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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

IPTV multimedia services and applications for IPTV – IPTV application event handling

IPTV application event handling: Audience measurement for IPTV distributed content services

Recommendation ITU-T H.741.3

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Recommendation ITU-T H.741.3

IPTV application event handling: Audience measurement for IPTV distributed content services

Summary

The ITU-T H.741.x series of Recommendations defines a foundational platform for audience measurement (AM) of IPTV services. They focus on the interface between terminal devices and an audience measurement aggregation function.

The AM platform integrates a method for end users to report personal information, and is designed to easily add time-shifted and interactive services and non-terminal device measurement points. While the ITU-T H.741.x series allows the implementation of audience measurement for IPTV services, its mechanism may be equally applicable to non-IPTV services.

The design philosophy in the ITU-T H.741.x series is focused on scalability, minimizing the use of resources, security, flexibility to support a variety of service provider deployments and rich privacy support to meet emerging regulations and legislation.

Recommendation ITU-T H.741.3 specifies audience measurement for IPTV distributed content services and, in particular, linear TV services. It describes specific configuration for linear TV and metadata and data structures used in the payload of AM messages. The informative appendices discuss specific implementation considerations for linear TV-specific implementation considerations, provide examples and describe capabilities and profiles.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.741.3	2012-06-29	16

Keywords

Audience measurement, audience rating service, audience viewership, contents rating, data structures, distributed content service, engagement metrics, implementation guidelines, IPTV application event handling, linear TV, metadata.

FOREWORD

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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.

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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.741.3

IPTV application event handling: Audience measurement for IPTV distributed content services

1 Scope

This Recommendation describes audience measurement for IPTV distributed content services. This includes specific events and samples, configuration and reporting for linear TV services. Subsequent releases will address additional IPTV distributed content services.

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.741.1] Recommendation ITU-T H.741.1 (2012), *IPTV application event handling: Audience measurement operations 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 H.770] Recommendation ITU-T H.770 (2009), *Mechanisms for service discovery and selection for IPTV services*.

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 configures audience measurement 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 to 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 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.

3.1.6 audience measurement system [ITU-T H.741.0]: The system which, with end-user permission, measures end-user behaviour by detecting application events within the IPTV service and collecting their data within the IPTV service.

3.1.7 configuration package [ITU-T H.741.0]: A configuration package is the data structure which specifies the target services to be measured, content filtering, measurement schedule, events and samples to be measured, and measurement report delivery.

3.1.8 content (object) [b-ITU-T T.174]: Encoded generic value, media or non-media data.

3.1.9 electronic programme guide (EPG) [b-ITU-T H.721]: A service navigation application which is used especially for scheduled linear programmes.

NOTE – In some traditional broadcast services, EPG is defined as an on-screen guide used to display information on scheduled live broadcast television programmes, allowing a viewer to navigate, select, and discover programmes by time, title, channel, and genre. This traditional definition does not cover "catalogues" for on-demand and download services (sometimes called electronic content guide or broadband content guide) and bi-directional interactive service (sometimes called interactive programme guide) for end-user interaction with a server or head-end.

3.1.10 end user [b-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 Internet protocol television (IPTV) [b-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 IPTV terminal device [b-ITU-T Y.1901]: A terminal device which has IPTV terminal function (ITF) functionality, e.g., an STB.

3.1.13 IPTV terminal function (ITF) [b-ITU-T Y.1901]: The end-user function(s) associated with a) receiving and responding to network control channel messages regarding session set-up, maintenance, and tear-down, and b) receiving the content of an IP transport from the network and rendering.

3.1.14 linear TV [b-ITU-T Y.1901]: A television service in which a continuous stream flows in real time from the service provider to the terminal device and where the end user cannot control the temporal order in which contents are viewed.

3.1.15 metadata [b-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 have 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.

3.1.16 measurement report [ITU-T H.741.0]: The data that the audience measurement function (AMF) generates from an end-user behaviour event or sample.

3.1.17 sample [ITU-T H.741.0]: A sample is a periodic action occurring on a configurable schedule time interval, during a service period, which captures specified information values.

3.1.18 sample set [ITU-T H.741.1]: A sample set contains one or more information fields, captured at a specific instance of periodic action occurring on a configurable schedule time interval, during a service period.

3.1.19 sample time [ITU-T H.741.0]: A sample time is when an instance of the periodic action occurs on a configurable schedule time interval, which captures specified information values, during a service period.

3.1.20 sample value [ITU-T H.741.0]: The content of an information field, captured at a specific instance of periodic action occurring on a configurable schedule time interval, during a service period.

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

3.1.22 service-common [ITU-T H.741.1]: Qualifier of measurements such as events and elements, and reports to indicate that these measurements and reports are commonly applicable to two or more distributed content or interactive services.

