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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

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

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Architecture for visual surveillance system interworking

Recommendation ITU-T H.626.3

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Recommendation ITU-T H.626.3

Architecture for visual surveillance system interworking

Summary

Recommendation ITU-T H.626.3 defines an architecture of visual surveillance system interworking. A visual surveillance system is deployed as a standalone and fully autonomous system, and the data and resources cannot be shared between different visual surveillance systems. The visual surveillance system interworking mechanism enables communication among the different visual surveillance systems, and this interworking mechanism can realize the cross-system sharing of data and resources. This Recommendation describes the architecture, entities, reference points, service control flows and deployment models for visual surveillance system interworking.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.626.3	2018-08-29	16	11.1002/1000/13669

Keywords

Architecture, deployment model, entity, interworking, reference point, service control flow, visual surveillance.

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Architecture for visual surveillance system interworking

1 Scope

This Recommendation describes the architecture, functional entities, reference points, service control flows and deployment models for visual surveillance system interworking.

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 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.

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

3.1.3 functional architecture [b-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 – 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.

3.1.4 functional entity [b-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.

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

3.1.6 reference point [b-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.

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

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

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 central control server (CCS): A device located at the central part of the visual surveillance system. It is used for centralized system management, service operation management and access control.

3.2.2 control protocol gateway (CPG): A gateway device located between two heterogeneous visual surveillance systems. It is used for routing, forwarding and the transformation of control signals between heterogeneous visual surveillance systems.

3.2.3 media gateway (MG): A gateway device located between two heterogeneous visual surveillance systems. It is used for routing, forwarding and the transformation of media between heterogeneous visual surveillance systems.

3.2.4 signal routing gateway (SRG): A gateway device located between two homogeneous visual surveillance systems. It is used for the routing and forwarding of control signals among homogeneous visual surveillance systems.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CCS Central Control Server

CPG Control Protocol Gateway

CU Customer Unit

HVSS Heterogeneous Visual Surveillance System

MDU Media Distribution Unit

MG Media Gateway

MSU Media Storage Unit

PTZ Pan/Tilt/Zoom

PU Premises Unit

SRG Signal Routing Gateway

5 Conventions

This Recommendation has no conventions.

6 Functional architecture for visual surveillance interworking

6.1 Architecture framework

The architecture framework for homogeneous visual surveillance system interworking is shown in Figure 6-1. Two visual surveillance systems are connected with each other through a private IP network or the Internet.

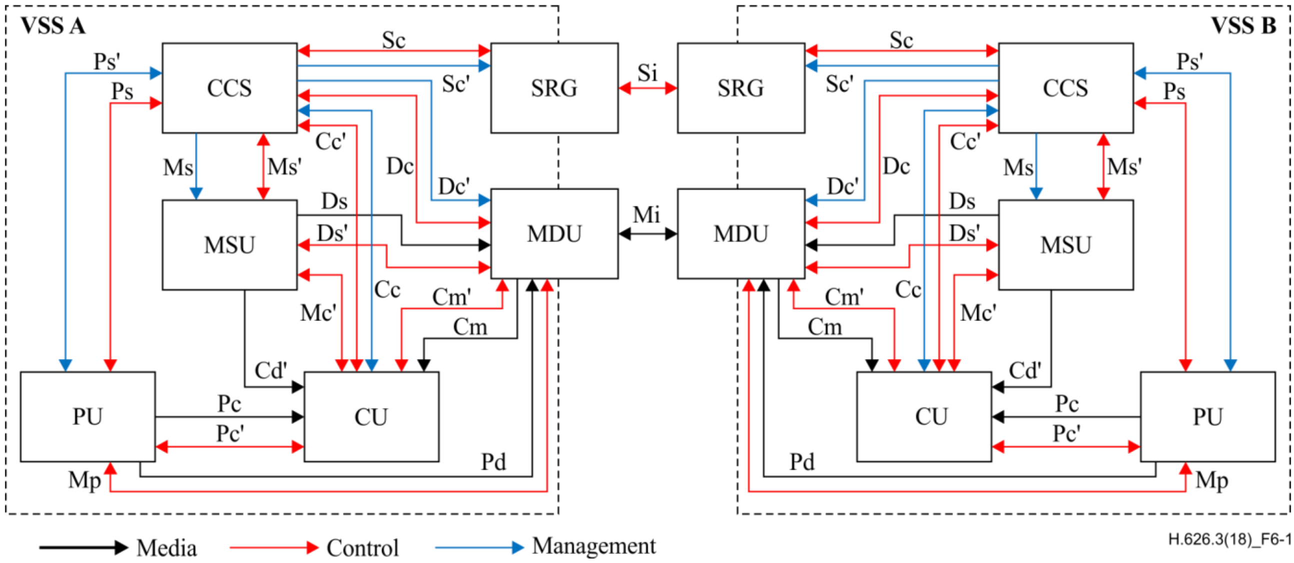

Figure 6-1 – Architectural framework for homogeneous visual surveillance system interworking

