

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

H.742.0

(07/2016)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS
IPTV multimedia services and applications for IPTV – IPTV
application event handling

**Use of video sensor devices for IPTV services:
Architecture and requirements**

Recommendation ITU-T H.742.0

ITU-T



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Recommendation ITU-T H.742.0

Use of video sensor devices for IPTV services: Architecture and requirements

Summary

A video sensor is a device used by technology to extract useful information, for example, the number, gender, and age of persons in front of camera, by processing video data captured by camera. Recommendation ITU-T H.742.0 describes an architecture and the requirements of IPTV application events extracted by video sensor devices. The requirements cover general functionalities, delivery mechanisms, metadata, and functions to avoid the risk of privacy infringement.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T H.742.0	2016-07-14	16	11.1002/1000/12910

Keywords

Audience measurement function, AMF, application event handling, Internet protocol television, IPTV, video sensor, video.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/1830-en>.

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

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Recommendation ITU-T H.742.0

Use of video sensor devices for IPTV services: Architecture and requirements

1 Scope

This Recommendation describes the requirements of IPTV application events extracted by video sensor devices. It describes an architecture and the requirements for general functionalities, delivery mechanisms, metadata, and functions to avoid the risks of privacy infringement.

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.741.0] Recommendation ITU-T H.741.0 (2012), *IPTV application event handling: Overall aspects of audience measurement for IPTV services.*
- [ITU-T H.741.2] Recommendation ITU-T H.741.2 (2012), *IPTV application event handling: Data structures of audience measurement for IPTV services.*
- [ITU-T X.1191] Recommendation ITU-T X.1191 (2008), *Functional requirements and architecture for IPTV security aspects.*
- [ITU-T Y.1901] Recommendation ITU-T Y.1901 (2008), *Requirement for the support of IPTV services.*
- [ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 aggregation function [ITU-T H.741.0]: The function that configure audience management functions (AMFs), then receives processed events, sample values and end-user information from AMFs. It may participate in the communication of end-user permissions.

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

3.1.3 application event [b-ITU-T H.740]: An application event is every end-user interaction or occurrence related with multimedia contents in IPTV applications. It includes an emergency event from event notification services

3.1.4 audience measurement [ITU-T H.741.0]: The measurement of people's engagement with IPTV services.

3.1.5 audience measurement data [ITU-T H.741.0]: End-user behaviour data which is related to a service and content consumption, combined or not with end-user information.

3.1.6 audience measurement function (AMF) [ITU-T H.741.0]: The function that, if given permission, measures the end-user behaviour by processing events or samples from IPTV services.

AMFs may request and collect end-user information. AMFs transfer processed events, samples and end-user information to aggregation functions.

3.1.7 content provider [ITU-T Y.1910]: The entity that owns or is licensed to sell content or content assets.

3.1.8 delivery [ITU-T Y.1910]: In the context of IPTV architecture, "delivery" is defined as sending contents to the end user.

3.1.9 digital signage [b-ITU-T H.780]: A system that sends information, advertising and other messages to electronic devices (e.g., displays, speakers) in accordance with the time of day and the location of the display, or the actions of audience. Contents and their relevant information, such as display schedules, are delivered over networks.

3.1.10 end user [ITU-T Y.1910]: The actual user of the products or services.

NOTE – The end user consumes the product or service. An end user can optionally be a subscriber.

3.1.11 IPTV [ITU-T Y.1901]: Multimedia services such as television/video/audio/text/graphics /data delivered over IP-based networks managed to support the required level of QoS/QoE, security, interactivity and reliability.

3.1.12 metadata [ITU-T Y.1901]: Structured, encoded data that describe characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities.

NOTE – EPG metadata has many applications and may vary in depth from merely identifying the content package title or information to populate an EPG to providing a complete index of different scenes in a movie or providing business rules detailing how the content package may be displayed, copied, or sold.

3.2.13 network provider [ITU-T Y.1910]: The organization that maintains and operates the network components required for IPTV functionality.

NOTE 1 – A network provider can optionally also act as service provider.

NOTE 2 – Although considered as two separate entities, the service provider and the network provider can optionally be one organizational entity.

3.1.14 privacy [b-ITU-T X.800]: The right of individuals to control or influence what information related to them may be collected and stored and by whom and to whom that information may be disclosed.

NOTE – Because this term relates to the right of individuals, it cannot be very precise and its use should be avoided except as a motivation for requiring security.

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

3.1.16 service provider [b-ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other end users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 video data: A set of digital images captured by a camera. A digital image is a numeric representation of a two-dimensional image.

3.2.2 video sensor: A device that has image processing ability, such as image compression, image manipulation with the video data captured by a camera. A video sensor can generate video sensor information alone, by processing video data when it has enough computational power. Otherwise, some functions of the video sensor are processed through external systems and the video sensor generates intermediate video sensor information.

3.2.3 video sensor information: Extracted and derived information from video data, for example, emotion, number, gender, and age of persons, or movement.