3.1.23 service navigation [b-ITU-T H.720]: A process of presenting information that allows the end user to discover, select and consume services.

3.1.24 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.

3.1.25 set-top box (STB) [b-ITU-T J.183]: A hardware box that contains digital signal demodulator, de-multiplexer, MPEG-2 decoder, and other functionalities and interfaces related to digital signal reception and presentation of the distributed programme at the subscriber's site.

3.1.26 stream [b-ITU-T J.200]: A unidirectional continuous flow of content.

3.1.27 subscriber [b-ITU-T M.3050.1]: The subscriber is responsible for concluding contracts for the services subscribed to and for paying for these services.

3.1.28 terminal device (TD) [b-ITU-T Y.1901]: An end-user device which typically presents and/or processes the content, such as a personal computer, a computer peripheral, a mobile device, a TV set, a monitor, a VoIP terminal or an audio-visual media player.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 channel surfing: The action by an end user of holding down a navigation key which causes linear TV services to be skipped.

3.2.2 mosaic: A display in which many services are received and displayed simultaneously in the format of a matrix of icons.

3.2.3 picture-in-picture: A service displayed over a small part of the main service display. Sound is usually from the main service only.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AM	Audience Measurement
AMF	Audience Measurement Function
API	Application Programming Interface
EPG	Electronic Programme Guide
HD	High Definition
HTTP	Hypertext Transfer Protocol
ID	Identifier
ms	milliseconds
PIP	Picture-In-Picture

QoE	Quality of Experience
QoS	Quality of Service
SP	Service Provider
TD-AMF	Terminal Device Audience Measurement Function
TV	Television

5 Conventions

In this Recommendation, the following conventions apply.

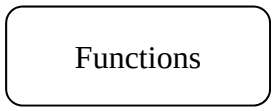
The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

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.

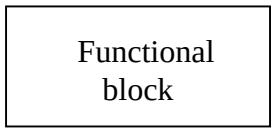
The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this specification can still be claimed even if this requirement is present.

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 the specification.

The keyword "functions" is defined as a collection of functionalities. It is represented by the following symbol in the context of IPTV architecture:



The keywords "functional block" are 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.

6 Overview

Audience measurement (AM) configuration, reporting and data structures for service-common events and samples are specified in [ITU-T H.741.1] and [ITU-T H.741.2]. This Recommendation specifies configuration, reporting and data structures for linear TV events and samples.

7 Specific audience measurement for linear TV

An IPTV terminal device may have different ways of displaying TV channels. For example, a TV channel may be displayed on the full screen of a TV, whereas some TVs may simultaneously receive two TV channels and display them both, one in full screen and the other in a picture-in-picture (PIP) mode. Subsequent channel changes may occur either on the full screen or in the reduced window for the second channel. Usually the audio channel is the one of the full screen TV channels.

A second alternative to full-screen display is when more than one TV channels may be displayed simultaneously, for example, in a mosaic. The audio channel is usually assigned to one TV channel for which the end user has shown more interest.

A "channel start" event, when configured and allowed, generates an audience-measurement report indicating the new channel and how it is displayed. If a "channel start" event follows a previously delivered service, then the report will also indicate that the previous service is no longer active.

A "channel stop" event indicates that the displayed TV channel associated with the "channel start" event is no longer being measured. This may occur for one of several reasons, for instance:

- Sampling of the linear TV channel playing is supported.
- The navigation methods used in linear TV are identifiable.
- The control device used in linear TV is identifiable.

7.1 Audience measurement configuration for linear TV

The AM configuration of linear TV is part of the AM configuration "Configuration of services to be measured", as described in [ITU-T H.741.1]. Each measurement request is configured to indicate whether linear TV measurements are to be made. Linear TV services may be configured with associated parameters as follows.

7.1.1 Channels to be measured

Either all channels or a list of channels to be measured may be configured. Alternatively, an "all channel except" list may be configured.

7.1.2 Summarization and filtering

Configuration of a channel change filter time between channel change events can be used to filter out unneeded reports. When configured, reports relating to infrequently used channels may be additionally delayed by the channel change filter time. In Figure 1 below, the report for event A is delayed until the channel change filter time following event A. The report for event B will not be reported. The report for event C will be determined depending upon the subsequent occurrence of another event within the channel change filter time.