As shown in Figure 6-1, VSS A and VSS B are two traditional visual surveillance systems with the same architecture, transmission protocol and workflows. In the traditional visual surveillance system, the functional entities CU, PU, MSU and MDU are defined in [ITU-T H.626]. And the functional entity CCS is the central control server which is used for centralized system management, service operation management and access control. The homogeneous VSS A and VSS B are connected by using the signal routing gateway (SRG) and MDU. The SRG is responsible for the control signal routing between the homogeneous visual surveillance systems and performs the authentication and security controls for the system interworking. Once the connection between the two homogeneous visual surveillance systems is established, the media can be received and distributed through the MDUs of the two systems.

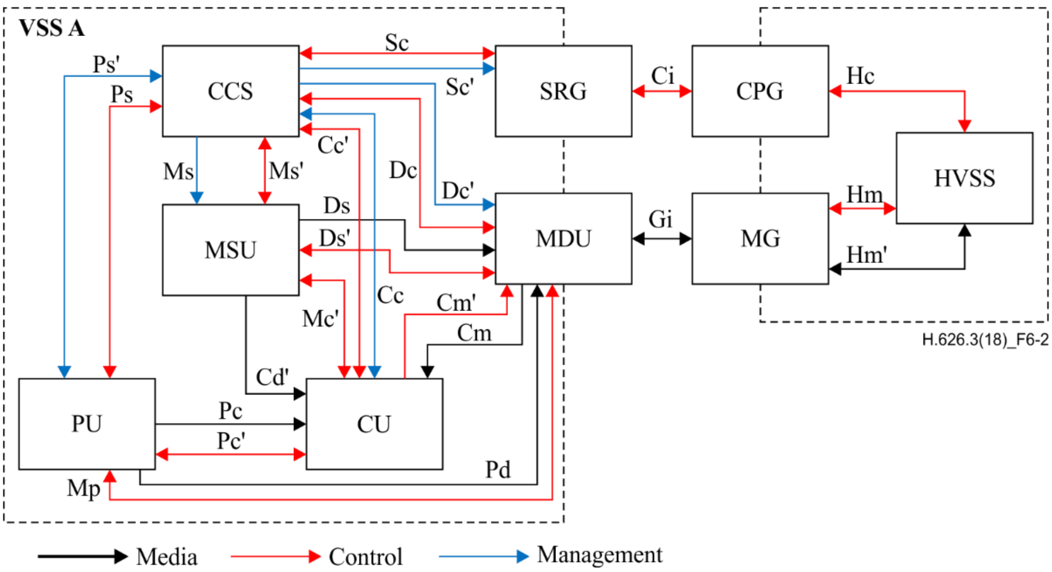

Figure 6-2 – Architectural framework for heterogeneous visual surveillance system interworking

The architecture framework for heterogeneous visual surveillance system interworking is shown in Figure 6-2. HVSS is a heterogeneous visual surveillance system which has different architecture, transmission protocols and control signals compared with a traditional visual surveillance system.

VSS A can communicate with the HVSS through the control protocol gateway (CPG) and media gateway (MG). The CPG is used for control signal routing between the traditional visual surveillance system and the HVSS. Because the control signals can be different between the VSS and the HVSS, the CPG can be used to perform the transformation of control signals between the VSS and the HVSS. The MG is used for media distribution between the traditional visual surveillance system and the HVSS. Because the media transmission protocols and media coding formats can be different between the VSS and the HVSS, the MG can be used to perform the transformation of media transmission protocols and media coding formats between the VSS and the HVSS.

6.2 Functional entities

In this Recommendation, the traditional **v**isual surveillance system (VSS) is built according to the standard architecture defined in [ITU-T H.626], except that it has the CCS which combines the functions of the CMU and the SCU defined in [ITU-T H.626], in order to describe the functional architecture clearly. In addition, in the practical visual surveillance system, some different functional entities can be integrated in the same physical device. For example, the media server in one visual surveillance system is used as not only the MSU but also the MDU. As another example, the CCS and the SRG can be integrated in one signal server in the visual surveillance system. The heterogeneous visual surveillance system (HVSS) has different architecture, transmission protocols and control signals compared with the traditional visual surveillance system.

