and camera

– Provides network transport, and transmits bidirectional media stream to other entities and alarm signals.

The media storage function is optional for the PU.

Audio decoding and play function is optional for the PU.

Figure 8-13 shows the function composition of the PU.

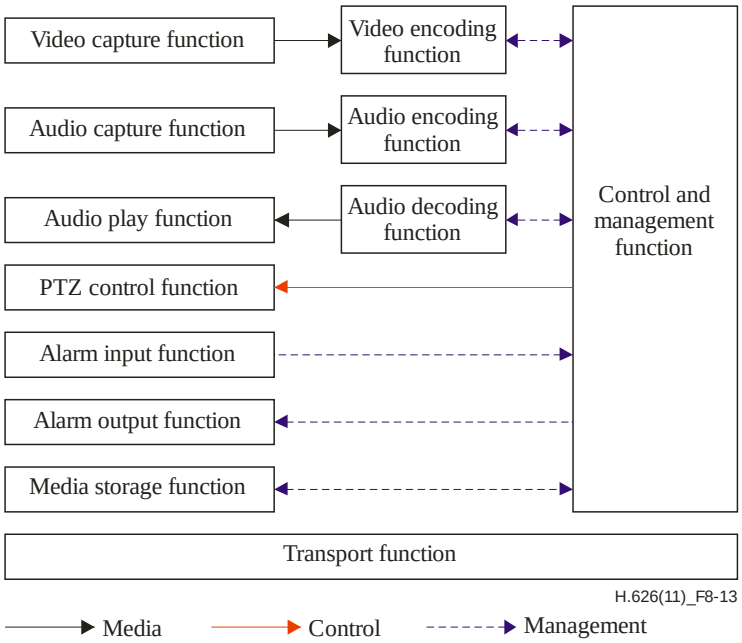



**Figure 8-13 – Function composition of the PU**

The devices of the PU include video capture devices such as various cameras and audio capture devices like microphones, pan and tilt devices, alarm input and output devices, audio/video/image encoding devices.

The PU main reference internal process is as follows.

After encoding by an encoding device of the video stream captured by a camera, of a voice stream captured by a microphone, and of alarm information collected by an alarm device, the PU sends the compressed information or media stream to the service platform or the customer unit that requests this information for real-time surveillance. Meanwhile, the PU extracts the control signal sent from the service platform, parsing the command code and transmitting the PTZ control command to pan and tilt the device to implement PTZ control.

### 8.6.7 CU: customer unit

The CU is the customer unit within the VS system. It is used to present multimedia information (such as audio, video, image, and alarm signal) to the end user. It implements the following functions:

– Multimedia decoding function

– Audio play and video/image display function

– Console interface for the end user to operate the VS system.

Figure 8-14 shows the CU functional composition.

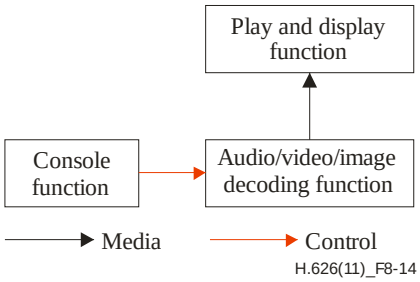



**Figure 8-14 – CU functional composition**

The CU main reference process is as follows.

After decoding and transcoding the media stream transported from the service platform or the PU by the decoding function entity, the media is output to the play and display function entity for presentation to the end user. The play and display function entity can implement some advanced functions, such as the multi-picture surveillance, multi-screen display, multi-screen alternation (e.g., auto-patrol), caption overlay, and designated-area shielding.

The console function provides the GUI to operate and control the VS system for end use. Through the console function, the authorized end user can, e.g., select and display remote video (audio is optional) of one or more surveilled objects, receive alarm signals and trigger linkage actions, set and control the display model, configure the auto-record or alarm conditions, start or stop recoding, and search and play the recorded file.

The CU could be based on PC, MOC, mobile phone, embedded video decoder, embedded web page client, IPTV STB, etc.

## 8.7 Service-control flow

This clause provides the service-control flow descriptions.

### 8.7.1 Alarm and linkage action (ALA)

The alarm and linkage action (ALA) function is used to respond to an input alarm signal event, generate an output alarm activity, and trigger the related linkage actions.

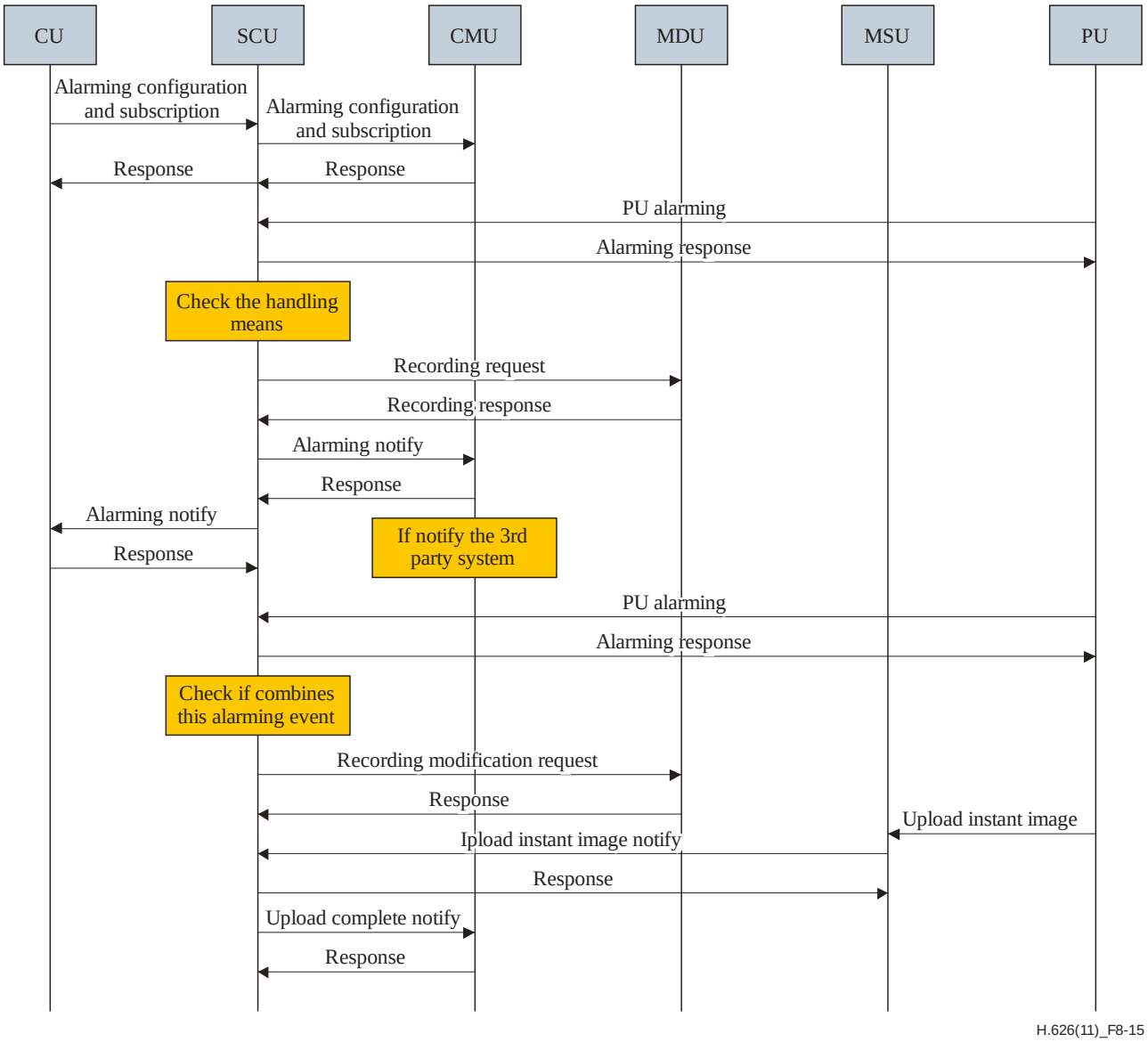



**Figure 8-15 – High-level procedural flows for alarm and linkage action**

Figure 8-15 shows the high-level procedural flows:

1. The CU connects to the SCU in the service platform, subscribes to the alarm service and sets the alarm configuration parameters and subscription.
2. The SCU transfers the configuration and subscription messages to the CMU which saves this information.
3. The CMU returns a response to the SCU which then transfers this response to the CU.
4. When the PU captures an alarm event, it notifies the SCU of this event.
5. The SCU returns an alarm response to the PU and checks how to handle this alarm event.
6. If it needs to start recording, the SCU requests the MDU to start recording. The MDU then returns a recording response to the SCU.
7. The SCU notifies the CMU of the alarm event. The CMU then returns a response to the SCU and determines whether it needs to notify the third-party system to trigger other linkage action, e.g., sending an e-mail or SMS.
8. The SCU notifies the CU of the alarm event. The CMU then returns a response to the SCU and determines how to present to end user.

9. If the PU sends an alarm message to the SCU continually, the SCU then returns a response to the PU and checks if it should combine these alarm events.
10. When recording is in progress, the SCU asks the MDU if it needs to modify the recording time. The MDU handles this request and returns a response to the SCU.
11. If an instant image snapshot is triggered, the PU sends a request and uploads the image file to the MSU.
12. After the image upload is complete, the MSU notifies the SCU of this action. The SCU returns a response to the MSU.
13. The SCU notifies the CMU that a snapshot image has been uploaded completely. The CMU then returns a response to the SCU.

### 8.7.2 Video/audio acquisition (VAA)

The service-control flow of video/audio acquisition (VAA) is classified into two operation modes: one for a single CU and one for multiple CUs.