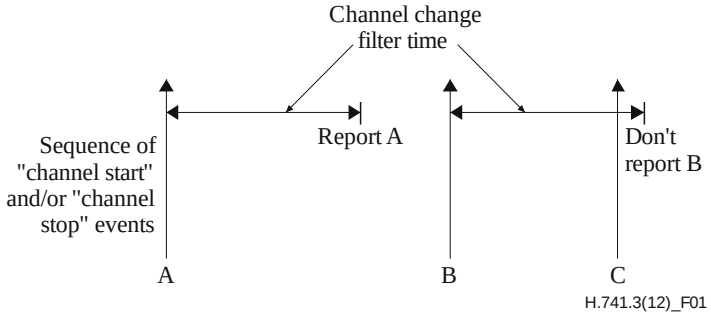


Figure 1 – Channel change report filtering

When event A is a channel start event, in order to minimize the reporting latency regarding leaving channel A, a channel stop event for A, using the measurement time of event B, is reported when event C occurs.

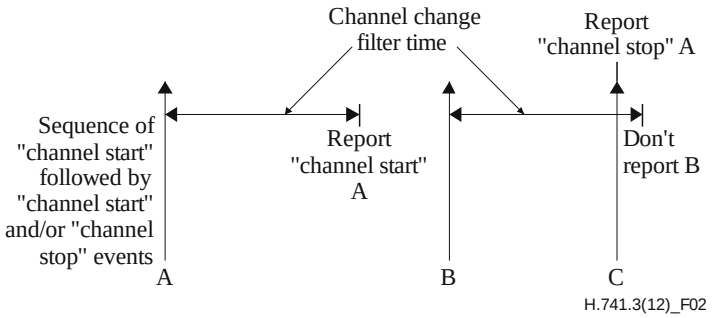


Figure 2 – Channel change filtered reporting following channel start event

7.1.3 Service navigation method

The reporting of which method was used to change channel may be configured.

7.1.4 Control device

The reporting of which device was used to change channel may be configured.

7.2 Linear TV metadata

The notation used in Tables 1 to 6 facilitates the specification of the corresponding schema:

– *Support*: 1 = mandatory (one instance), 0-1 = optional (maximum one instance), 0-* = (optional and multiple instances possible), 1-* = mandatory and multiple instances possible)

– *Type*: string, integer, float, etc.

– *Container:* elements are defined to group associated elements

In the following tables containing data structures, an alternative representation may be shown which illustrates the data structure. In the event of discrepancy between an alternative representation and the table, the correct information is to be found in the table.

Table 1 summarizes audience measurement elements for linear TV.

Table 1 – Audience measurement elements for linear TV

Element	Definition	Type	Notes or value domain
ServiceInstanceID	Identifies the instance of a specific service. Distinguishes among services when multiple services are displayed.		Defined in [ITU-T H.741.2]
ServiceIdentifier	Contains the "unique name for the service within the service provider's domain" (according to [ITU-T H.770]) which starts to be received.		NOTE – Defined in [ITU-T H.770] with the encoding in Figure 3.

Table 1 – Audience measurement elements for linear TV

Element	Definition	Type	Notes or value domain
ChannelChangeFilter	Reports channel start and channel stop events only when the time following an event, without either subsequent event occurring, is greater than ChannelChangeFilter ms.	xs:integer	Values: time in milliseconds, 0 means report all channel start and channel stop events. NOTE – This sets the minimum time to report latency for channel start and channel stop events, to at least the specified time in milliseconds.
ControlDevice	Indicates the device type used to navigate to a channel.		Defined in [ITU-T H.741.2]
StartNavMethod	Indicates the method used to navigate to a channel.	xs:integer enumeration	Values: 0 = up/down arrow, 1 = channel surfing, 2 = scheduled channel change, 3 = EPG, 4 = Last (previous), 5 = Favourite, 6 = number entry, 7 = unknown, 8 = other
StopNavMethod	Indicates the method used to navigate away from a channel.	xs:integer enumeration	Values: 0 = up/down arrow 1 = channel surfing 2 = scheduled channel change 3 = EPG 4 = Last (previous) 5 = Favourite 6 = number entry 7 = unknown 8 = other 999 = turn off terminal device
ViewMode	Identifies the viewing mode of the linear TV service which starts to be received.	xs:integer enumeration	0 = unknown 1 = full screen 2 = Picture-in-Picture 3 = Mosaic 4 = Other
NOTE – The value of "unknown" for enumerated valued elements indicates that element information is not available; the value of "other" indicates that the element information is available but does not match one of the defined enumerated values.			

```
<xsd:complexType name="IndividualServiceType">
 <xsd:sequence>
  <xsd:element name="ServiceIdentifier" type="H770IdType"/>
  <xsd:element name="ServiceProviderIdentifier"
               type="H770IdType" minOccurs="0"/>
  <xsd:element name="AdditionalServiceDescriptionLocation"
               type="anyURI" minOccurs="0"/>
  <xsd:element name="LogicalChannelNumber"
               type="xsd:positiveInteger" minOccurs="0"/>
 </xsd:sequence>
</xsd:complexType>
```

Figure 3 – XML encoding for ServiceIdentifier in linear TV audience measurement

ViewMode is an element to identify how the channel being received is rendered on the terminal device when started. The display modes are listed below:

– Full screen (means that only the linear TV video is displayed, independent of the percentage of the display covered by the video).