4 Abbreviations and acronyms

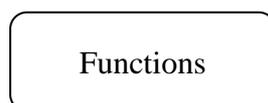
This Recommendation uses the following abbreviations and acronyms:

AMF	Audience measurement function
EPG	Electronic program guide
IP	Internet protocol
IPTV	Internet protocol television
QoE	Quality of experience
QoS	Quality of service
SP	Service provider
STB	Set-top box
TV	Television
UVS	Use of video sensor devices
VSI	Video sensor information
WAN	Wide area network

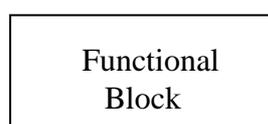
5 Conventions

In this Recommendation:

- The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.
- The keywords "is recommended" indicate a requirement which is recommended, but which is not absolutely required. Thus, this requirement need not be present to claim conformance.
- The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.
- The keyword "functions" are defined as a collection of functionalities. It is represented by the following symbol in the context of IPTV architecture:



- The keyword "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 in the context of IPTV architecture:



NOTE – In the future, other groups or other Recommendations may possibly further subdivide these functional blocks.

Requirements in clauses 8, 9 and 10 are identified using the following conventions [ITU-T Y.1901]:

- Mandatory requirement is identified to R;
- Recommended requirement is identified to RR;
- Optional requirement is identified to OR.

6 Overview

A video sensor is a device used by technology to extract useful information, for example, the number, gender, and age of persons in front of camera, by processing video data captured by camera.

Through the use of this technology with digital signage system, information about how an audience watches the display can be extracted. It means the effect of the digital signage system can be measured. On the other hand, through the use of this technology with IPTV terminal devices, information on whether or not persons are watching TV can be extracted in the IPTV terminal device side. If home gateway implements the aggregation function of this information, it can collect this information from several IPTV terminal devices and may show their situations on the other terminal screen. For example, a family member may switch off the TV so that nobody can watch it in order to reduce the consumption of electric energy.

Information, such as end-user presence in front of TV or end-user properties extracted by sensor information is useful for advanced services. However, as this additional information is more detailed personal private information than simple operational histories in audience measurement, it must be treated very carefully by the advanced service system and persons who are working with this service or system. Without careful handling of this information, private information will be stolen, extracted or opened and there may be a risk of serious misuse of private information.

While the spread of IPTV services across the world, new services based on the above additional information may be developed and spread. Before spreading such services, it is necessary to clarify the risk of privacy infringement, and ensure that this is understood by IPTV service providers, implementers and end-users; also, it is necessary to implement the technologies to avoid such risks. If such technologies will not be implemented and privacy infringement may occur, IPTV services themselves may be viewed as dangerous services where privacy protection is concerned. As a result, the number of IPTV service subscribers may be reduced.

To mitigate such risk, this Recommendation describes the requirements of IPTV application events extracted by video sensor devices.

7 Domain and architecture

Figure 7-1 shows the main domains that are involved in the provision of IPTV service with video sensor devices based on [ITU-T Y.1910]. These domains do not define a business model. These domains do not mean video data captured by camera devices are delivered to out of home without permission. This decomposition does not preclude that one provider be involved in the support of any given IPTV service across more than one domain.

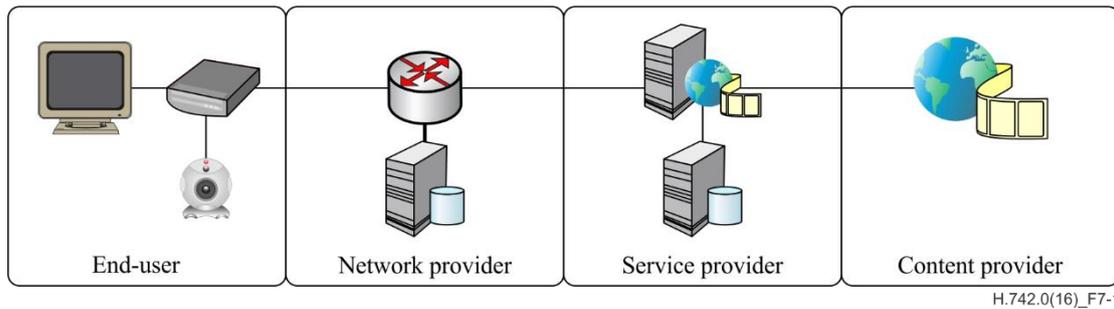


Figure 7-1 – IPTV domains with video sensor devices

Figure 7-2 provides an overview of the IPTV functional architecture with video sensor devices. Functions and functional blocks described in this clause are common to all architectural approaches as detailed in [ITU-T Y.1910] except where stated differently.

The key applicable concepts are described below and indicated in red in Figure 7-2:

- The video sensor device functional block in application client functions is added as one of other client functional blocks in [ITU-T Y.1910].
- In the home network functions in [ITU-T Y.1910], Video Sensor Home Network Functional block is added.
- In the application functions, Video Sensor Application Functional Block is added as one of IPTV application functions in [ITU-T Y.1910].
- Terminal Device Audience Measurement Functions in application client functions are added as one of other functions in [ITU-T Y.1910].
- In the application functions, Aggregation Functions are added as one of IPTV application functions in [ITU-T Y.1910].