According to the functional architecture framework of visual surveillance interworking, there are two visual surveillance interworking mechanisms which are respectively the homogeneous system interworking mechanism and the heterogeneous system interworking mechanism. In order to implement the visual surveillance interworking mechanisms, the relevant functional entities are needed for the communication of control signals and media between different visual surveillance systems, and they include SRG, MDU, CPG and MG. The MDU is the media distribution unit defined in [ITU-T H.626], and it is used to transport media between different traditional VSSs.

NOTE – The interworking architecture described in this Recommendation can also apply to the interworking between two different HVSSs.

6.2.1 CPG: control protocol gateway

The control protocol gateway (CPG) is used for the transformation and transmission of control signals between the traditional VSS and HVSS. The detailed functions include:

– receive the control signals from the HVSS, SRG and other CPGs;
– perform the transformation of network transmission protocols, control signals and device addresses between the VSS and the HVSS;
– seek a transmission path of control signals for the interworking between the VSS and HVSS;
– forward the control signals to the HVSS, SRG and other CPGs.

6.2.2 MG: media gateway

The media gateway (MG) is used for the transformation and transmission of media between the traditional VSS and HVSS. The detailed functions include:

– receive the media (stream and files) from the HVSS, MDU and other MGs;
– if necessary, perform the transformation of media transmission protocols and media formats between the VSS and HVSS;
– seek a media transmission path between the VSS and HVSS;
– forward the media (stream and files) to the HVSS, MDU and other MGs.

6.2.3 SRG: signal routing gateway

The signal routing gateway (SRG) is used for the transmission of control signals between traditional VSSs. The detailed functions include:

– receive the control signals from the VSS, CPG and other SRGs;

– seek a transmission path of control signals for the interworking between two VSSs;

– forward the control signals to the VSS, CPG and other SRGs.

6.3 Reference points

6.3.1 Reference point Mi: MDU-MDU

The reference point Mi is located between two MDUs of two homogeneous visual surveillance systems. It is used for media transmission between two homogeneous visual surveillance systems.

6.3.2 Reference point Si: SRG-SRG

The reference point Si is located between two SRGs of two homogeneous visual surveillance systems. It is used for the transmission of control signals between two homogeneous visual surveillance systems.

6.3.3 Reference point Ci: SRG-CPG

The reference point Ci is located between the SRG and the CPG. It is used for the transmission of control signals between two heterogeneous visual surveillance systems.

6.3.4 Reference point Gi: MDU-MG

The reference point Gi is located between the MDU and the MG. It is used for media transmission between two heterogeneous visual surveillance systems.

6.3.5 Reference point Hm: HVSS-MG

The reference point Hm is located between the HVSS and the MG. It is used for the transmission of control signals between the HVSS and the MG.

6.3.6 Reference point Hm': HVSS-MG

The reference point Hm' is located between the HVSS and the MG. It is used for the media transmission between the HVSS and the MG.

6.3.7 Reference point Hc: HVSS-CPG

The reference point Hc is located between the HVSS and the CPG. It is used for the transmission of control signals between the HVSS and the CPG.

6.3.8 Reference point Sc: CCS-SRG

The reference point Sc is located between the CCS and the SRG. It is used for the transmission of control signals between the CCS and the SRG.

6.3.9 Reference point Sc': CCS-SRG

The reference point Sc' is located between the CCS and the SRG. It is used for the transmission of management signals between the CCS and the SRG.

NOTE – The CCS combines the functions of the CMU and SCU defined in [ITU-T H.626] in order to describe the functional architecture for visual surveillance interworking clearly. The related reference points between the CCS and other functional entities in the VSS are the same as those defined in [ITU-T H.626].

6.4 Service control flows

This Recommendation focuses on the interworking between different visual surveillance systems. Therefore, the service control flows within one visual surveillance system is not presented in this Recommendation. In order to clearly describe the service control flows for system interworking in the following subsections, the internal functional entities in one visual surveillance system, which do not have the interaction with the external functional entities in another visual surveillance system, are defined as one logical unit VS.

6.4.1 Real-time media acquisition across visual surveillance systems

When a user of VSS A wants to acquire the media resource of VSS B, VSS A initiates a request and sends it to VSS B through the SRG. Then, VSS B makes a response to distribute the media to VSS A through the MDU.