– Picture-in-picture (means a second service is displayed over a small part of the display of the main service. Sound is usually from the main service only).

– Mosaic (in which many linear TV channels are received and displayed simultaneously in the same format as a matrix of small TV screens).

– Other – includes presentation of video in other modes.

Table 2 provides information regarding events which are specific to the linear service.

Table 2 – Types of linear TV events

Event	Definition	Notes or value domain
Linear ChannelStart	This event occurs when a user starts watching a TV channel or switches to another TV channel for which AM reporting is authorized by the user and configured to be reported about by the SP. It causes reporting of the ChannelStart data structure defined in Table 6.	
Linear ChannelStop	This event occurs: 1) when a user stops watching a linear TV service without starting another linear TV service; 2) when a user switches to another channel for which reporting is forbidden by the user or is configured not to be reported about by the service provide (SP); 3) when the content of a specified class starts playing although it is forbidden to be measured by the user or configured not to be measured by the SP; 4) following restoration from a communications loss to indicate the time at which a channel was no longer being received; 5) when it causes reporting of the ChannelStop data structure defined in Table 6. This event may also occur during channel change filtering.	NOTE – An example of case 5 is when an AM operation is restored following power-down.

When a measurement request includes LinearTVQualifier, and is configured with EventTrigger, then the events LinearChannelStart and LinearChannelStop are by default included in the events to be measured and reported, having the highest priority.

The sample set identifiers in Table 3 are used to indicate elements to be reported when scheduled time sampling is used.

Table 3 – Sample set identifier for linear TV

Sample set identifier	Description
ChannelPlaying	Indicates that the ChannelPlaying data structure defined in Table 6 is to be reported when sampled.

7.2.1 Linear TV elements for "measurement request"

The specific elements to be inserted in a measurement request data structure for linear TV service are specified in Table 4.

Table 4 – "LinearTVQualifier" extension to "measurement request" data structure

Element	Definition	Support/ type	Notes or value domain
LinearTVQualifier	This element indicates that LinearTV services are to be measured and is a container for the identification of the LinearTV services to be measured.	0-1	
NavMethod	Element of LinearTVQualifier Indicates that the navigation method is to be reported for channel start and channel stop events.	0-1 Integer enumerated	0 = do not report 1 = report
ControlDevice	Element of LinearTVQualifier Indicates that the device type used for channel navigation is to be reported.	0-1	Defined as ControlDevice in [ITU-T H.741.2]
ViewMode	Element of LinearTVQualifier Indicates that the ViewMode is to be reported for channel start events.	0-1 Integer enumerated	0 = do not report 1 = report
Obscuration	Element of LinearTVQualifier Indicates that the Obscuration is to be reported for channel start events.	0-1 Integer enumerated	0 = do not report 1 = report
ChannelQualifier	Element of LinearTVQualifier Container for channel qualification elements.	0-1	
ChannelList	Element of ChannelQualifier List of channel IDs (service identifiers) to be measured.	0-1 (Note)	
ServiceIdentifier	Element of ChannelList. This element identifies a specific LinearTV channel to be measured.	1-*	Defined in Table 1
AllChannels ExceptList	Element of ChannelQualifier List of channel IDs (service identifiers) not to be measured.	0-1 (Note)	
ServiceIdentifier	Element of AllChannelsExceptList. This element identifies a specific LinearTV channel not to be measured.	1-*	Defined in Table 1

Table 4 – "LinearTVQualifier" extension to "measurement request" data structure

Element	Definition	Support/ type	Notes or value domain
ChannelChangeFilter	Element of LinearTVQualifier Only report channel start and channel stop events when the time following an event without either subsequent event occurring is greater than ChannelChangeFilter ms.	0-1	Defined in Table 1
NOTE – Either "ChannelList" or "AllChannelsExceptList" may be present, or neither of them. When neither of them is present, this means "all channels".			

Figure 4 contains an alternative representation of the measurement request extension data structure.

```
LinearTVQualifier (0-1)
| NavMethod (0-1)
| ControlDevice (0-1)
| ChannelQualifier (0-1)
| | ChannelList (0-1)
| | | ServiceIdentifier (1-*)
| | AllChannelsExceptList (0-1)
| | | ServiceIdentifier (1-*)
| ChannelChangeFilter (0-1)
```

Figure 4 – Alternative representation of measurement request extension data structure

7.2.2 Linear TV elements for "measurement request set"

As some elements may be repeated in a number of measurement requests with the same value, a measurement request set is defined to provide an optimization mechanism to include default values for elements which have the same value in a number of measurement requests. Multiple measurement request sets may be present in a configuration package.