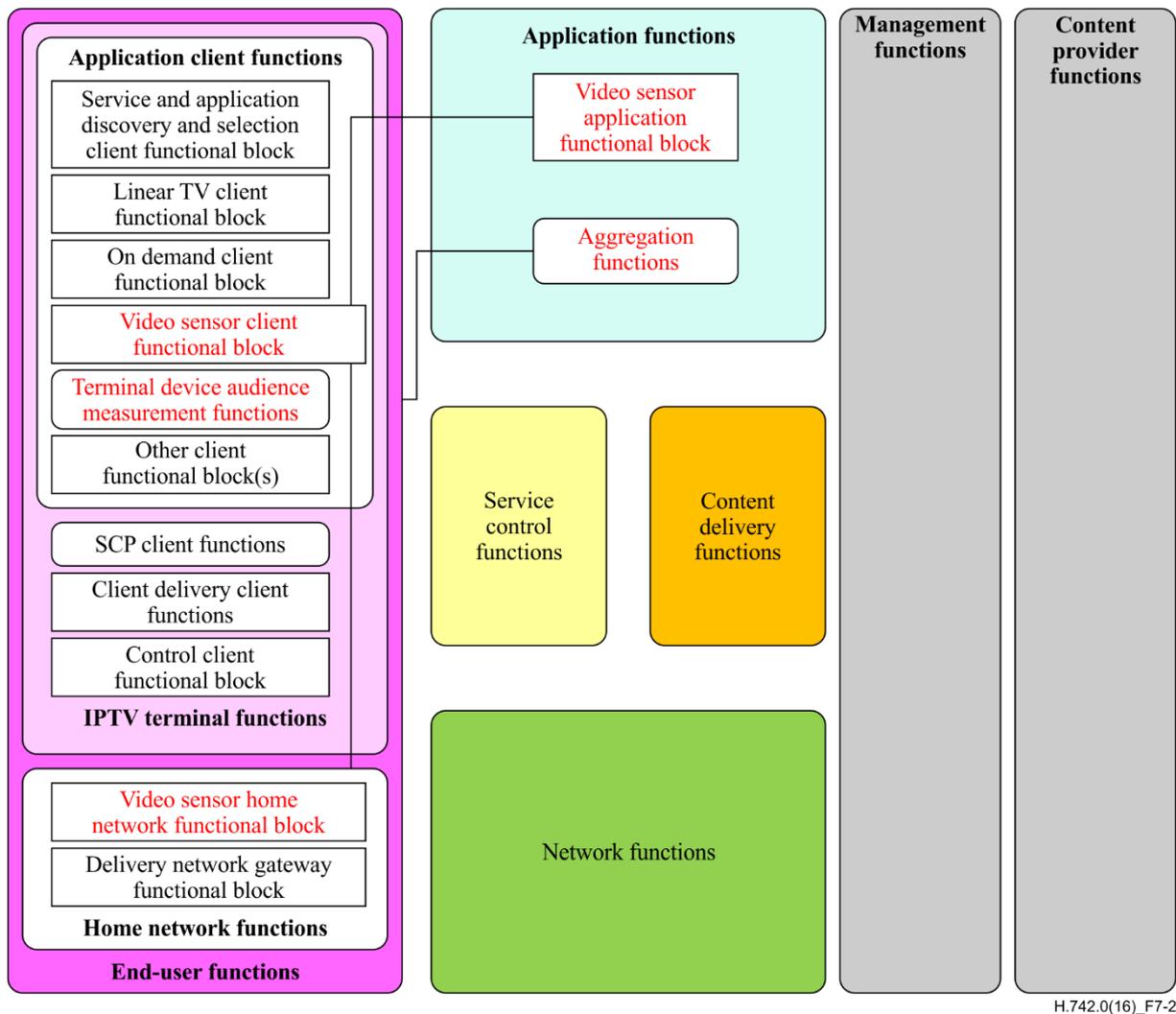


Figure 7-2 – IPTV video sensor device architectural overview

8 Requirements of application event by video sensor device

8.1 Risks related to IPTV terminal devices used with video sensor device

The following are the privacy infringement risks:

- Software errors or virus in the IPTV terminal device with video sensor device may deliver not only extracted information but also the video image itself captured by a camera to the other servers.
- Software errors or virus in the home gateway [b-ITU-T H.622.1] device that controls IPTV terminal device with video sensor device may order it to deliver not only extracted information, but also the video image itself captured by a camera to the other servers.

If the destination of the above-mentioned data is the server in WAN and it was designed by privacy brokers, the captured video data may be flowed and used for crime and so on.

8.2 Requirements for avoiding the risks of privacy infringement

It is required that end-users understand the risks of privacy infringement and that they allow the use of their privacy information in order for IPTV architecture to measure the video sensor-based information. (R-1)

- IPTV terminal devices with video sensor are required to implement functions that avoid delivering data other than the prior designed format. (R-2)

- The server that collects the information extracted by the video sensor device is required to implement functions that avoid receiving data other than the prior designed format. (R-3)

9 Functional requirements

9.1 Video processing functional requirement

- Video sensors are required to capture the video and output the result of video processing in real-time. It is not necessary to output the result as the same frame rate of video capture. (R-4)

9.2 Terminal authentication functional requirement

- Video sensors are required to be authenticated by authentication server for IPTV services. (R-5)
- Video sensors are required to be related with users of IPTV services. (R-6)