The audio acquisition function is optional for the VS service. The service-control flow is similar to that of the video acquisition function, although the audio channel is separated from the video channel, so the following high-level procedural flows are applicable for both video acquisition and audio acquisition.

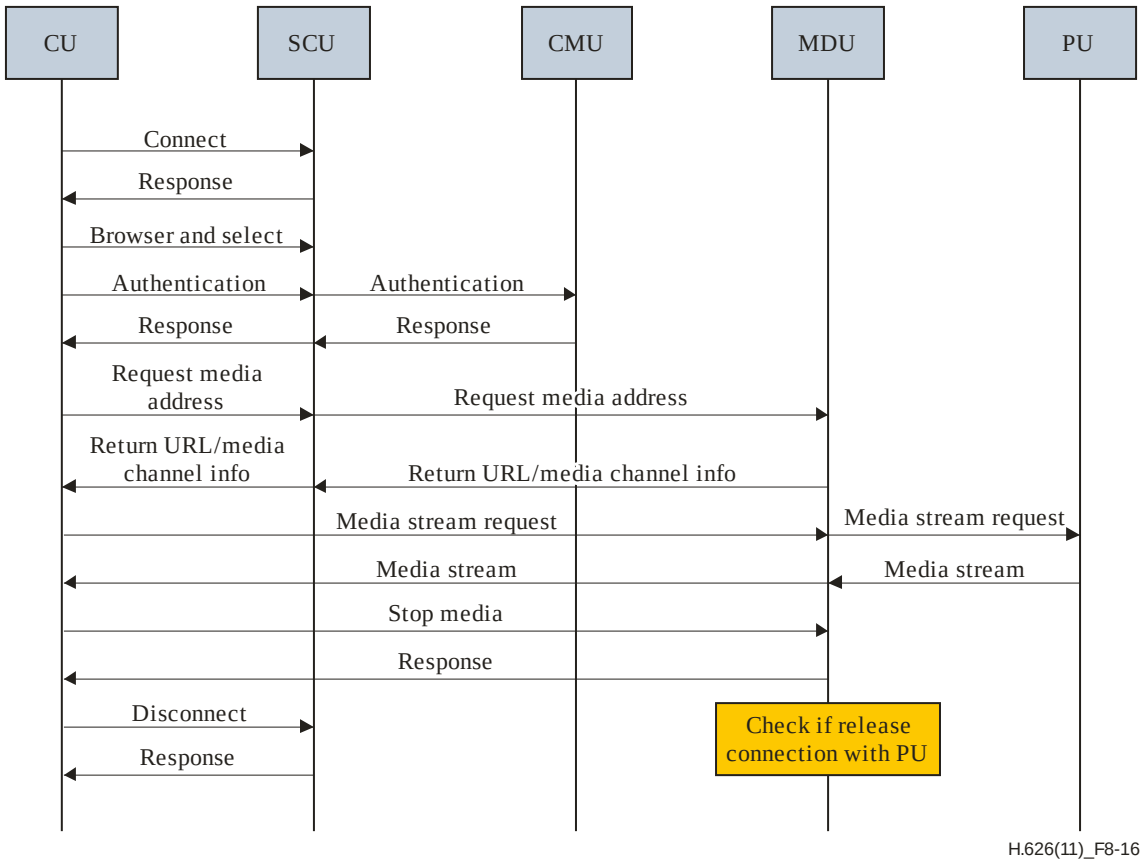



**Figure 8-16 – High-level procedural flows for real-time for one single CU**

Figure 8-16 describes the case of a CU that selects and views a real-time surveillance video/audio from a single PU. In this operation mode, the CU can view multiple PUs at the same time. To get the media stream, the CU obtains a media address from the service platform and creates a media channel with every PU. Since the procedural flows are the same for all PUs; only one PU is shown in Figure 8-16.

1. First, the CU initiates a request and creates a connection with the SCU which then returns a response to the CU.
2. The CU gets the list of PUs from the service platform and selects the PU from which to acquire a real-time media stream.
3. The CU sends authentication information to the SCU, which then transfers it to the CMU, which in turn returns the authentication result to the SCU, which then transfers it back to the CU.
4. The CU requests the SCU for the media serving address. The SCU then transfers this request to the MDU.

   The MDU handles this request and returns the URL/media channel info of the selected PU to the SCU, which then transfers it to the CU.
5. With the media address thus obtained, the CU initiates a media stream request to the MDU. The MDU then requests the PU for a media stream.
6. If needed, the PU creates a media channel with the MDU and sends a media stream to the MDU.
7. The MDU transfers the media stream to the CU. When the CU receives the media stream, it decodes and plays it.
8. When the CU stops the real-time media acquisition, it sends a stop-media request to the MDU.
9. The MDU stops sending the media stream and returns a response to the CU.
10. The MDU needs to check release of the media channels with the PU when no media acquisition is requested from the PU.
11. The CU requests the SCU to disconnect. The SCU then returns a response to the CU which, in turn, ends the real-time media acquisition.

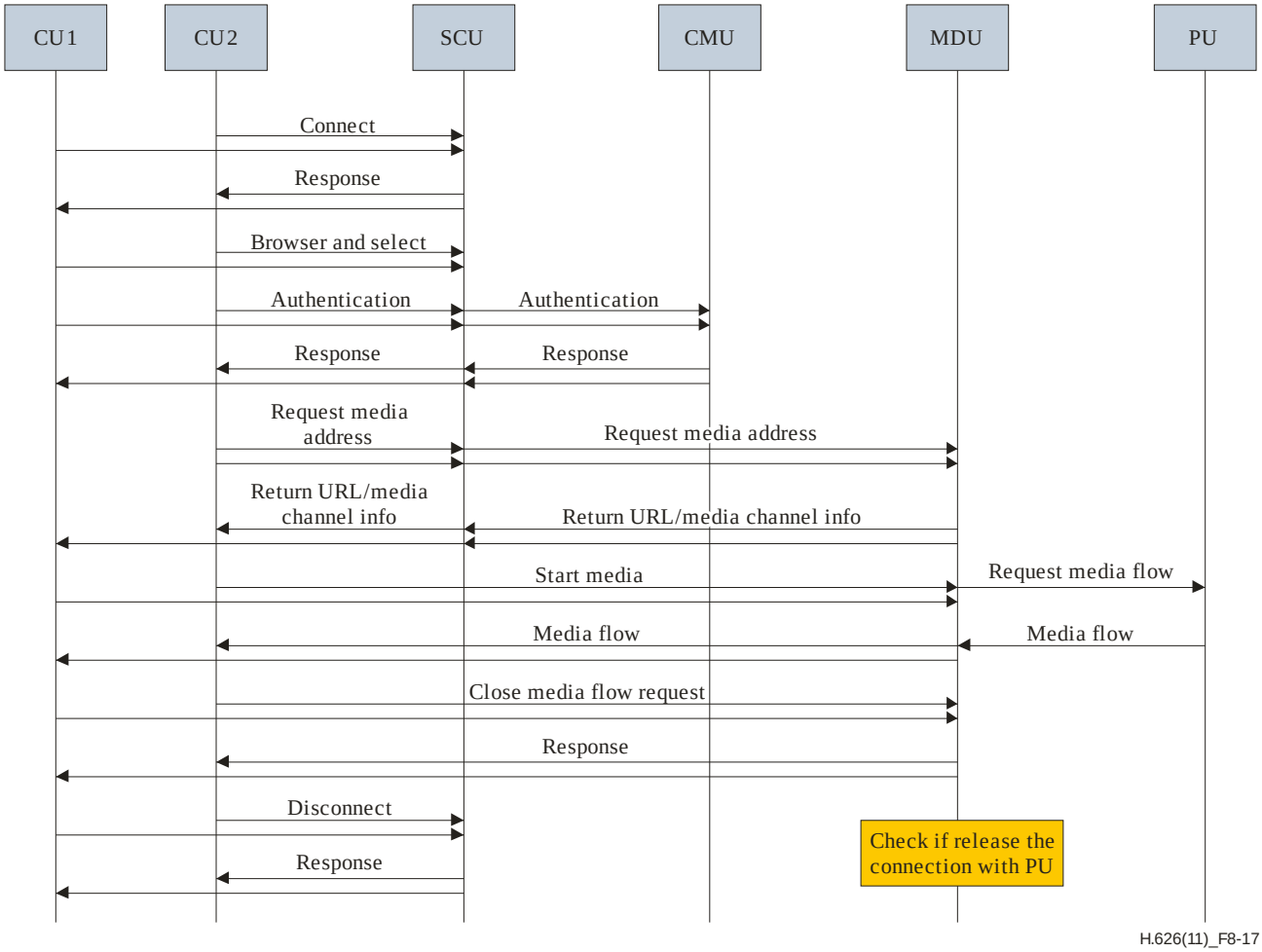



**Figure 8-17 – High-level procedural flows for real-time media acquisition for multiple CUs**

Multiple CUs select and view real-time surveillance video/audio from the same PU (see Figure 8-17):

1. First, multiple CUs initiate requests and create connections with the SCU in the service platform.
2. Each CU gets the list of PUs from the service platform, and selects one of them to view.
3. Each CU sends authentication information to the SCU, which then transfers this information to the CMU. The CMU Then returns the authentication result to the SCU, which then transfers it to the respective CU.
4. Each CU requests a media serving address from the SCU. The SCU then transfers these requests to the MDU.
5. The MDU handles the requests and returns the media addresses of the selected PUs to the SCU, which then transfers them to the respective CU.
6. Each CU initiates a media stream request to the MDU with the channel information of the selected PU. The MDU checks if the media stream from the selected PU to the MDU already exists and, after verification, requests the PU for the media stream. In the scenario where multiple CUs request a media stream from the same PU, the MDU makes a single request for the media stream to the PU, then transcodes (if needed), replicates and distributes the media stream to multiple CUs.
7. The PU creates a media channel with the MDU and sends the media stream to the MDU.

