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services – Advanced multimedia services and applications

Architectural requirements for visual surveillance

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ITU-T Recommendation H.626 (ex H.VSarch)

Architectural requirements for visual surveillance

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ITU-T Recommendation H.626

Architectural requirements for visual surveillance

Summary

The purpose of Rec. 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, 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, visual surveillance management system, interworking and service convergence between visual surveillance system and other multimedia systems.

Keywords

Visual Surveillance, Camera, IP network, Alarming, PTZ Control, Recording and playback

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 the end users in a friendly manner (including accessibility aspects), based on managed broadband network with quality, security and reliability ensured.

The objective of this document is to describe the architectural requirements of the visual surveillance system, which satisfies the needs as described in visual surveillance requirements [see ITU-T F.743]. This document defines functional requirements, model, architecture, entities, reference points and service control flow of the 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), <i>Requirements and service description for visual surveillance</i>
[ITU-T Y.101]	Recommendation ITU-T Y.101 (2000), <i>Global Information Infrastructure terminology: Terms and definitions</i>
[ITU-T Y.110]	Recommendation ITU-T Y.110 (1998), <i>Global Information Infrastructure principles and framework architecture</i>
[IETF RFC 2616]	IETF RFC 2616 (1999), <i>Hypertext Transfer Protocol – HTTP/1.1</i>

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

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

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

NOTE 1 – In this Recommendation, Customer has the same meaning with End User.

3.1.3 EPG [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 2 – The functional entities can be used to describe a set of reference configurations. These reference configurations identify which reference points are visible at the boundaries of equipment implementations and between administrative domains.

NOTE 3 – The definition is not only applicable to NGN, but also to other IP packet switch based network.

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 4 – 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 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 5 – A reference point may correspond to one or more physical interfaces between pieces of equipment.

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

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

3.2 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, 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 managed broadband network with ensured quality, security and reliability.

4 Abbreviations and acronyms

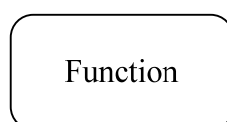
This Recommendation uses the following abbreviations and acronyms:

AAA	Authentication, authorization and accounting
CDN	Content delivery network
CMU	Centre management unit
CU	Customer unit
EPG	Electronic program guide
FE	Functional entity
FCAPS	Fault, configuration, accounting, performance and security
HTTP	Hypertext transfer protocol
IMS	IP multimedia subsystem
IPTV	Internet protocol television
MCU	Multimedia control unit
MDU	Media distribution unit
MOC	Monitor centre
MSU	Media storage unit
MSCF	Media switch and control function
MZMU	Multi-zones management unit
NGN	Next generation network
PC	Personal computer
PU	Premises unit

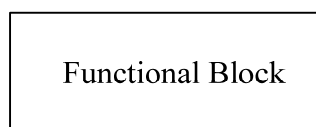
QoS	Quality of service
RTSP	Real-time streaming protocol
SCU	Service control unit
STB	Set top box
SMS	Short message service
PTZ	Pan/tilt/zoom
VCR	Video cassette record
VS	Visual surveillance

5 Conventions

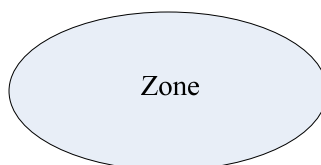
- **Function:** In the context of the visual surveillance architecture, "function" is defined as a collection of functionalities. It is represented by the following symbol:



- **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 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 VS.

6.1 Roles of visual surveillance

The roles of VS include those who are involved in the business activities which fit in a value chain of VS. The roles of VS could be identified as following:

- **Third-party Application Provider:** The one who provides 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 optionally also act as the service provider (Refer to [ITU-T Q.1290, 1998]). In this document, Network Provider means the entity that provides 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 (Refer to [ITU-T M.3320, 1997]). In this document, Service Provider means the entity that provides services and/or service integration.
- Surveilled Object: The target (such as site, human, and related environment) is surveilled.