There are four possible levels to set values:

– Highest priority – configured in individual measurement request

– Second level – default in measurement request

– Third level – configured in measurement request set

– Fourth level – default in measurement request set

The values configured in each measurement request supersede those configured in Table 5.

Figure 5 contains an alternative representation of the MeasurementRequestSet extension data structure.

Table 5 – Linear TV extension to "MeasurementRequestSet" data structure

Element	Description	Support/ type	Notes or value domain
Measurement RequestSet	This element is a container for a general default section containing elements with identical values for a set of measurement requests and the corresponding set of measurement requests.	1-*	Defined in [ITU-T H.741.2]
DefaultNavMethod	Element of MeasurementRequest Set. Indicates that the navigation method is to be reported for channel start and channel stop events.	0-1 Default=0	Defined as NavMethod in Table 4
DefaultControl Device	Element of MeasurementRequest Set. Indicates the device type used to navigate to a service.	0-1 Default=0	Defined as ControlDevice in [ITU-T H.741.2]
DefaultViewMode	Element of MeasurementRequest Set. Indicates that the ViewMode is to be reported for channel start events.	0-1 Default=0	Defined as ViewMode in Table 1
DefaultObscuration	Element of MeasurementRequest Set. Indicates that the Obscuration is to be reported for channel start events.	0-1 Default=0	Defined as Obscuration in Table 4
DefaultChannel Qualifier	Element of MeasurementRequest Set. Container for channel qualification elements.	0-1 Default= All channels	Defined as ChannelQualifier in Table 4
DefaultChannel ChangeFilter	Element of MeasurementRequest Set. Only report channel start and channel stop events when the time following an event without either subsequent event occurring is greater than ChannelChangeFilter ms.	0-1 Default:0	Defined as ChannelChangeFilter in Table 1

```
MeasurementRequestSet
| DefaultNavMethod
| DefaultControlDevice
| DefaultViewMode
| DefaultObscuration
| DefaultChannelQualifier
| DefaultChannelChangeFilter
```

Figure 5 – Alternative representation of MeasurementRequestSet extension data structure

7.2.3 Linear TV elements for "audience measurement report package"

NOTE – The measurement report header already contains the report creation time.

The data structure in Table 6 is part of the data structure for the audience measurement report package of [ITU-T H.741.0]. Multiple elements which are associated with a single trigger time may be included in a particular instance of MeasurementReport.

Figure 6 contains an alternative representation of the Measurement Report extension data structure.

Table 6 – Linear TV extension to "MeasurementReport" data structure

Element	Description	Support/type	Notes or value domain
Measurement Report	Element of AMReportPackage. Container for a measurement report.	1-*	Defined in [ITU-T H.741.2]
ChannelStart	Element of MeasurementReport Indicates that a channel start event has taken place.	0-1	
ControlDevice	Element of ChannelStart Indicates the device type used to navigate to a channel.	0-1	Defined in Table 1
StartNavMethod	Element of ChannelStart Indicates the method used to navigate to a channel.	0-1	Defined in Table 1
PreviousService InstanceID	Element of ChannelStart Identifies the instance of the previous specific service.	0-1	Defined as ServiceInstanceID in Table 1 Reported when ChannelStart follows a ChannelStart. Not reported when a ChannelStart follows a ChannelStop.
ServiceInstanceID	Element of ChannelStart Identifies the instance of the current specific service.	1	Defined in Table 1
ServiceIdentifier	Element of ChannelStart This element contains the "unique name for the service within the service provider's domain" (according to [ITU-T H.770]) which starts to be received.	1	Defined in Table 1

Table 6 – Linear TV extension to "MeasurementReport" data structure

Element	Description	Support/type	Notes or value domain
ViewMode	Element of ChannelStart Identifies the viewing mode of the linear TV service which starts to be received.	0-1	Defined in Table 1
Obscuration	Element of ChannelStart Indicates the percentage of image obscured.	0-1	Defined in [ITU-T H.741.2]
ChannelStop	Element of MeasurementReport It indicates that a channel stop event has taken place.	0-1	
ControlDevice	Element of ChannelStop Indicates the device type used to navigate to a channel.	0-1	Defined in Table 1
StopNavMethod	Element of ChannelStop Indicates the method used to navigate away from a channel.	0-1	Defined in Table 1
ServiceInstanceID	Element of ChannelStop Identifies the instance of a specific service.	1	Defined in Table 1
ChannelPlaying	Element of MeasurementReport Container for channel(s) playing information.	0-*	NOTE – This element is activated by configuring sample set identifier ChannelPlaying of Table 3
ServiceIdentifier	Element of ChannelPlaying This element contains the "unique name for the service within the service provider's domain" (according to [ITU-T H.770]) which starts to be received.	1	Defined in Table 1
ServiceInstanceID	Element of ServiceIdentifier Identifies the instance of a specific service.	1	Defined in Table 1