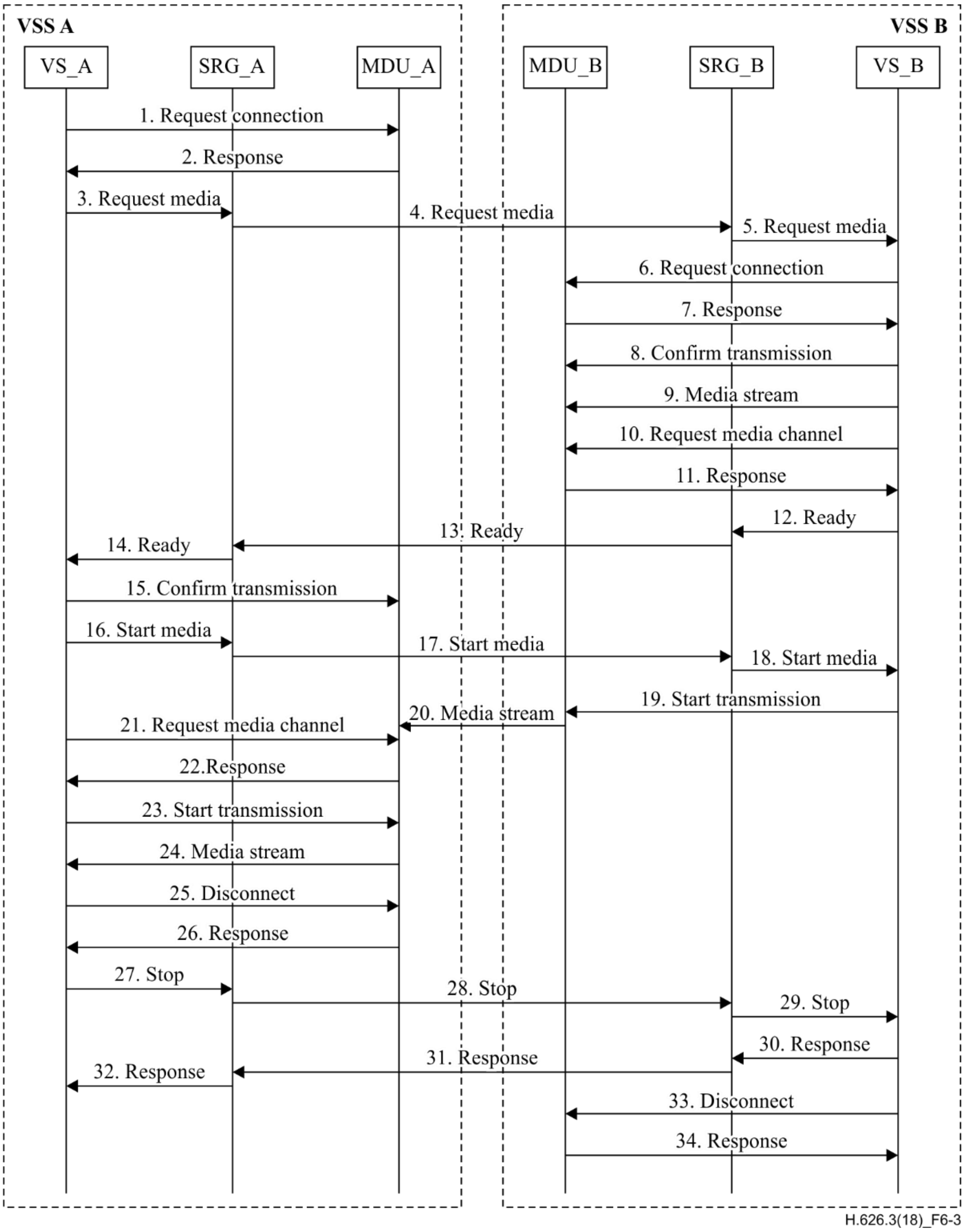

Figure 6-3 – High-level procedural flows for media acquisition across visual surveillance systems

Figure 6-3 shows the procedural flows of real-time media acquisition across the visual surveillance systems:

1) VS_A initiates a request for real-time media and sends a connection establishment request to MDU_A.
2) After receiving the request, MDU_A returns the channel information to VS_A.
3) VS_A requests SRG_A for the real-time media stream from VSS B.
4) SRG_A transfers the request to SRG_B.
5) SRG_B transfers the request to VS_B.
6) VS_B sends a connection establishment request to MDU_B.
7) After receiving the request, MDU_B returns the channel information to VS_B.
8) VS_B informs MDU_B that the media transmission is ready.
9) VS_B transmits the media stream to MDU_B.
10) VS_B sends a media channel request message to MDU_B for transmission.
11) MDU_B responds to VS_B with a ready signal.
12) VS_B sends the ready signal to SRG_B.
13) SRG_B transfers the ready signal to SRG_A.
14) SRG_A returns the ready signal to VS_A.
15) VS_A informs MDU_A that the media transmission channel is ready.
16) VS_A then sends a request to SRG_A to start the media transmission from the VSS B.
17) SRG_A transfers the request to SRG_B.
18) SRG_B transfers the request to VS_B.
19) VS_B then informs MDU_B to start the media transmission.
20) MDU_B receives the request and starts to send the media stream to MDU_A.
21) VS_A sends a media channel request message to MDU_A for transmission.
22) MDU_A responds to VS_A with a ready signal.
23) VS_A informs MDU_A to start the media transmission.
24) MDU_A then transfers the media stream to VS_A.
25) When VS_A stops the real-time media acquisition, it sends a stop-media request to MDU_A to disconnect.
26) MDU_A responds to VS_A with a confirmation message.
27) VS_A informs SRG_A to stop the media transmission from VSS B.
28) SRG_A sends the stop-media request to SRG_B.
29) SRG_B transfers the stop-media request to VS_B.
30) VS_B responds to SRG_B with a disconnected confirmation.
31) SRG_B transfers the response to SRG_A.
32) SRG_A transfers the response to VS_A.
33) VS_B informs MDU_B to disconnect.
34) MDU_B responds to VS_B with a confirmation message.

NOTE – The real-time media acquisition workflows between the heterogeneous visual surveillance systems is the same as those between the homogeneous systems, except that the SRG and MDU in Figure 6-3 are replaced with the CPG and MG respectively.

6.4.2 Media playback across visual surveillance systems

When a user of VSS A wants to play back the media resource of VSS B which has been previously recorded, VSS A initiates a request and sends it to VSS B through the SRG. Then, VSS B makes a response to distribute the media to VSS A through the MDU.