8. The MDU distributes the media stream to each CU that initiated the media stream request.
9. Each CU receives the media stream which it then decodes and transcodes, and outputs the media data to the display devices to play.
10. When a CU wishes to stop viewing the real-time media acquisition, it sends a stop-playing request to the MDU.
11. The MDU stops sending the media stream to that particular CU. If all the CUs wish to stop viewing real-time video/audio of the PU, the MDU stops sending the media stream to all the CUs.
12. The MDU notifies the PU to stop sending the media stream to MDU, and to release the media channel between PU and MDU.
13. Each CU requests the SCU to disconnect. The SCU then returns a response to the respective CU. Each CU then ends real-time media acquisition.

### 8.7.3 Instant image snapshot (IIS)

The instant image snapshot (IIS) function is used to get instant image information based on video from the surveilled object.

There are two ways to obtain an instant image snapshot: one is by the CU implementing snapshot action, and the other is by the PU implementing snapshot action.

The former method involves the CU implementing the snapshot action when playing the surveillance video. The CU gets a frame from the video stream and saves it locally as a snapshot image. There is no interaction with other parts or functional entities of the VS system, so this procedural flow is not discussed in this Recommendation.

The latter method involves implementing the snapshot action in the PU, which then uploads the snapshot image to the service platform from which the CU gets access to this image.

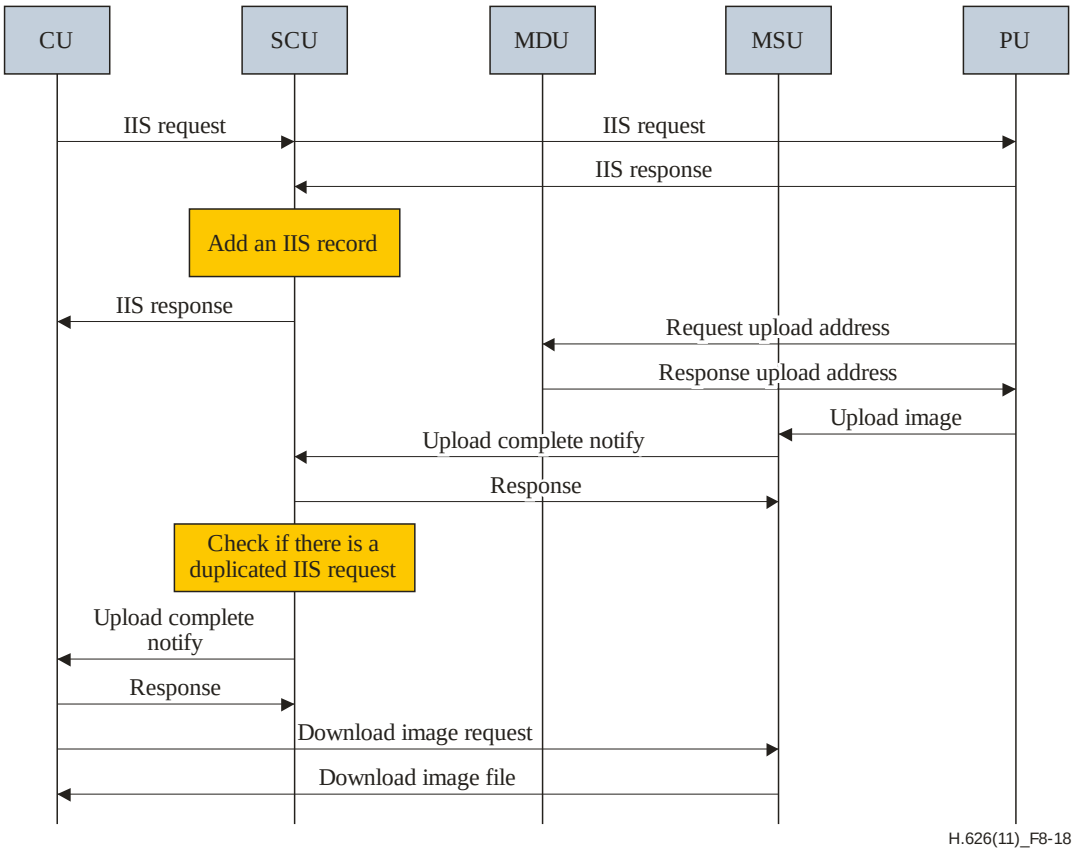



**Figure 8-18 – High-level procedural flows for instant image snapshot**

Figure 8-18 shows the high-level procedural flows for instant image snapshots (IIS), which are as follows:

1. The CU requests the SCU for an IIS with the identification of the requested PU.
2. The SCU transfers this request to the requested PU, which returns a response to the SCU.
3. The SCU adds an IIS record in the service platform and returns a response to the CU.
4. The PU requests the MDU for the image upload address.
5. The MDU handles this request and returns the image upload address to the PU.
6. The PU implements snapshot action and uploads the image to the MSU.
7. When the image uploading action is completed, the MSU notifies the SCU which then returns a response to the MSU.
8. The SCU checks if there are duplicated IIS requests in the same channel. In the affirmative, the SCU sends the identification and storage address of the image uploaded by the PU to the CU which had sent the duplicate request.
9. The CU requests the MSU to download the snapshot image.
10. The MSU handles this request and sends the image to the CU. The CU receives this image for viewing.

### 8.7.4 Recording and playback (RnP)

The recording function is used to record multimedia information about the surveilled object, and stores this information either in terminal devices or in the service platform.

There are two recording modes depending on trigger conditions: automatic and manual. There are three different methods of media storage: in the service platform, in the PU, and in the CU.

When the CU views real-time surveillance data and stores the received media stream in the CU, no additional interactions with other parts of the VS system is required. The flows of this scenario are simple and hence the following procedural flows do not cover this method.

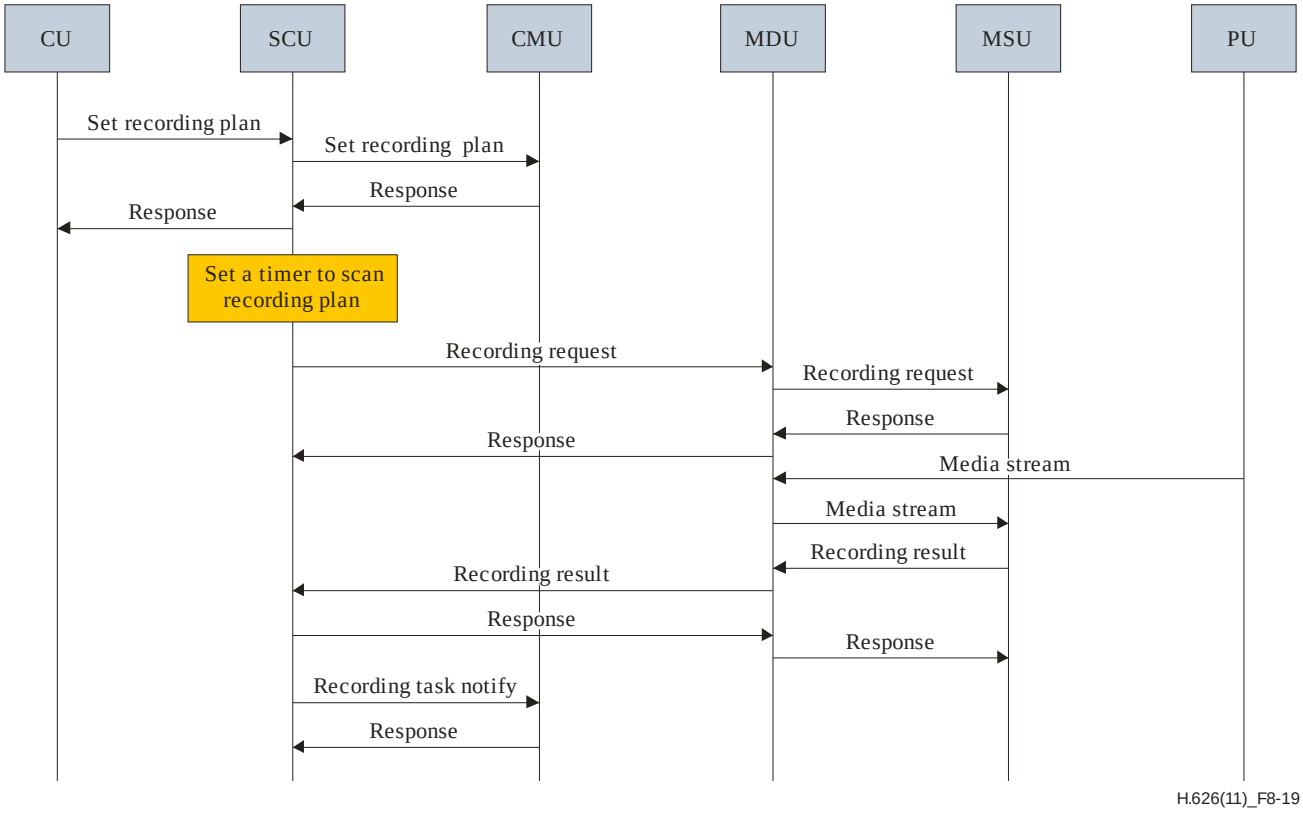



**Figure 8-19 – High-level procedural flows for automatic recording in the service platform**

Figure 8-19 shows the procedural flows for recording in the service platform by automatic mode (e.g., triggered by a timer), which are as follows:

1. The CU sets a recording plan in the service platform of the SCU.
2. The SCU transfers this recording plan to the CMU, which saves this plan (e.g., in a database).
3. The CMU returns a response to the SCU for this recording plan, and the SCU then returns this response to the CU.
4. In the service platform, the SCU sets a timer to constantly scan all of the recording plans or monitors other preset configuration conditions.
5. When the SCU gets a recording event, it sends a recording request to the MDU which transfers this request to the MSU.
6. The MSU returns a response to the MDU, which in turn transfers this response to the SCU.
7. The media stream is sent from the PU to the MDU, which transfers the media stream to the MSU for storage and management.
8. When the timer expires, the MSU notifies the MDU that the recording task is completed, with information on the start and end time. The MSU transfers this notification to the SCU.
9. The SCU returns a response to the MDU, which in turn transfers this response to the MSU.
10. The SCU notifies the CMU that the recording task is completed, and the CMU saves the related recording information.
11. The CMU returns a response to the SCU. The whole recording task is finished.