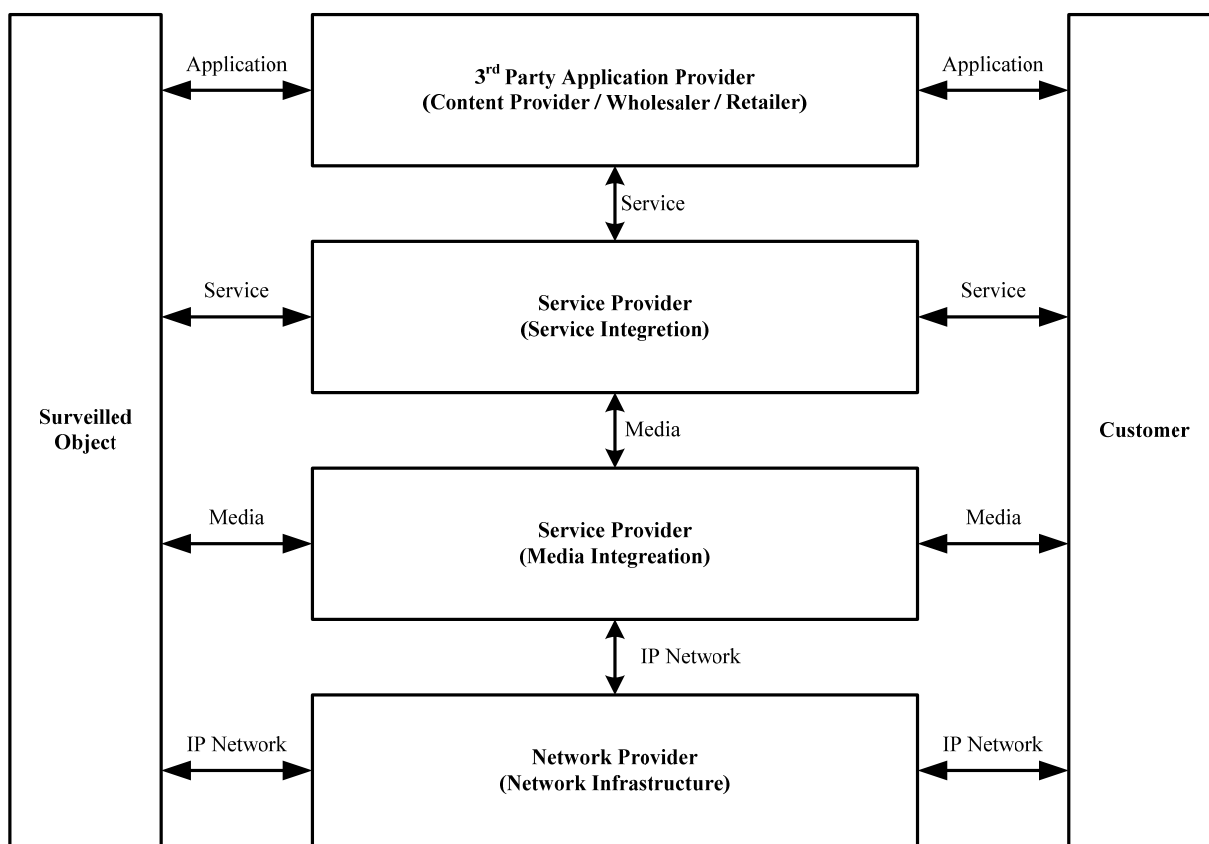


Figure 6-1 – Roles and relationships of VS

The relationships among the roles of 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 provides also 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 as 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.