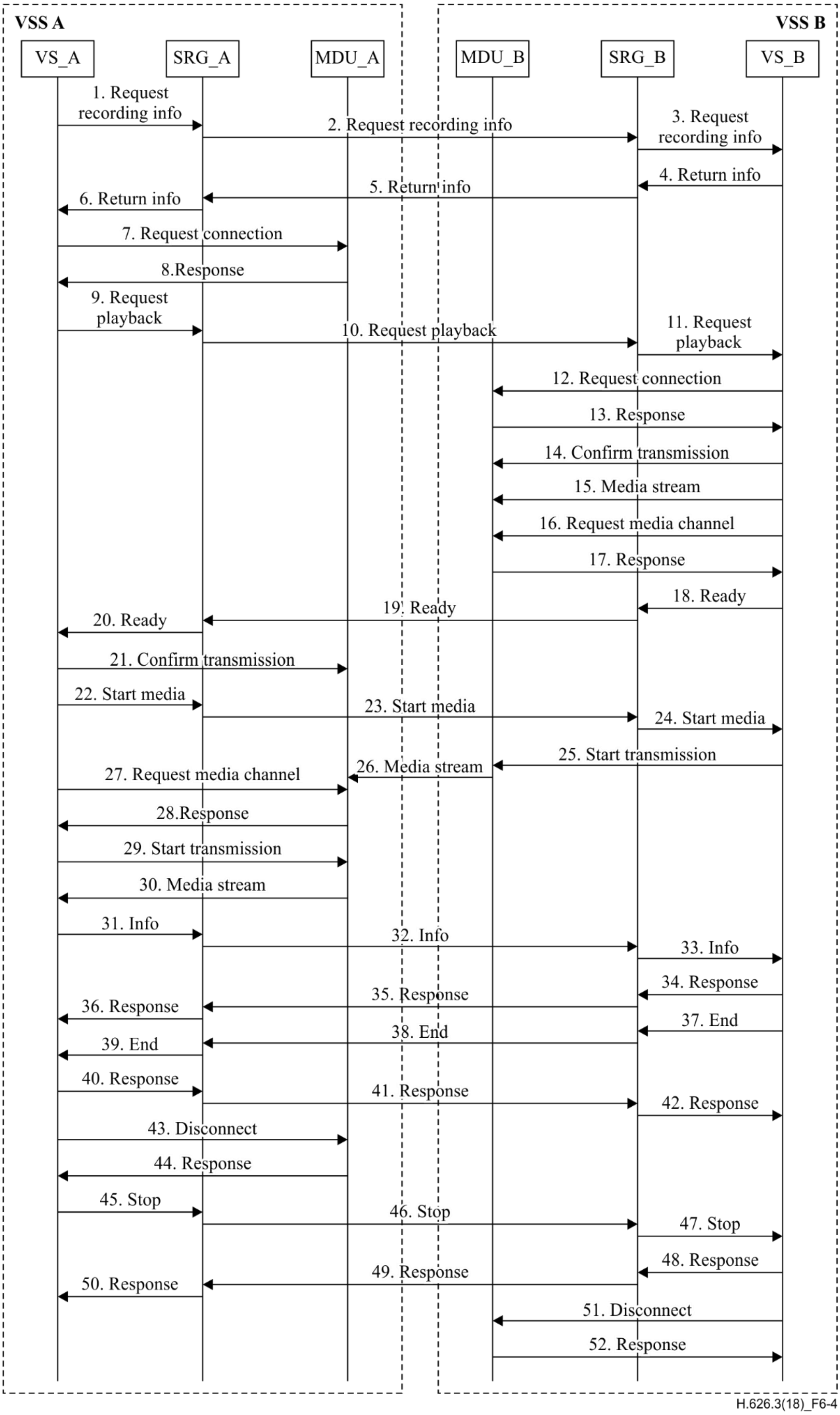

Figure 6-4 – High-level procedural flows for media playback across visual surveillance systems

Figure 6-4 shows the procedural flows of media playback across visual surveillance systems:

VS_A sends a request to SRG_A for querying the video recording information of VSS_B.

1) SRG_A sends the request to SRG_B for querying the video recording information.
2) SRG_B transfers the request to VS_B.
3) VS_B transfers the results to SRG_B.
4) SRG_B transfers the results to SRG_A.
5) SRG_A transfers the results to VS_A.
6) VS_A then sends a connection establishment request to MDU_A.
7) After receiving the request, MDU_A returns the channel information to VS_A.
8) VS_A transfers the media request to SRG_A.
9) SRG_A transfers the request to SRG_B.
10) SRG_B transfers the request to VS_B.
11) VS_A sends a connection establishment request to MDU_B.
12) After receiving the request, MDU_B returns the channel information to VS_B.
13) VS_B informs MDU_B that the media transmission is ready.
14) VS_B transmits the media to MDU_B.
15) VS_B sends a media channel request message to MDU_B for transmission.
16) MDU_B responds to VS_B with a ready signal.
17) VS_B sends the ready signal to SRG_B.
18) SRG_B transfers the ready signal to SRG_A.
19) SRG_A returns the ready signal to VS_A.
20) VS_A informs MDU_A that the media transmission is ready.
21) VS_A then sends a request to SRG_A to start the media transmission from VSS B.
22) SRG_A transfers the request to SRG_B.
23) SRG_B transfers the request to VS_B.
24) VS_B then informs MDU_B to start the media transmission.
25) MDU_B receives the request and starts to send the media stream to MDU_A.
26) VS_A sends a media channel request message to MDU_A for transmission.
27) MDU_A responds to VS_A with a ready signal.
28) VS_A informs MDU_A to start the media transmission.
29) MDU_A then transfers the media stream to VS_A.
30) During media playback VS_A sends the media playback control request to SRG_A.
31) SRG_A transfers the control information to SRG_B.
32) SRG_B transfers the control information to VS_B.
33) VS_B responds to SRG_B.
34) SRG_B transfers the response to SRG_A.
35) SRG_A transfers the response to VS_A.
36) When the media playback is over, VS_B sends a playback end message to SRG_B.
37) SRG_B transfers the end message to SRG_A.
38) SRG_A transfers the end message to VS_A.
39) VS_A responds to SRG_A.

40) SRG_A transfers the response to SRG_B.

41) SRG_B transfers the response to VS_B.

42) When VS_A stops the media playback, it informs MDU_A to disconnect.

43) MDU_A responds to VS_A with a confirmation message.

44) VS_A informs SRG_A to stop the media transmission from VSS B.

45) SRG_A transfers the media-stop request to SRG_B.

46) SRG_B transfers the media-stop request to VS_B.

47) VS_B responds to SRG_B with a disconnected confirmation.

48) SRG_B transfers the response to SRG_A.

49) SRG_A transfers the response to VS_A.

50) VS_B informs MDU_B to disconnect.

51) MDU_B responds to VS_B with a confirmation message.

NOTE – The media playback workflows between the heterogeneous visual surveillance systems is the same as those between the homogeneous systems, except that the SRG and MDU in Figure 6-4 are replaced by the CPG and MG, respectively.

6.4.3 PTZ control across visual surveillance systems

The PTZ control function is used to pan, tilt and zoom video cameras, switch auxiliary peripherals (such as flashlight, fan and rain brush) and present the position of related physical devices. When a user of VSS A wants to control the PUs of VSS B, VSS A initiates a request and sends it to VSS B through the SRG. Then, VSS B makes a response to VSS A through the SRG.