9.3 Data output functional requirement

- Video sensors are required to output the data in accordance with clause 10. (R-7)

9.4 Transmission functional requirement

- Video sensors are required to transmit data as IP data transmission via wired networks or wireless networks. (R-8)

9.5 Data storage functional requirement

- If video sensors store the video data or VSI, video sensor must not store the video data that are able to identify the captured user. (R-9)

9.6 Service subscribing functional requirement

- Video sensors are required to be equipped with the functionality to change the IPTV services that are to be connected. (R-10)

9.7 Security functional requirement

- Video sensors are required not to transmit the data that are able to identify the user captured. (R-11)
- The transmitted data are required to be secured. (R-12)
- Video sensors are required to be equipped with the functionality to stop the function to turn on/off through the remote site. (R-13)
- Video sensors are required to be equipped with the functionality to turn themselves on/off. (R-14)

9.8 Metadata functional requirement

- Video sensors are required to deliver metadata that describe VSI. VSI metadata are recommended to be in conformance with audience measurement metadata structure [ITU-T H.741.2]. (R-15)

10 Requirements for the delivery of audience measurement data with video sensors

As VSI comprises personal data, video sensor home network functional block (VSHN) must not deliver VSI to outside of home network as a default and must be controlled securely based on the following requirements.

- It is required that VSHN not deliver VSI to outside of home network without the user's permissions. (R-16)

- It is required that VSHN be equipped with the functions to register VSs that deliver VSI to outside of home network, and to set permission for the delivery of VSI to outside of home network. (R-17)
- It is required that VSHN be equipped with the function to terminate the communication to deliver VSI to outside of home network by unregistered video sensor devices or video sensor devices without permissions. (R-18)
- It is required that VSHN be equipped with the function to encrypt the communication to deliver VSI to outside of home network. (R-19)

Appendix I

Video sensor devices event scenario

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

A video sensor is a device used to generate useful information, for example, the emotion, number, gender, and age of persons, or movement, by processing video data captured by a camera. By combining this device with IPTV terminal devices, IPTV terminal devices can, for example, recognize the state and attributes of the end-user.

If the end-user permits the collection of such information for use by the sensor server functions, this information is useful for new IPTV services, such as user-specific advertisement, interactive programs. For example, gender information may be useful for gender-specific advertisement to users and motion and gesture recognition, as well as for collecting user response for questionnaires or quizzes (Figure I.1).

Regarding home use, if an application on the home gateway implements the sensor server functions, tablet terminals, for example, connected with such sensor server functions may show the information on whether end-users are watching TV or not, by counting the number of people watching (Figure I.2). Turning TV sets off whenever they are not being watched is useful for electrical energy management. This application must not deliver the information to outside-of-the-home network without the end-user's permission.

VSI is not video information, but video-derived information. VSI is private information that is more sensitive than audience measurement based on usage histories of IPTV services. Therefore, it must be treated more securely. Without secure handling of this information, private information will be stolen, extracted or opened and there may be a risk of serious misuse of private information. The following items must be studied:

- Standardizing metadata between IPTV terminal devices measuring the additional information and the servers aggregating it;
- Clarifying the risks attendant on the processing of the additional information;
- Requirements and functions for avoiding the risks of privacy infringement.

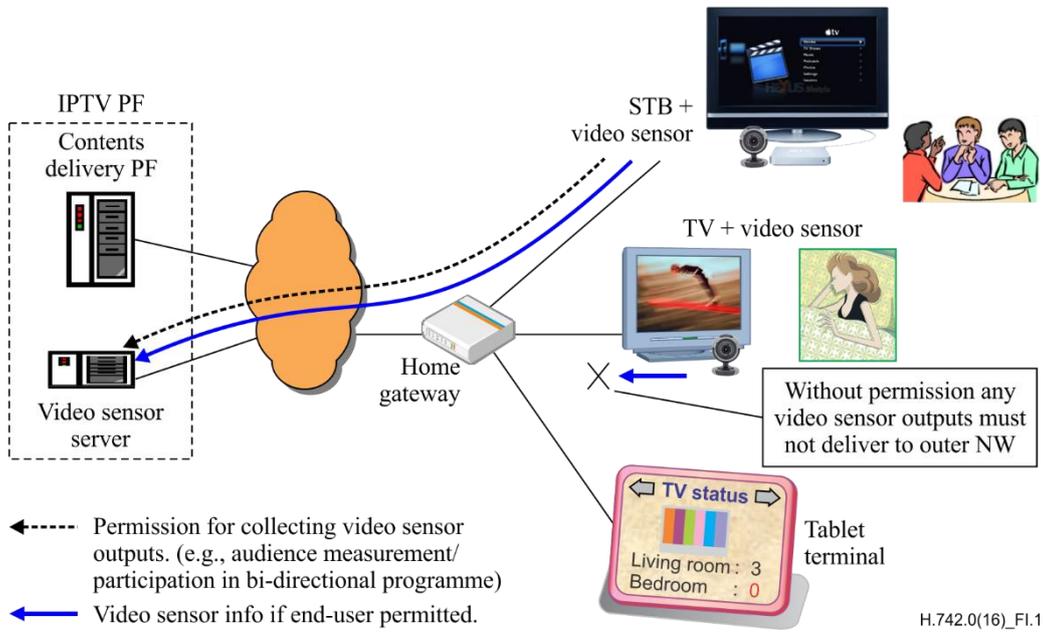


Figure I.1 – Video sensor device event scenario for audience measurement or bi-directional program