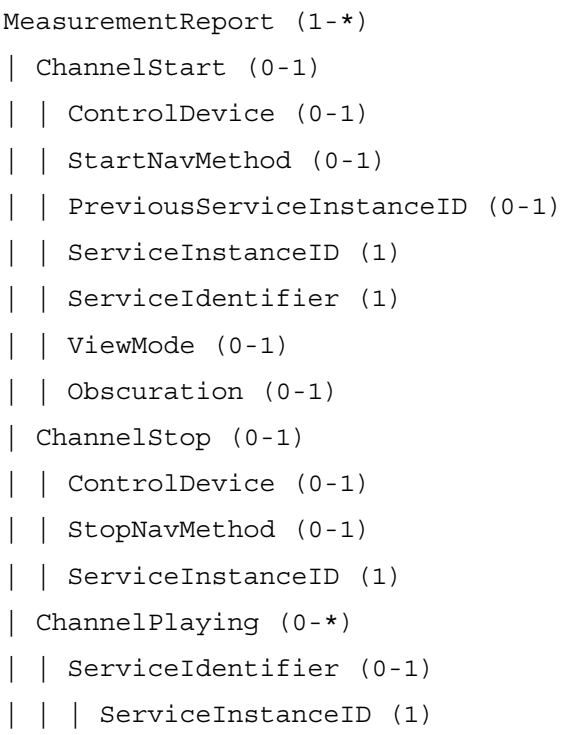


Figure 6 – Alternative representation of MeasurementReport extension data structure

Appendix I

Implementation considerations

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

I.1 Considerations regarding the enabling of control device reporting

Conditions that may lead to this reporting option being enabled include:

1) When a stakeholder wants information regarding the control devices used by an audience; for example,
    a) to understand the statistical distribution of control devices used in order to guide product investments;
    b) to combine with other information. For example:
        i) to combine control device information with display device information to provide a count of tablets in use to control HD TVs.
        ii) to combine with navigation methods to obtain a better end-user signature.

I.2 Considerations regarding the enabling of navigation method reporting

Conditions that may lead to this reporting option being enabled include the following:

1) If a client application is deployed to distinguish between end users based upon behavioural usage patterns, then information provided by reporting navigation methods may improve the application's ability to distinguish among end users.
    a) If the client application receives AM reports, then it is recommended that this reporting be enabled.
    b) If the client application uses an API to communicate with the AMF, then it may not be necessary to enable this reporting.
2) If a server application is deployed to distinguish between end users based upon behavioural usage patterns, then information provided by reporting navigation methods may improve the application's ability to distinguish among end users. If the server application is part of the aggregation functions, or has an API to communicate with aggregation functions, then it may be advisable to enable this reporting.

I.3 Considerations for specifying channels to be measured

There are three methods for specifying channels to be measured: specification by inclusion, specification by exclusion, or measurement of all channels (default).

Channel specification by inclusion. Conditions that may lead to this method being selected include:

1) Not all channels are desired to be measured.
2) The list of channels to be measured is smaller than the list of channels not to be measured.

Channel specification by exclusion. Conditions that may lead to this method being selected include:

1) Not all channels are desired to be measured.
2) The list of channels to be measured is larger than the list of channels not to be measured.

I.4 Considerations for using channel change filtering and how to choose the value

In order to reduce bandwidth and processing, the channel change filter prevents channel change reports when channels are frequently changed, for example, as occurs during sequential up-arrow channel changing. If reporting of transitional channels to a final channel is not desired, then it is recommended that channel change filtering be used. Conditions that may help choose the filter period include:

1) sufficient time to allow a button push;

2) Insufficient time for an end user to get a meaningful impression of the content, i.e., it is too short a viewing period to be considered "watching".

Appendix II

Examples of configuration and reporting of the terminal device audience measurement function

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

II.I Configuration example

Assuming the following example requirements:

1) General
   a) An external permission mode with permission level 3
   b) The configuration package is to become effective immediately
   c) All reports are to be sent to the same address
   d) Re-transmission of up to five additional times following transport non-acknowledgement from aggregation functions.
2) For most linear channels:
   a) Measure all channels except Channels 50, 53, 58 and 60. Do not measure religious content.
   b) Events to be measured and reported include:
      i) channel change events
      ii) only channel start and channel stop events when the time following an event without either subsequent event occurring is greater than two seconds
      iii) the following with the channel start event:
         (1) channel identifier
         (2) channel change (navigation) method
         (3) viewing mode (e.g., full screen, picture-in-picture)
         (4) content identifier
         (5) event time
      iv) the following with the channel stop event
         (1) event time
   c) Information to be frequently sampled and reported, include:
      i) channel identifier
      ii) content identifier info
      iii) sample times
   d) Measurement times
      i) Always
   e) Reporting
      i) Report batches of events within 60 seconds of any event
      ii) Measurements will be stored if the AMF is unable to send reports
3) For specific linear channels:
   a) Collect both events and samples for Channels 50, 53, 58 and 60. Do not measure religious content.
   b) Events to be measured and reported include:

i) Channel change events
ii) Report only channel start and channel stop events when the time following an event without either subsequent event occurring is greater than two seconds
iii) Report the following with the channel start event:
(1) channel identifier
(2) channel change (navigation) method
(3) viewing mode (e.g., full screen, picture-in-picture)
(4) content identifier
(5) event time
iv) Report the following with the channel stop event:
(1) event time

c) Measurement times:
i) Always.
ii) Time sampling every five minutes.
iii) Ignore the sample if its value is the same as the previous sample's value.

d) Reporting:
i) Upon demand by aggregation functions
ii) Measurements will be stored if the AMF is unable to send reports
iii) Samples will be stored with lower priority than events

The example solution in Figure II.1 shows values assigned to the configuration package data structure to meet the above requirements. Relevant defaults are shown in grey; it is not required that they be explicitly included in the configuration.

```
AMFConfigPackage (1)
   PackageID (1) = 2345
     @PackageVersion (0-1) = 2
   EffectivityDateAndTime (0-1) = immediately
   MeasurementRequestSet (1-*)
      DefaultDeliveryAddress (0-*) = http://defaultdeliveryaddress.com
      DefaultRetransmitNumber (0-1) = 5
      MeasurementRequest (1-*)
         MeasurementRequestID (1) = 1
         LinearTVQualifier (0-1)
            NavMethod (0-1) = 1 (report)
            ControlDevice = 0 (do not report)
            ChannelQualifier (0-1)
               AllChannelsExceptList (0-1)
                  ServiceIdentifier (1-*) = "channel50"
                  ServiceIdentifier (1-*) = "channel53"
                  ServiceIdentifier (1-*) = "channel58"
                  ServiceIdentifier (1-*) = "channel60"
            ChannelChangeFilter (0-1) = 2000
```

```
   AllContentClassExceptList (0-1)
      ContentClassDomain (1-*) = "TV-Anytime"
         ContentClassID (1-*) = "Religious"
   MeasurementSchedule (1-*)
      MeasurementPeriod (0-*)
         DayOfTheWeek (0-*)= 0 (everyday)
         StartTime (0-*) = 00:00:00.00
         EndTime (0-*) = 23:59:59.99
      EventTrigger (0-*)
      TimeTrigger (0-1)
         SampleSet (0-*)
           @SampleSetIdentifier (1)= ChannelPlaying
         Periodicity (1) = 300
         Priority (0-1) = 1
         NothingNewReportMode (0-1) = 2 (create a complete AM sample)
   MeasurementDeliverySchedule (0-1)
      ImmediatePush (0-1)
         MeasurementReportNumberByPush (0-1) = 3
         MaxTimeBetweenDelivery (0-1) = 60
MeasurementRequest (1-*)
   MeasurementRequestID (1) = 2
   LinearTVQualifier (0-1)
      NavMethod (0-1) = 1
      ControlDevice = 0 (do not report)
      ChannelQualifier (0-1)
         ChannelList (0-1)
            ServiceIdentifier (1-*) = "channel50"
            ServiceIdentifier (1-*) = "channel53"
            ServiceIdentifier (1-*) = "channel58"
            ServiceIdentifier (1-*) = "channel60"
      ChannelChangeFilter (0-1) = 2000
   AllContentClassExceptList (0-1)
      ContentClassDomain (1-*) = "TV-Anytime"
         ContentClassID (1-*) = "Religious"
   MeasurementSchedule (1-*)
      MeasurementPeriod (0-*)
         DayOfTheWeek (0-*)= 0 (everyday)
         StartTime (0-*) = 00:00:00.00
         EndTime (0-*) = 23:59:59.99
```

```
    EventTrigger (0-*)
MeasurementDeliverySchedule (0-1)
    StorageCongestionPolicy (0-1) = 1 (drop sufficient)
    Pull (0-1)
```

Figure II.1 – Example of an AMF configuration package

NOTE 1 – Sample times and event times – MeasurementReportTriggerTime is used to report the time that an event occurs or an element is sampled. No additional configuration for this is needed.

NOTE 2 – Content ID info could be derived from content source and time for LinearTV.