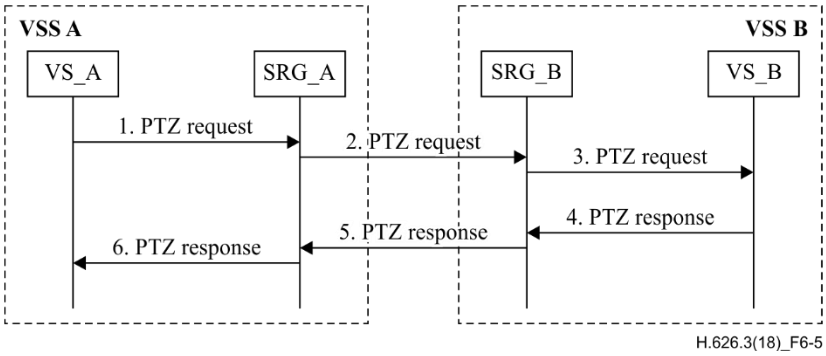

Figure 6-5 – High-level procedural flows for PTZ control across visual surveillance systems

Figure 6-5 shows the procedural flows of PTZ control across visual surveillance systems:

1) VS_A sends a PTZ control request to SRG_A.

2) SRG_A transfers the request to SRG_B.

3) SRG_B transfers the request to VS_B.

4) VS_B parses this request and transfers the PTZ control commands to the related physical devices. The devices then perform PTZ operations and VS_B returns a response to SRG_B.

5) SRG_B transfers the response to SRG_A.

6) SRG_A transfers the response to VS_A.

NOTE – The PTZ control workflow between the heterogeneous visual surveillance systems is the same as those between the homogeneous systems, except that the SRG in Figure 6-5 is replaced by the CPG.

6.4.4 Event subscription across visual surveillance systems

The event subscription function is used to send a subscription message to the target system to receive the report for the specific event. When a user of VSS A wants to know if VSS B has a specific event, it can request VSS B for subscribing to the event report. When the event occurs, VSS B will notify VSS A.

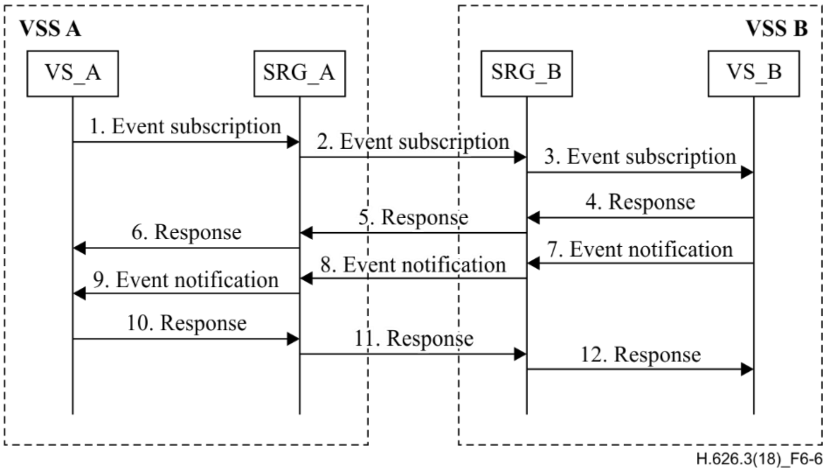

Figure 6-6 – High-level procedural flows for event subscription across visual surveillance systems

Figure 6-6 shows the procedural flows of event subscription across visual surveillance systems:

1) VS_A sends an event subscription request to SRG_A.
2) SRG_A transfers the request to SRG_B.
3) SRG_B transfers the request to VS_B.
4) VS_B responds to SRG_B.
5) SRG_B transfers the response to SRG_A.
6) SRG_A transfers the response to VS_A.
7) When the event occurs, VS_B sends a notification to SRG_B.
8) SRG_B transfers the notification to SRG_A.
9) SRG_A transfers the notification to VS_A.
10) VS_A responds to SRG_A.
11) SRG_A transfers the response to SRG_B.
12) SRG_B transfers the response to VS_B.

NOTE – The event subscription workflows between the heterogeneous visual surveillance systems is the same as those between the homogeneous systems, except that the SRG in Figure 6-6 is replaced with the CPG.

6.4.5 Directory subscription across visual surveillance systems

The directory subscription function is used to get a list of PUs from a VS. When a user of VSS A wants to get the PU list of VSS B, VSS A sends a request to VSS B for subscribing to the device directory. If the device directory changes, VSS B will notify VSS A to update the directory immediately.