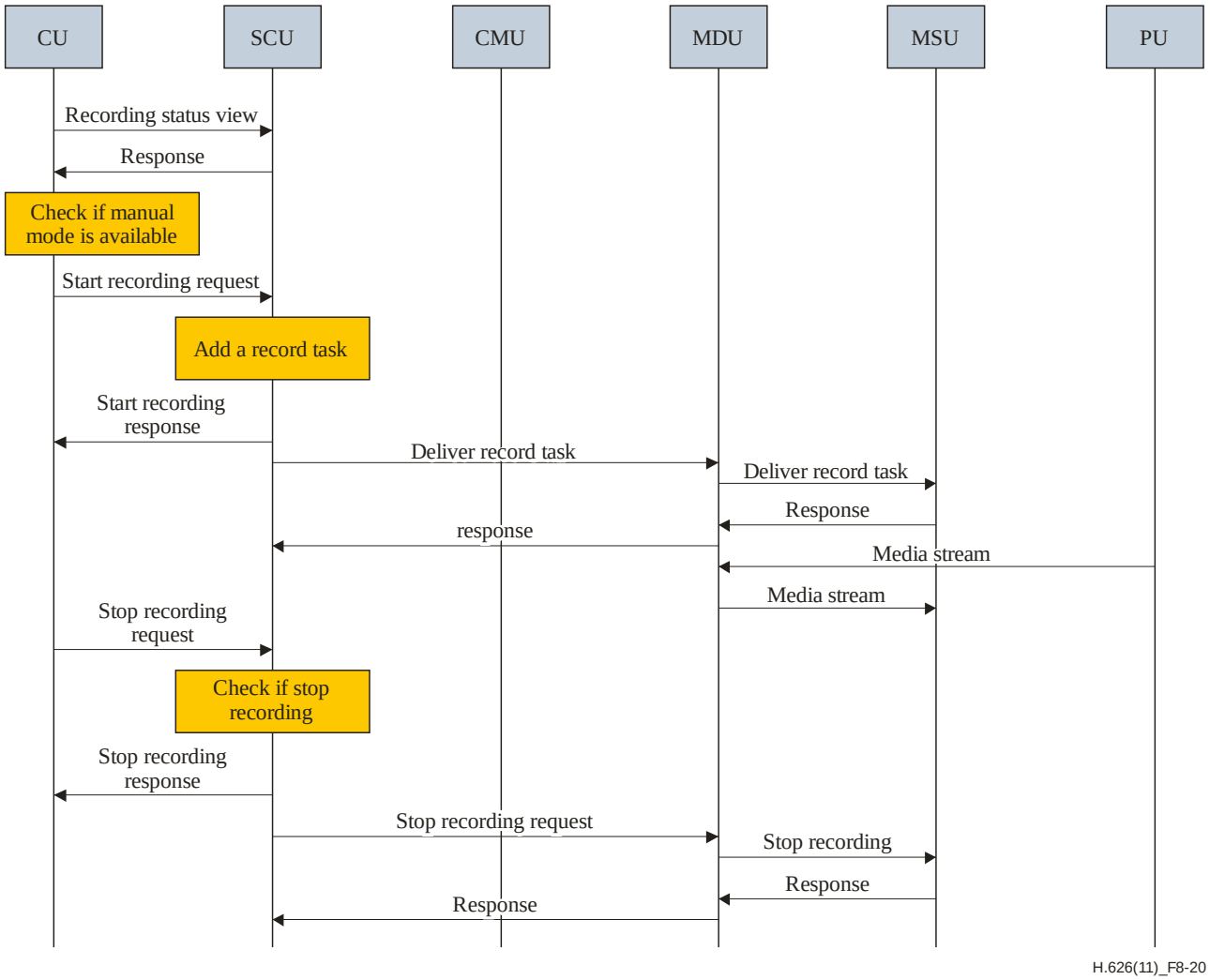



**Figure 8-20 – High-level procedural flows for manual recording in the service platform**

Figure 8-20 shows the procedural flows for recording in the recording platform by manual mode:

1. The CU sends a recording status view request to the SCU.
2. The SCU returns a response with the current recording status to the CU.
3. After receiving the recording status, the CU checks on the availability of recording in the service platform by manual mode.
4. If the manual mode is available, the CU sends a start recording request to the SCU.
5. The SCU adds a recording task to the list, and returns a response to the CU.
6. The SCU delivers this recording task to the MDU, which assigns the task to the MSU.
7. The MSU returns a response to the MDU which transfers this response to the CU.
8. The media stream is sent from the PU to the MDU, which transfers the media stream to the MSU for storage.
9. When the CU wants to finish this task, it sends a stop recording request to the SCU.
10. The SCU checks if recording have stopped, taking into consideration other conditions such as automatic recording tasks.
11. The SCU sends a stop recording request to the MDU which transfers this request to the MSU.

12. The MSU stops recording and storing the media stream. The MSU then returns a response to the MDU, which transfers this response to the SCU.

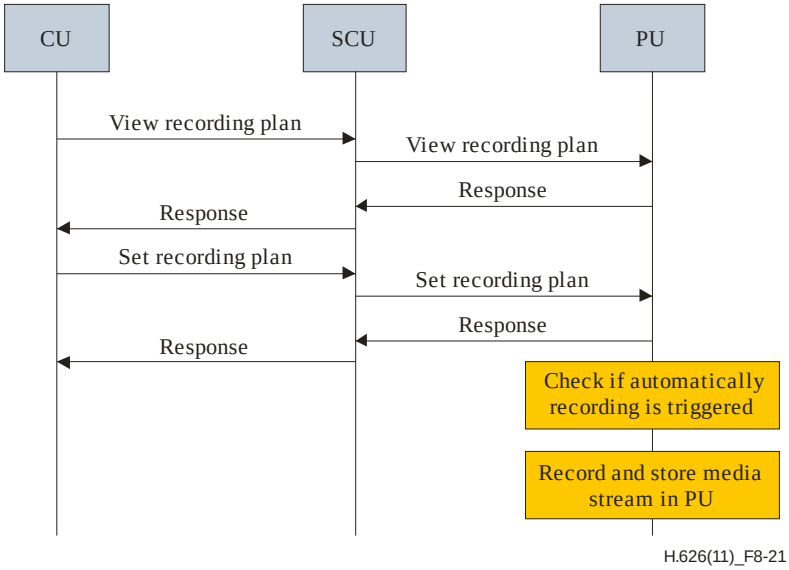



**Figure 8-21 – High-level procedural flows for recording in the PU by automatic mode**

Figure 8-21 shows the procedural flows for recording in the PU by automatic mode:

1. The CU sends a request to the SCU to view the recording plan, and it transfers this request to the PU.
2. The PU returns a response with the recording plan to the SCU, which transfers this response to the CU.
3. The CU sends to the SCU a recording plan setting for the PU.
4. The SCU transfers this recording plan setting to the PU, which saves the data.
5. The PU sets a timer to scan all of the recording plans constantly, or monitors other preset configuration conditions.
6. When the PU gets a recording event, it starts recording and saving the media stream in the PU. The PU stops recording when the triggering conditions are over.

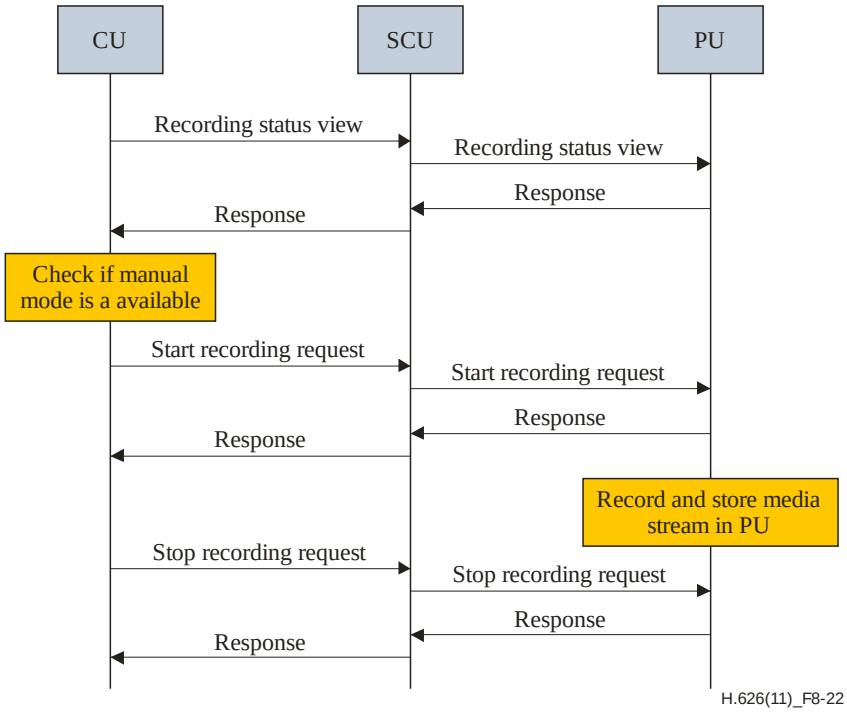



**Figure 8-22 – High-level procedural flows for recording in the PU by manual mode**

Figure 8-22 shows the procedural flows for recording in the PU by manual mode:

1. The CU sends a recording status view request to the SCU, which transfers this request to the PU.
2. The PU returns a response with the current recording status to the SCU, which transfers this response to the PU.
3. After receiving the recording status, the CU checks if recording in the PU by manual mode is available.
4. If the manual mode is available, the CU sends a start recording request to the SCU, which transfers this request to the PU.
5. The PU starts to record and save the media stream in the PU.
6. When the CU wants to finish this task, it sends a stop-recording request to the SCU.
7. The SCU transfers this request to the PU.
8. The PU checks if recording has stopped, taking into consideration other conditions such as automatic recording tasks. The PU returns a response to the SCU, which transfers this response to the CU.