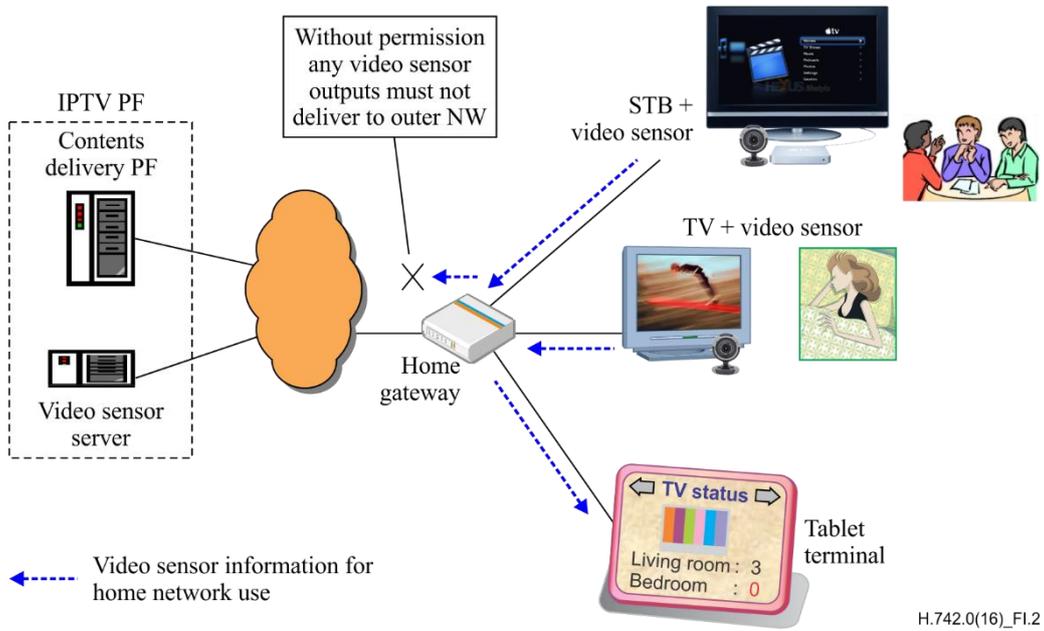


Figure I.2 – Video sensor device event scenario for in-house electrical energy management

Appendix II

Video sensor information generation scenario

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

It is difficult to generate VSI by a video sensor client alone when the video sensor client has limited computational ability. In this case, the video sensor server may generate VSI with the video sensor client. Depending on the situation, all analysis may be processed by video sensor server alone.

The above-mentioned cases require not only more careful handling of data, but also the acquisition of the highest level of permission from end-users. Also, it is desired that video sensor server discards the received data, such as original video data or data that are not full analysed, immediately after completing the generation of the VSI to prevent data leakage.

Overload can occur in the network and server if the video sensor client itself transmits video data to the video sensor server and the video sensor server takes charge of all video data analysis processes that generates VSI (see Figure II.2). Thus, the proper selection about transmission cycle of video data and data encoding should be made.

If some computational ability of video sensor clients can be used, it can reduce the load of video sensor servers. The video sensor client first performs the task to generate intermediate data, which will be processed by the video sensor server, then the video sensor server generates the final VSI (see Figure II.3). For example, when the video sensor generates binary pixel data and sends them to the video sensor server, the transmission data size is reduced and the VSI is generated with lower load than when the original video data was transmitted.

Besides, technologies such as difference image extraction and feature detection can be flexibly applied depending on the performance of the video sensor client and the video sensor server.

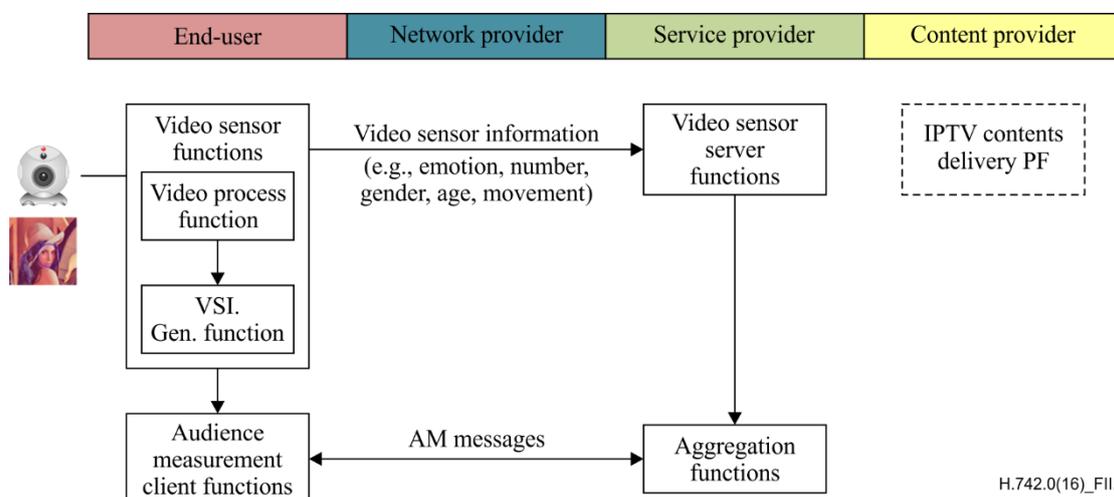


Figure II.1 – Video sensor information generation scenario when video sensor clients generate video sensor information only