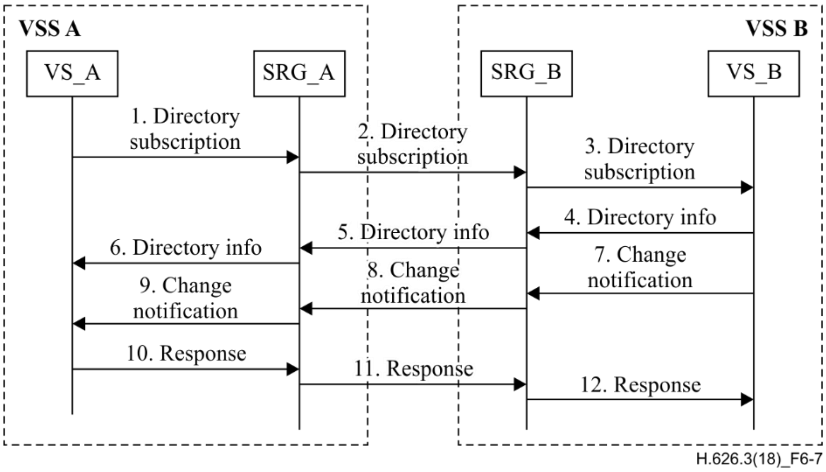

Figure 6-7 – High-level procedural flows for directory subscription across visual surveillance systems

Figure 6-7 shows the procedural flows of directory subscription across visual surveillance systems:

1) VS_A sends a directory subscription request to SRG_A.
2) SRG_A transfers the request to SRG_B.
3) SRG_B transfers the request to VS_B.
4) VS_B returns the directory to SRG_B.
5) SRG_B transfers the directory to SRG_A.
6) SRG_A transfers the directory to VS_A.
7) When the directory changes, VS_B sends an update message to SRG_B.
8) SRG_B transfers the message to SRG_A.
9) SRG_A transfers the message to VS_A.
10) VS_A responds to SRG_A.
11) SRG_A transfers the response to SRG_B.
12) SRG_B transfers the response to VS_B.

NOTE – The directory subscription workflows between the heterogeneous visual surveillance systems is the same as those between the homogeneous systems, except that the SRG in Figure 6-7 is replaced with the CPG.

7 Deployment models for visual surveillance interworking

There are two deployment models for interworking among different visual surveillance systems, which are respectively the peer-to-peer deployment model and the hierarchical deployment model.

7.1 Peer-to-peer deployment model

As shown in Figure 7-1, in the peer-to-peer deployment model, two VSSs can be connected with each other in a peer-to-peer mode, and the VSSs are equally privileged, equipotent participants in this distributed network system. The resource and data of one VSS can be shared with the other VSS in the interconnected network system. The SRGs can be used for the communication of control signals between two VSSs, and the MDUs are used for the communication of media (streams and files) between two VSSs. For the sharing of the resource and data between VSS_A and VSS_B, SRG_A needs to initiate a connection request to SRG_B. If VSS_A has the interworking authorization with VSS_B, the control signals and media can be transmitted between the two VSSs.

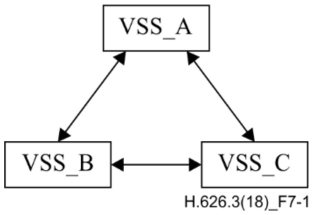

Figure 7-1 – Peer-to-peer deployment model

7.2 Hierarchical deployment model

As shown in Figure 7-2, in the hierarchical model, the different VSSs are connected to form a hierarchical network structure, in which a central root VSS node (the top level of the hierarchy) is connected to one or more other VSS nodes that are one level lower in the hierarchy (i.e., the second level), while each of the second level VSS nodes will also have one or more other nodes that are one level lower in the hierarchy (i.e., the third level) connected to it. The top level central root VSS node is the only VSS node that has no other node above it in the hierarchy. The control signals and media (streams and files) are progressively forwarded according to the hierarchical network connection structure of visual surveillance systems by using the SRGs and MDUs respectively. In the hierarchical deployment model, the SRG in one level needs to initiates a connection request to the SRG that is one level higher in the hierarchy, and has the interworking authorization with the upper level SRG.

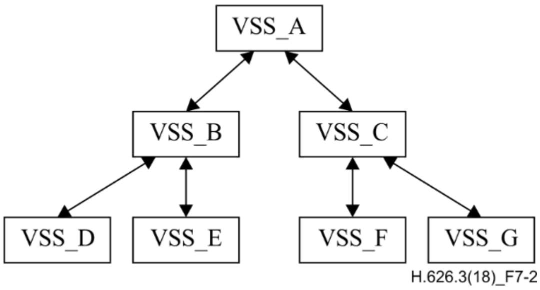

Figure 7-2 – Hierarchical deployment model

NOTE – In the deployment model for system interworking defined in clauses 7.1 and 7.2, the interworking system can be not only VSS but also HVSS.

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