The playback function is used to play audio and video information that has been previously recorded and stored.

There are three locations at which recorded media can be stored: in the service platform, in the PU and in the CU. When playing recorded media from the PU, there are two playback modes: direct playback from the PU, and playback transferred by the MDU in the service platform.

The CU plays the recorded media that has been stored just like playing any local media file. As additional interaction with other parts of the VS system is not needed, the following procedural flows do not cover this scenario.

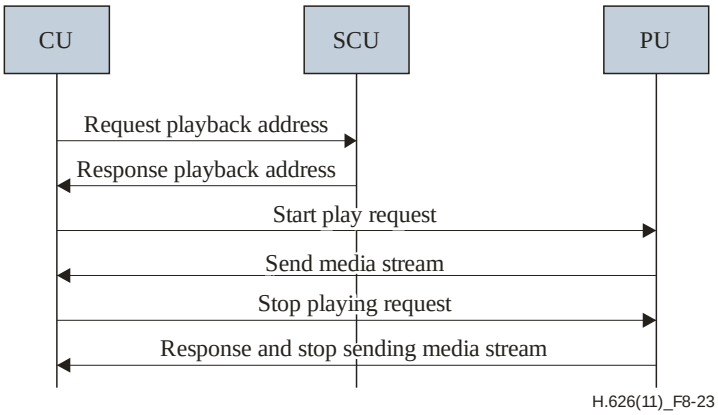



**Figure 8-23 – High-level procedural flows for playback directly from the PU**

Figure 8-23 shows the procedural flows for playback directly from the PU:

1. The CU requests the SCU for the playback address.
2. The SCU returns a response with the playback address to the CU.
3. The CU requests the PU to send the media stream with the address thus obtained.
4. After authentication, the PU handles this request and starts sending the media stream to the CU.
5. To end this playback, the CU sends a stop-playing request to the PU.
6. The PU handles this request, stops sending media stream and returns a response to the CU.

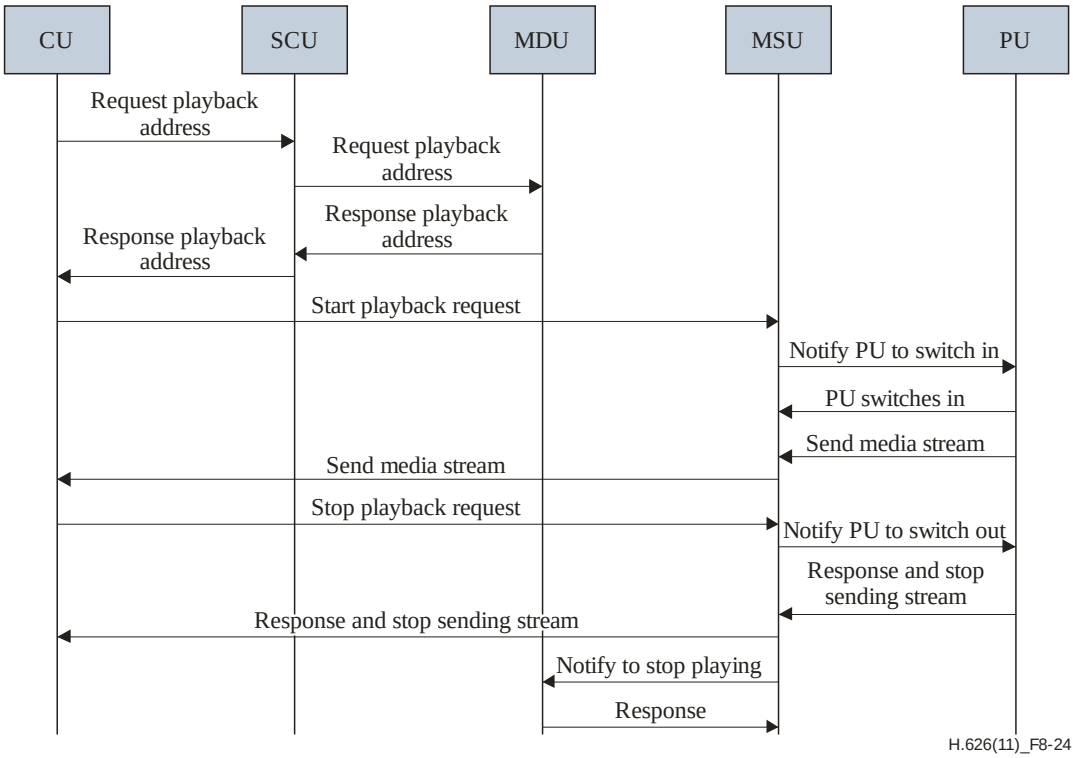



**Figure 8-24 – High-level procedural flows for playback from the PU by transferred mode**

The procedural flows for playback from the PU by transferred mode are (see Figure 8-24):

1. The CU requests the SCU for a playback address. The SCU transfers this request to the MDU.
2. The MDU returns a response with the playback address to the SCU which transfers it to the CU.
3. The CU requests the MSU to send the media stream with the address thus obtained.
4. After authentication, the MSU notifies the PU to switch in.
5. The PU switches in and starts sending the media stream to the MSU.
6. The MSU starts transferring the media stream to the CU.
7. To end this playback, the CU sends a request to stop playing to the MSU.
8. The MSU notifies the PU to switch out.
9. The PU switches out and stops sending the media stream to the MSU.
10. The MSU stops sending the media stream and returns a response to the CU.
11. The MSU then notifies the MDU that the playback is finished. The MDU returns a response to the MSU.

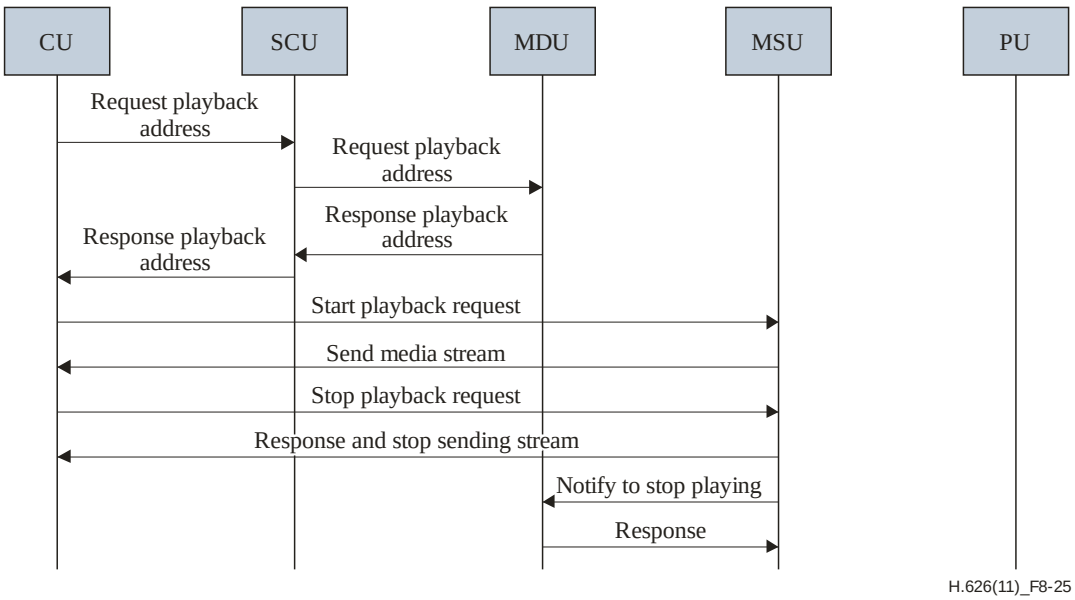



**Figure 8-25 – High-level procedural flows for playback from the service platform**

Figure 8-25 shows the procedural flows for playback from MSU in the service platform:

1. The CU requests the SCU for the playback address. The SCU transfers this request to the MDU.
2. The MDU returns a response with the playback address to the SCU which transfers this response to the CU.
3. The CU requests the MSU to send the media stream with the address thus obtained.
4. After authentication, the MSU starts sending the media stream to the CU.
5. To end this playback, the CU sends a request to stop playing to the MSU.
6. The MSU stops sending the media stream and returns a response to the CU.
7. The MSU notifies the MDU that playback is finished. The MDU returns a response to the MSU.