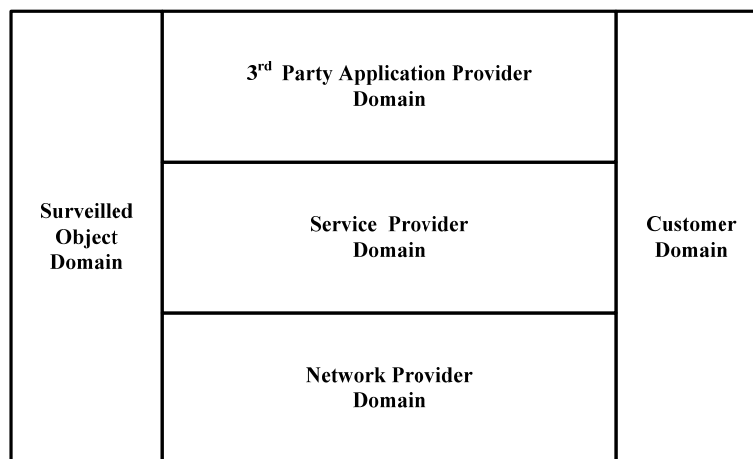


Figure 6-2 – Domains of VS

7 Functional requirements

This clause describes the functional requirements on 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 and it is used to respond to an input alarm signal event, give an output alarm activity and trigger the related linkage actions.

Reference procedures:

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

1. When 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 CU, and may also trigger the linkage actions, such as running Recording, Instant Image Snapshot functions, call the police and send out alarm messages with 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 kind 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 surveilled object.

Reference procedures:

The VS system is composed of CUs, PUs and service platform. PUs capture and records the video/audio information, encodes and transforms it into a media stream, and sends 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 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 analog 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 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 video from Surveilled Object.

Reference procedures:

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

1. Customer sends a request of instant image snapshot from CU to PU
2. PU receives this request of instant image snapshot, it snapshots an image from surveilled video and sends back a response of instant image snapshot back to CU with the image data
3. CU receives the response of Instant Image Snapshot from PU, separates the image data and does further image processing

Trigger conditions:

The instant image snapshot function may be triggered 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 Customer, 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, and is used to record multimedia (such as audio, image, video) information from Surveilled Objects and stored these multimedia information either in terminal devices or service platform.

The playback is an operation mode of media play, which is used to play audio and video which has 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 PU or CU.
2. The recorded media is stored in either PU or service platform (such as 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 by manual mode (to the command of 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 Administrator, Operator and/or Surveillant).

Operation constraints:

The recording and playback function can be enabled or disabled by all kinds of customer, i.e. Surveillant, Operator and Administrator. In some situations, recording on the customer side (i.e. via CU) could be determined by Surveillant. However, recording on the Surveilled Object side (i.e. via PU) and 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 end user and Surveilled Object (human beings).

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

- Unidirectional voice communication mode (UVCN): one-way communication from customer/CU to Surveilled Object/PU (e.g. speech/audio broadcasting)
- Bidirectional voice communication mode (BVCM): bidirectional, simultaneous communication both from Customer/CU to Surveilled Object/PU, and from Surveilled Object/PU to Customer/CU (e.g. talkback)

7.2.2 Reference procedures

Reference procedures for UVCN:

The order of the reference procedure for UVCN is:

1. The CU gets the list of PUs from service platform, selects and creates the group to which it intends to speak or broadcast.

2. The CU sends a request-to-broadcasting to Service platform with the group it had created earlier.
3. Service platform receives and handles this request, distributes media broadcasting requests to the PUs in this group.
4. Every PU that receives the request creates a unidirectional media channel with 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 Service platform. The SCU in 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 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], 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), preset 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 'First Come, First Serve' rules. In this situation, it is recommended to use some suitable policy to avoid someone's frequent and continuous occupation.
- Token ring mode: joining the users who apply PTZ control into a circle, and the one who receives the token will get PTZ control privilege; once the user finished or the token expires, the token will pass to next user, and the next user will get the PTZ control privilege.
- Overwhelming mode: the one who has higher level priority will get the PTZ control privilege than 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 PTZ control function is:

1. The Customer send the operation control commands from the CU to 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 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 an 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 used by Surveillants with low priority level.