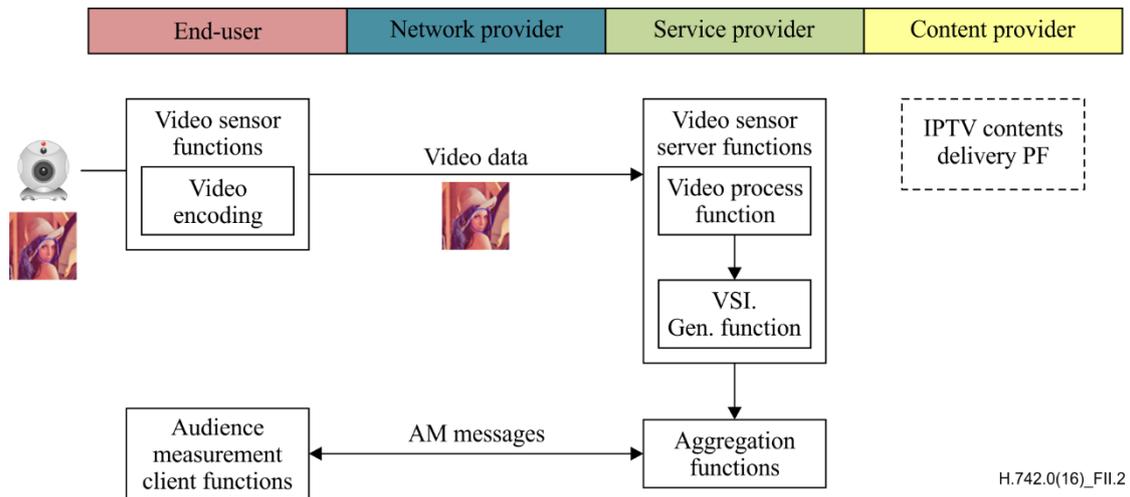


Figure II.2 – Video sensor information scenario when video sensor servers generate video sensor information only

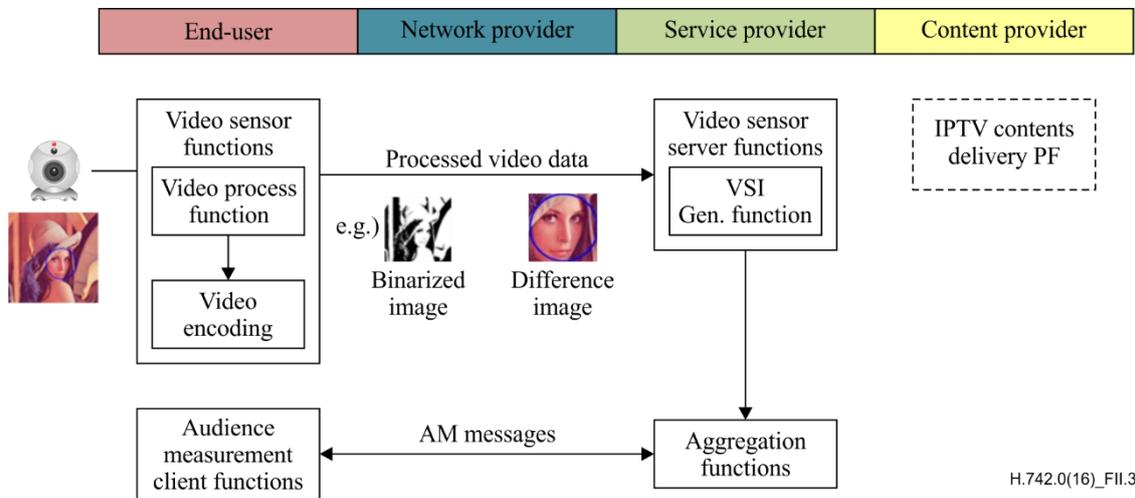


Figure II.3 – Video sensor information generation scenario when video sensor servers generate video sensor information with video sensor clients

Appendix III

Use cases of video sensor information

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

III.1 Targeted advertising service

III.1.1 Overview

Existing targeted advertising for IPTV is mostly serviced based on location and demographic information. As a result, its preciseness is lower than mobile advertisement, which has constant users. Therefore, more precise targeted advertising service can be provided to advertisers and viewers if VSI is used.

Generally, advertisements are included when the user selects free VOD content in IPTV. In this case, the video sensor generates VSI which can distinguish the number of users and the part they play through inputting the content selection signal. Using this information, the video sensor is able to supply the advertisements which meets the user's preferences. For example, whenever mothers and fathers are viewing, vehicle and shoes advertisements, respectively, will be provided and if whole family is a viewer, pizza advertisement can be provided.