### 8.7.5 Voice (audio) communication

There are two modes for voice (audio) communication: unidirectional voice communication mode (UVCM) and bidirectional voice communication mode (BVCM). The following describes high-level service-control flows for these two modes.

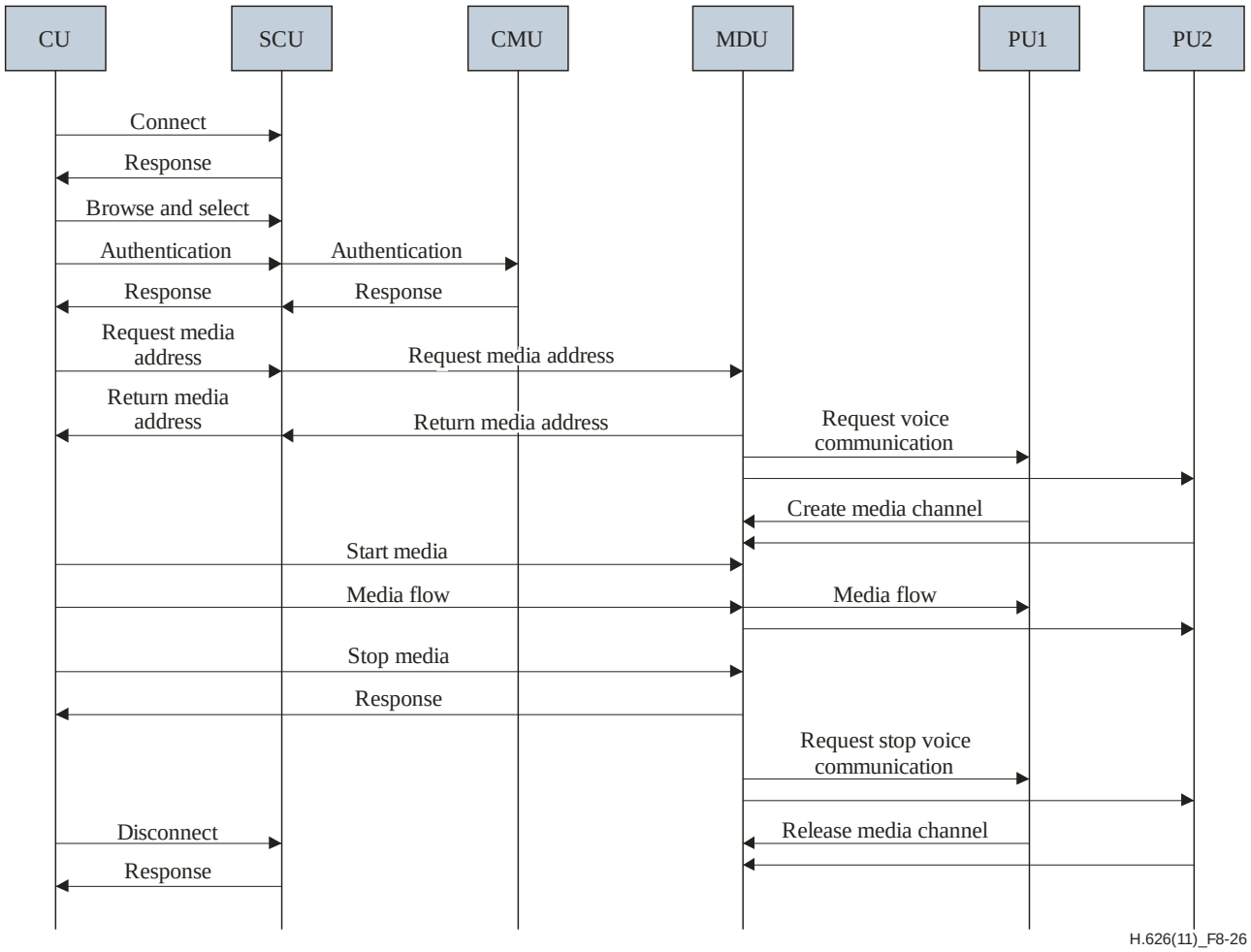



**Figure 8-26 – High-level procedural flows for unidirectional voice (audio) broadcast**

The flows for unidirectional voice communication (also named 'broadcast') are (see Figure 8-26):

1. The CU creates a connection with the SCU, which returns a response to the CU.
2. The CU obtains the list of PUs from the service platform and selects the PUs with which it wishes to communicate.
3. The CU sends authentication information to the SCU, which transfers this information to the CMU.
4. After authentication, the CMU returns the authentication result to the SCU; the SCU then transfers the authentication result to the CU.
5. The CU requests the SCU for the media address. The SCU transfers this request to the MDU.
6. The MDU returns a response with the media address (such as URL or media channel information) to the SCU, which transfers this response to the CU.
7. The MDU sends a unidirectional voice communication request to each PU that has been selected.
8. Each PU receives the request and creates a unidirectional media channel with the MDU.

9. The CU sends a start media request to the MDU with the address thus obtained, and creates a unidirectional media channel to the MDU.
10. The CU sends the media stream to the MDU, which transfers or broadcasts it to every selected PU.
11. To stop the voice (audio) communication, the CU requests the MDU to stop the media stream. The MDU transfers this request to each affected PU and returns a response to the CU.
12. Each PU releases the unidirectional media channel with the MDU.
13. The CU releases the unidirectional media channel with the MDU and sends a disconnect request to the SCU, which in turn returns a response to the CU. The CU then disconnects from the service platform.

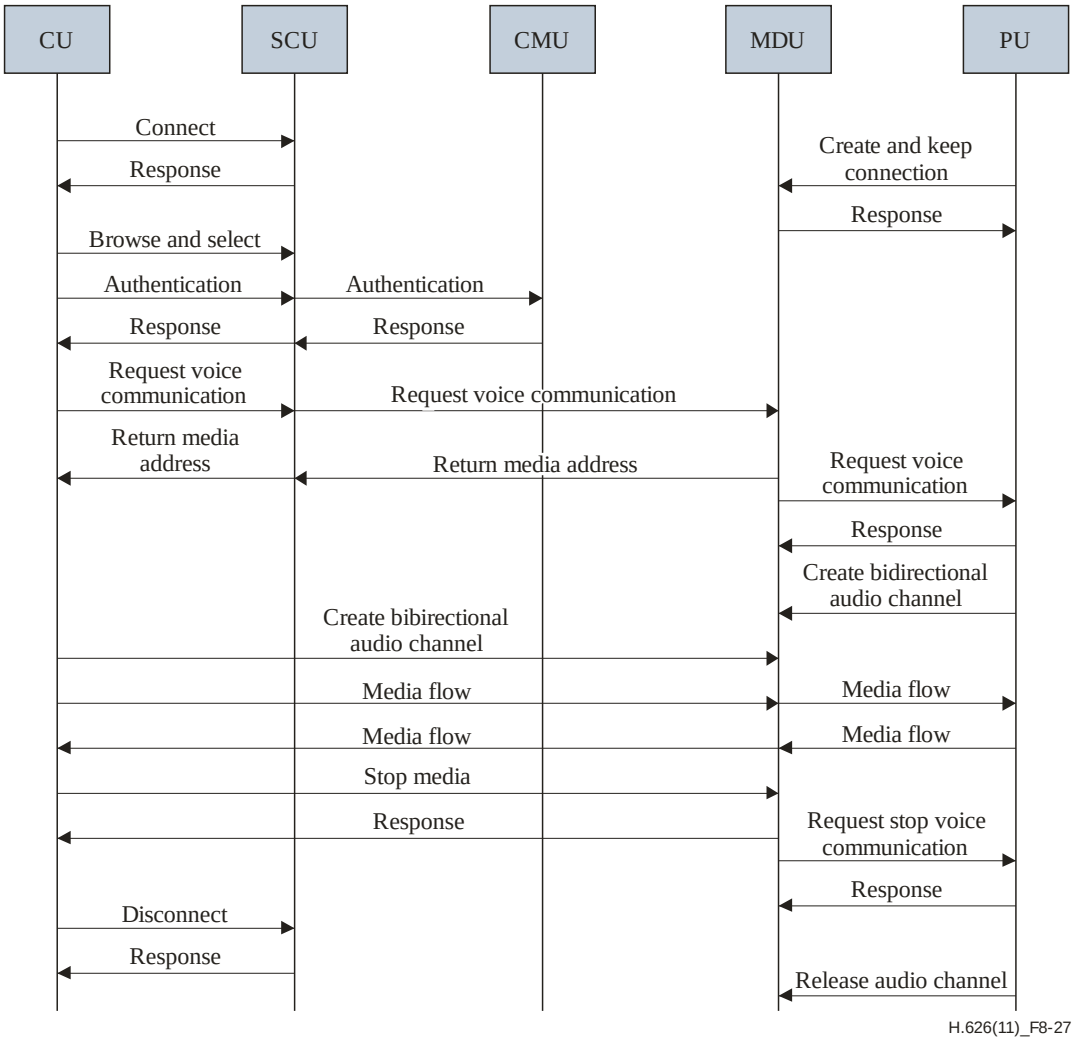



**Figure 8-27 – High-level procedural flows for real-time voice communication**

The flows for bidirectional voice communication are (see Figure 8-27):

1. The CU creates a connection with the SCU in the service platform, and the SCU returns a response to the CU.
2. The PUs create and keep connections with the service platform. The CU obtains and browses the list of PUs from the service platform, and selects a PU with which to communicate.