VSI has a different destination depending on the targeted advertising management method. If advertisement lists or files are saved in the IPTV terminal, VSI will be used in the IPTV terminal only since advertisements shown should be determined by IPTV terminal. On the other hand, if final discretion is not on the IPTV terminal, VSI will be delivered to the external advertising operator who organizes advertisement dynamically.

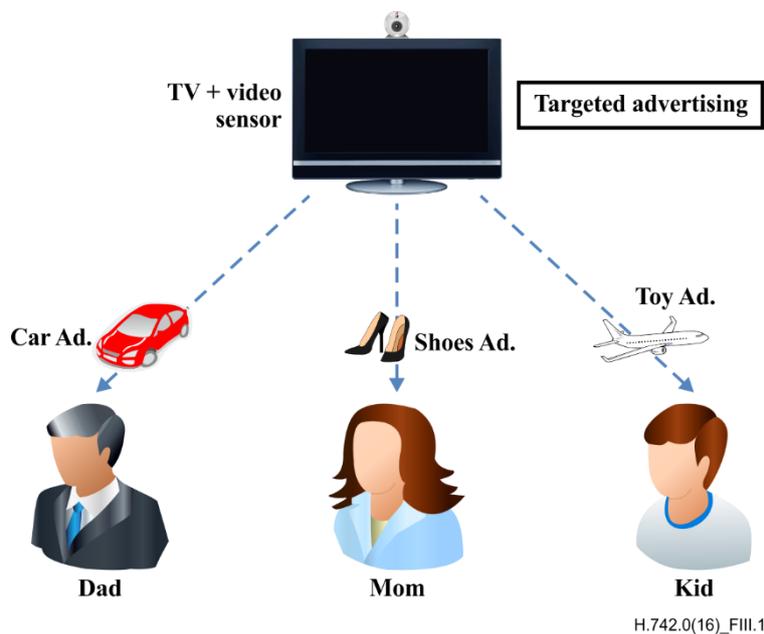


Figure III.1 – Targeted advertising services

III.1.2 Problems to be solved

- There are the occasions where advertisements are provided to viewers who advertisers do not want to target. For example, the effectiveness will be reduced in case of showing a sports car advertisement to the people in their eighties.
- In many cases, advertisement is exposed to the same viewer more often than the advertiser intended.

- Teenagers can be exposed to harmful advertising, such as alcohol and tobacco.

III.1.3 Potential benefits

- Viewers can avoid tedious advertisements which do not relate to their interests as well as repeating advertisements.
- It can protect minors from harmful advertising.
- Advertisers can expose intended viewers to advertising efficiently.
- It can support IPTV advertising business by improving the accuracy of targeted advertising.

III.1.4 Requirements

- Permission for the range of VSI related to targeted advertising service provided should be secured.
- In case there is no entry from viewers for instance mid-advertisement, the video sensor should be provided with information about advertisement exposure time in order to enable targeted advertising.
- VSI generation time should not exceed the planned time frame.

III.1.5 Relevant standardization

- VSI metadata is recommended to be in conformance with audience measurement metadata structure [ITU-T H.741.2].

III.2 Personalized screen service

III.2.1 Overview

Most of the conventional IPTV provides the identical menu screen with identical initial screen and channel guide, and there can also be a cumbersome login procedure if a distinctive menu can be set by user. Therefore, if actual VSI viewer information is used, a screen customized by the viewer can be provided without any extra login procedure.