3. The CU sends authentication information to the SCU, which transfers this information to the CMU.
4. After authentication, the CMU returns the authentication result to the SCU. The SCU then transfers the authentication result to the CU.
5. The CU requests the SCU for the media address. The SCU transfers this request to the MDU.
6. The MDU returns a response with the media address (such as URL or media channel information) to the SCU. The SCU transfers the address to the CU.
7. The MDU requests the selected PU for a bidirectional voice communication.
8. The PU receives the request and creates a bidirectional media channel with the MDU.
9. The CU requests the MDU to start the media flow with the address thus obtained, and creates a bidirectional media channel with the MDU.
10. The CU sends the voice stream to the MDU through the channel created between the CU and the MDU. The MDU transfers the voice stream to the PU through this channel.
11. The PU sends the voice stream to the MDU through the channel created between the PU and the MDU. The MDU transfers the voice stream to the CU through this channel.
12. The CU requests the MDU to stop voice communication. The MDU transfers this request to the PU and returns a response to the CU.
13. The PU releases the bidirectional media channel with the MDU.
14. The CU releases the bidirectional media channel with the MDU, and sends a disconnect request to the SCU, which returns a response to the CU. The CU then disconnects from the service platform.

### 8.7.6 PTZ control

The PTZ control function is used to, e.g., pan, tilt and zoom video cameras, switch auxiliary peripherals (such as flashlight, fan and rain brush), and preset the position of related physical devices.

Figure 8-28 shows the high-level procedural flows:

1. The CU sends a PTZ control request to the SCU with authentication information.
2. After authentication, the SCU transfers this request to the PU.
3. The PU parses this request and transfers the PTZ control commands to the related physical devices. The devices then perform PTZ operations.
4. The PU returns a response to the SCU, which transfers this response to the CU.
5. The SCU writes logs for each event.
6. The SCU uploads the logs to the CMU, which returns a response to the SCU.

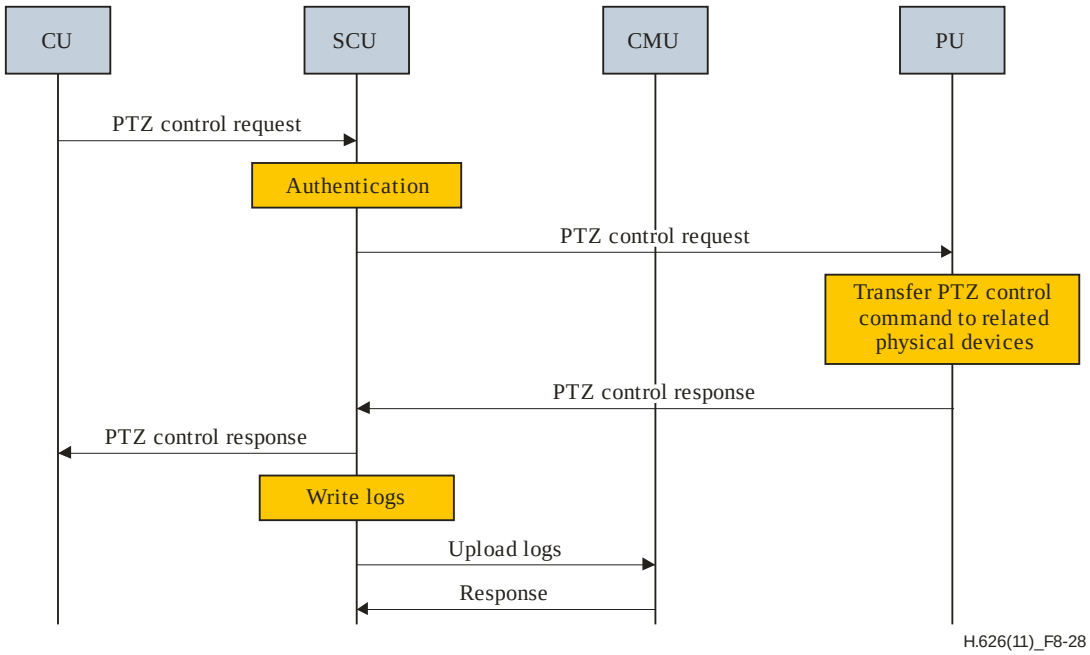



**Figure 8-28 – High-level procedural flows for PTZ control**

## 9 Hierarchical deployment model

The video acquisition system supports a hierarchical deployment structure. Resources can be accessed by the end user or other functional entities in different zones. A zone is composed of all the decomposed components which are managed by the same CMU described in the former text.

### 9.1 Connection models

There are two different modes for connecting multiple-service platforms, parallel and cascade connection modes.

In the parallel connection mode, two CMUs in different service platforms are parallel, they can visit resources managed by each other. Figure 9-1 shows the structure.


**Figure 9-1 – Multiple-platform connection in parallel mode**

In the cascade connection mode, the CMU in different service platforms are not parallel and form hierarchical structure, as illustrated in Figure 9-2. CMU-B and CMU-C can access resources managed by CMU-A. Similarly, CMU-A can access resources managed by CMU-B or CMU-C. However, CMU-B and CMU-C cannot access each other directly, as interactions are intermediated by CMU-A.

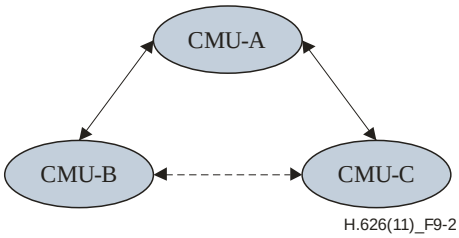



**Figure 9-2 – Multiple-platform connection in cascade mode**

## 9.2 Multi-zone management unit

The connection mode between multiple CMUs in different service platforms is configured and managed by the multi-zone management unit (MZMU) illustrated in Figure 9-3. MZMU in one zone manages the devices and resources belonging to other service platforms, as well as the routing information. At the same time, it allocates devices and resources to share with other service platforms. The MZMU function includes registration of service platforms, devices allocation, devices and resources searching, etc.

MZMUs in different zones communicate with each other by configured information such as IP address and authentication information.

The MZMU shares the database system (DBS) of the VS system with the CMU in the same zone, so that the other function entities in the same zone can get information about devices allocated by the MZMU through the CMU.

The interface Zz between two MZMUs in different zones is used to deliver allocating information for multiple-zone communication.

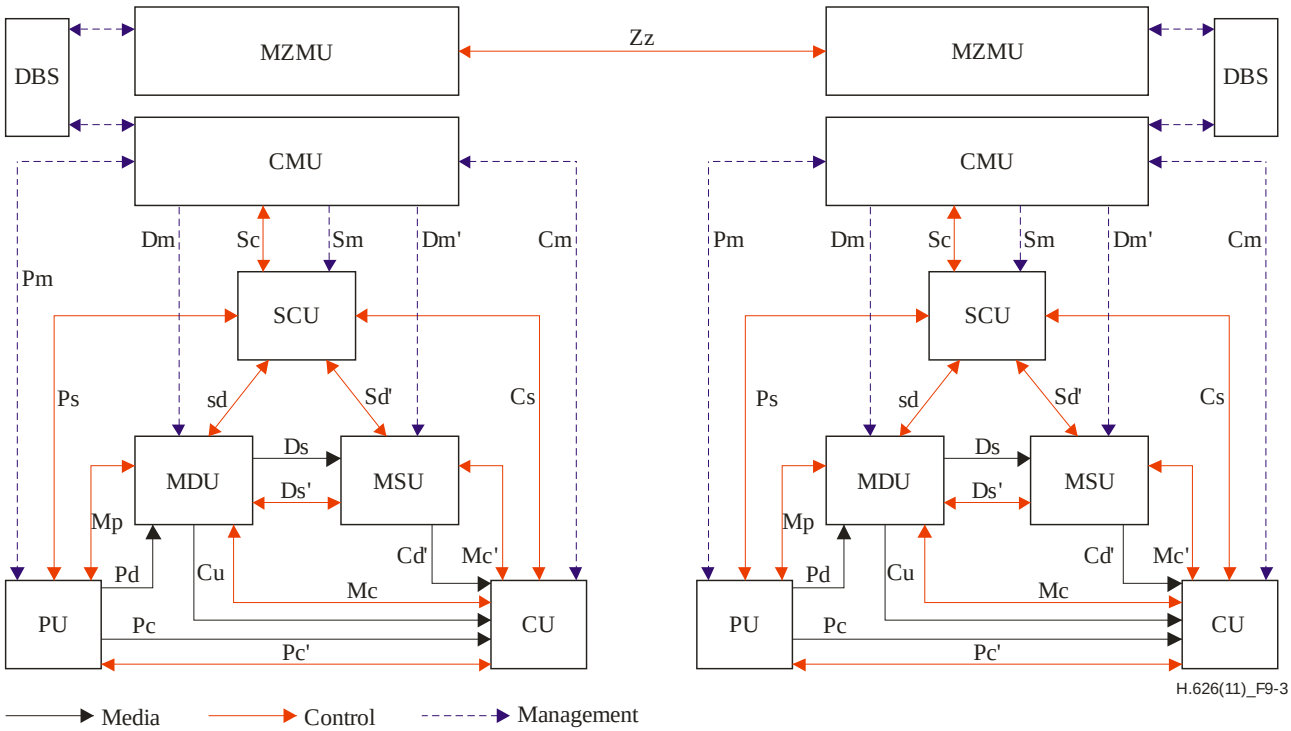



**Figure 9-3 – Multiple zones communicate through MZMU**

## 9.3 Deployment instances

**Instance 1 by parallel connection mode:**

This instance is illustrated in Figure 9-4. Service platform 1 (P1) is located in zone A, and service platform 2 (P2) is located in zone B. Two CUs, CU1 and CU2, access P1 and P2 respectively. PU1 is located in zone A and PU2 is located in zone B. PU1 and PU2 connect with P1 and P2, respectively. CU1 needs to visit PU2, and CU2 needs to visit PU1.

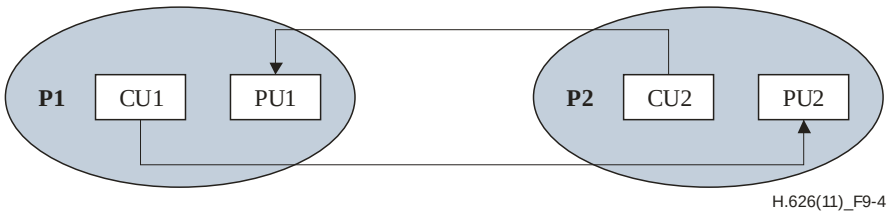



**Figure 9-4 – Multiple zones communicate by parallel connection mode**

The following procedure shows how CU1 visits PU2, and similarly it shows how CU2 visits PU1:

1. The CMU of P1 is registered to the MZMU of P2 through the MZMU of P1. After registration, the administrator configures the routing information for visiting the CMU of P2 in the MZMU of P1.
2. The administrator allocates and shares PU2 to P1 through the MZMU of P1.
3. Further, the administrator allocates PU2 to CU1 through the MZMU of P1.
4. Then, CU1 requests P1 to get the media stream of PU2. P1 transfers this request to P2 according to the routing information configured in the MZMU of P1.
5. CU1 gets the media stream from PU2 directly, or transferred by the MDU in two service platforms.

**Instance 2 by cascade connection mode:**

This instance is illustrated in Figure 9-5. Service platform 1 (P1) is located in zone A, and service platform 2 (P2) is located in zone B. Two CUs, CU1 and CU2, access P1 and P2, respectively. PU1 is located in zone A and PU2 is located in zone B. PU1 and PU2 connect with P1 and P2, respectively. CU1 needs to access PU2, and CU2 needs to access PU1.

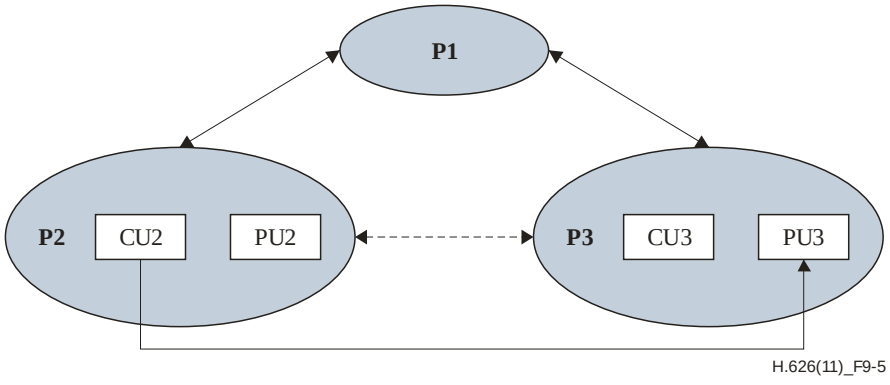



**Figure 9-5 – Multiple zones communicate by cascade connection mode**

The following procedure shows how CU2 accesses PU3, and similarly it shows how CU3 accesses PU2:

1. P3 shares its resources with P1 by configuration in the MZMU of P3 and permits P1 to share theses resources with other service platforms.
2. P2 requests P1 to share the resources belonging to P3.
3. P1 allocates and shares PU3 to P2 through configuration in the MZMU of P1.
4. Further, P2 allocates PU3 to CU2 through configuration in the MZMU of P2.
5. Then, CU2 requests P1 to get the media stream of PU3. P1 transfers this request to P3 according to the routing information configured in the MZMU of P1.
6. CU2 gets the media stream from PU3 directly or transferred by the MDUs of P2 and P3.

## 10 Interworking and convergence

This clause addresses the system interworking and service convergence between VS and other multimedia systems, such as IPTV and videoconferencing.

### 10.1 Interworking with videoconferencing

The interworking and convergence between VS and videoconferencing systems is based on the consideration that surveilled media stream is introduced into videoconferencing system through the media stream server in the service platform, CUs or PUs of the VS system.

The following are instances of interworking between VS and videoconferencing systems:

**Instance 1**: A surveilled video stream is introduced into the videoconferencing system through the media stream server in the service platform of the VS system.

– A streaming server is added between the service platform of the VS system and the videoconferencing system. The streaming server stores the media resource providing for video conferencing from the VS system, and publishes the link addresses of the media resource to an EPG server.
– A videoconferencing terminal accesses the EPG server to select and obtain the media address.
– The videoconferencing terminal initiates sending of the media stream request to the streaming server with the media address, and obtains the media stream from the streaming server. It then transfers it to the MCU or other terminals in the video conferencing system.

**Instance 2**: A surveilled video stream is introduced into the videoconferencing system through the CU in the VS system.

– The CU in the VS system creates connections with the videoconferencing terminal, including signalling and media communication.
– The CU decodes the media stream and transfers it from the VS system to the videoconferencing terminal. This media stream is served as one of the input media sources for the videoconferencing terminal.
– The videoconferencing terminal broadcast this media stream within the videoconferencing system.

**Instance 3**: A surveilled video stream is directly introduced into the videoconferencing system through the PU in the VS system.

– The PU in the VS system creates connections with the MCU in the videoconferencing system.

– The MCU regards this PU as a virtual videoconferencing terminal and convenes it into the video conferencing.
– The MCU handles the media stream from the PU like from other videoconferencing terminals.

### 10.2 Interworking with IPTV

The interworking and convergence between VS and IPTV systems is based on the following considerations:

– The VS system can provide the VS service to the IPTV end user via interworking with the IPTV system.
– The IPTV end user can access the VS system via IPTV terminal devices (e.g., set-top box), which can act as the end-user functions.
– The IPTV end user can access the VS system via IPTV EPG, which can act as the VS service entry.
– The audio, video and alarm signal information from the VS system can be inserted into the closest related IPTV CDN system, and be delivered to IPTV terminal devices (e.g., set-top box).
– The IPTV end user can play audio and video and get alert signals information from the VS system, and can also control the PTZ functions of the video camera with authorization.

The following describes an instance of interworking between VS and IPTV:

– PUs, the IPTV system and user terminals connect to the same bearer network used for multimedia services.
– PUs capture video and audio information from the surveilled objects, transcode and encode into the media stream.
– PUs send the media stream to media servers in the IPTV system. The media servers process, store and manage the media stream data.
– User terminals connect to the PUs through the IPTV system, view the real-time video and audio information captured by the Pus, and also take remote control of the PUs.
– User terminals can also view the recording media data from PUs stored in media servers in the IPTV system.

## 11 Visual surveillance management system

The relatively independent VS system, unified network management system (UNMS), implements four main functions: configuration, system alert and notification, performance measurement, and signal tracking.

It is recommended that the UNMS provide the topological graph of the whole VS system, from which the administrator observes the structure of the network and devices, and the performance status of the network devices, etc.

### 11.1 Configuration function

It is recommended that the UNMS implement configuration and management for all devices in the VS system, including platform and terminal devices. Configuration and management functions implement the configuration for device-performance parameters, and service-related properties, etc. The UNMS supports input and output of device configuration data.

## 11.2 Signal tracing function

Signal tracing has two models: one is to track user behaviour, and the other is to track the signal flow and process inside the service platform:

– Tracing a user's behaviours: The UNMS sends commands to the terminals to indicate that the terminals send back a signal record for a specific performance.

– Tracing internal signal flow: The signal flow inside the service platform, such as signals from SCU to MDU, MDU to MSU, and so on, are recommended to be observed directly through the UNMS, not only the flow track but also the signal content.

## 11.3 Alert and notification function

– Alert and notification function implements alert collection, process, presenting, report and regulation management for all the devices within the entire system.

– Alert processing includes alert filtering, confirmation, elimination, synchronization, alert-level promotion, etc. It also supports the alert information forwarding by e-mail, SMS, etc.

– Alert presence function supports presenting new alert messages by voice and light. Voice presence, voice alert is to notify customers about a new alert message available, as well as the alert level through voice signal. Light presence is to notify customers about a new alert message available by changing colour or flickering the icon or text in the topological graph.

– Alert report function supports search and statistics for current and historic alert information record.

– Alert regulation management function supports redefining the alert level, alert filtering, etc.

## 11.4 Performance measurement function

The performance measurement function provides for device performance monitoring and analysis. According to the performance data collected from devices in the system, the UNMS processes and generates performance reports in order to provide information for maintenance and management personnel, indicating the system deployment, design and modification, and improving QoS of the VS service.

# Appendix I

## Security considerations

(This appendix does not form an integral part of this Recommendation.)

This clause describes some security considerations for visual surveillance (VS):

– Authentication for access to device, network, service and media.
– Authorization for use of device, network, service and media.
– Integrity and confidentiality of device, network, service and media.
– Log to trace the use of device, network, service and media.
– Encryption of the media content for redistribution.
– Constraints of exportation licenses.
– Key management.

# Bibliography


[b-ITU-T H.Sup.1] ITU-T H-series Recommendations – Supplement 1 (1999), *Application profile – Sign language and lip-reading real-time conversation using low bit rate video communication.*

[b-ITU-T J.200] Recommendation ITU-T J.200 (2001), *Worldwide common core – Application environment for digital interactive television services.*

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

[b-ITU-T M.3320] Recommendation ITU-T M.3320 (1997), *Management requirements framework for the TMN X-Interface.*

[b-ITU-T Q.1290] Recommendation ITU-T Q.1290 (1998), *Glossary of terms used in the definition of intelligent networks.*

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

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