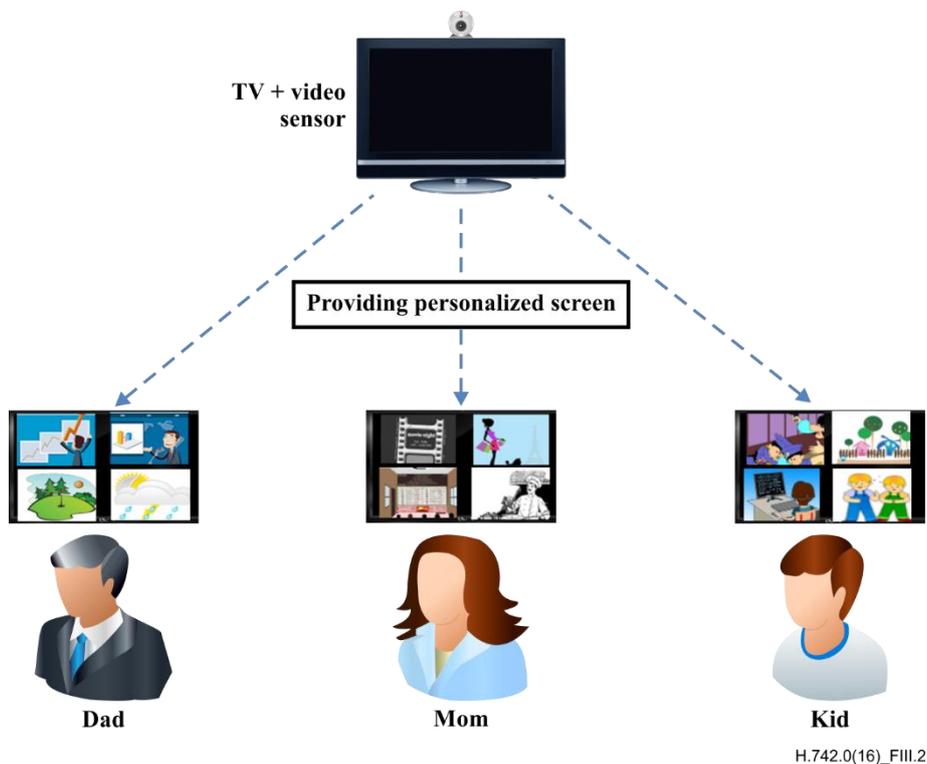


Figure III.2 – Personalized screen based on UVS

For example, whenever the father presses the initial screen button, news and sports content will be listed and activated; any additional information will be related to traffic conditions and the stock market. In the case of the mother, drama and films will be recommended; any activated additional information will be related to shopping and food. If screen service is linked with personal mobile devices, it will be able to access different personal menu screens while identical content is streamed through the TV screen. Also, other IPTVs in the home can provide a personalized menu screen. VSI does not require transmitting externally since it is used only in IPTV terminal.

III.2.2 Problems to be solved

- In many cases, viewers do not receive preferred recommendation lists or additional information.
- Login procedure using a remote control is inconvenient and it also requires considerable time.

III.2.3 Potential benefits

- The user can access personalized screen service through simple user interface, such as a video sensor.
- IPTV business can expect revenue increase related to content and advertising consumption by providing personally customized information.

III.2.4 Requirements

- When providing personalized screen service through TV only, there should be a screen control algorithm for instance of multiple viewers.
- Default screen should be provided in case of error in the video sensor.

III.2.5 Relevant standardization

- When personalized screen service is provided through a secondary terminal, it can be related to multi-screen or second screen standardization.

III.3 IPTV ratings analysis service

III.3.1 Overview

Generally, ratings analysis has been based on remote control information analysis with TV device units rather than on personal use due to the characteristics of TVs which are viewed by multiple individuals. For example, if certain content is on four TVs among ten, rating may be estimated as 40%. In the case of advertising content, rating indicators would not yet be fixed and advertising expenses would be fixed proportional to TV ratings.

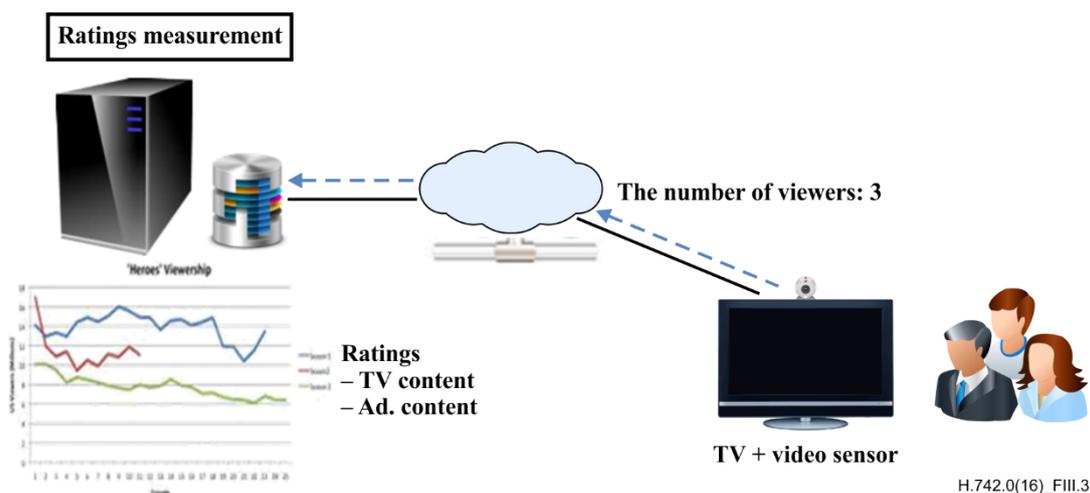


Figure III.3 – IPTV ratings analysis service

If a video sensor is used, ratings for personal unit as well as advertising content can be measured since the sensor can detect the number of viewers relatively precisely in a short time whenever content is exposed. For example, when assuming that four family members are watching content A and two family members are watching content B, rating will be same if the previous method was used. However, the A content ratings will be higher if detected viewer information is applied. Advertising content ratings can be measured by the same method as broadcasting content if the number of viewers is detected for a certain time during the short exposure time.

III.3.2 Problems to be solved

- Advertisement ratings analysis is difficult to measure and accuracy is less compared to broadcasting ratings analysis.
- It is difficult to determine the number of viewers in ratings analysis based on device unit.

III.3.3 Potential benefits

- The number of viewers can be estimated quite precisely since ratings analysis provides information at the individual user level.
- The video sensor is able to estimate the number of viewers who are exposed to advertising content in addition to ratings.

III.3.4 Requirements

- Preliminary permission from viewers for ratings analysis is required.
- At least one VSI generation should be enabled within the total advertisement content exposure time.

III.3.5 Relevant standardization

- VSI metadata is recommended to be in conformance with audience measurement metadata structure [ITU-T H.741.2]

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