II.2 Example measurement reports associated with example configuration of Figure II.1

Given the example configuration of Figure II.1, example end-user behaviours are assumed which, together with the configuration, result in a series of measurement reports being delivered.

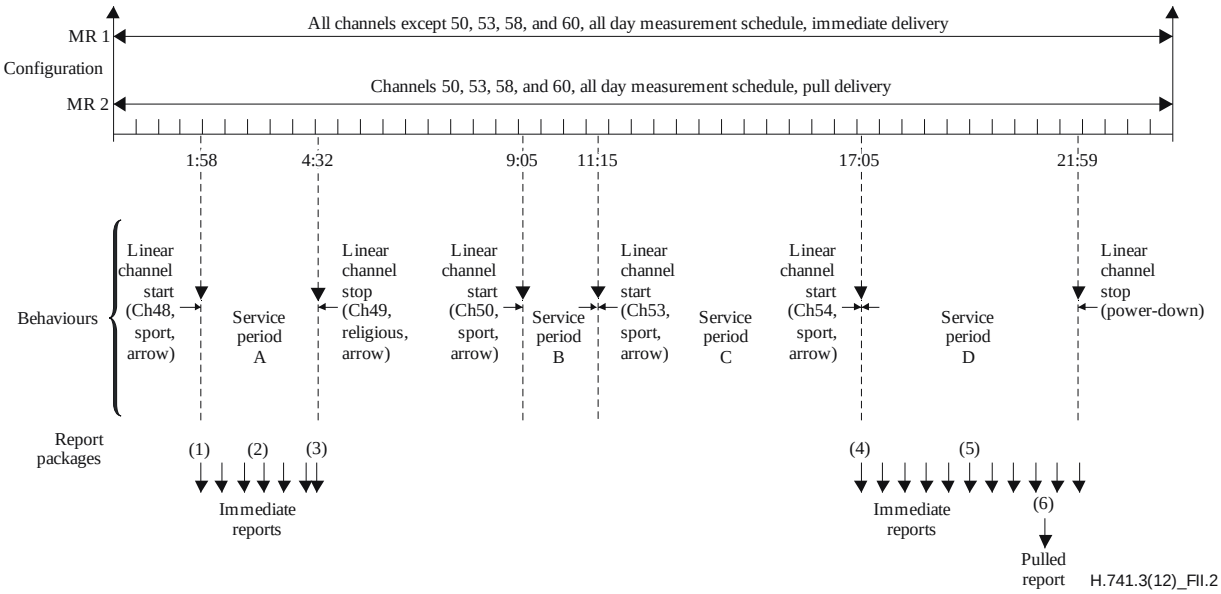


Figure II.2 – Example of end-user behaviours and measurement reports

It is assumed that the navigation method used is the remote control up/down arrow. All reports of measurement request 1 are delayed by up to one minute to allow for aggregation. All reports of both measurement requests will be delayed by at least two seconds (channel change filter time). Religious programmes are considered restricted and measurements regarding them are not to be reported. Channel 49 is assumed to be playing only religious programmes during this example. This example shows how sampling ChannelPlaying in real-time may prevent long report latency.

Six reports packages indicated in Figure II.1 are delivered as follows:

1) Per measurement request 1, at 0158 hours the first measurement of channel start event on Ch48 for service period A is taken and delivered immediately after a one-minute delay, with the T0 sample value of ChannelPlaying as report package (1). The service is subsequently sampled every five minutes, including ChannelPlaying, and it generates a sequence of similar report packages (2) with timestamps from 0158 hours to 0428 hours.

2) Per measurement request 1, at 0432 hours the channel is changed to Ch49, which is showing restricted content; this is reported as a channel stop event in report package (3) and delivered immediately after a one-minute delay. The new service is not measured.

3) Per measurement request 2, at 0905 hours the channel is changed to Ch50, which is showing non-restricted content, and the channel start is measured and stored.

4) Per channel change filtering in both measurement requests 1 and 2, after being tuned to Ch50, the up arrow is pressed three times every 0.5 seconds to get to Ch53, which is showing non-restricted content, at 11:15:00.0 to Ch51, at 11:15:00.5 to Ch52, and at 11:15:01.0 to Ch53. Per Figure 2 in clause 7.1.2, a ChannelStop report is generated for Ch50 at 11:15:00.5. A ChannelStart report is generated for Ch53 at 11:15:01.0. Both reports are stored for later delivery.

5) Per measurement request 1, at 1705 hours the channel is changed to Ch54, which is showing non-restricted content, and delivered immediately after a one-minute delay, with the T0 sample value of ChannelPlaying, as report package (4). ChannelPlaying is subsequently sampled every five minutes and it generates a sequence of similar report packages (5) with timestamps from 1705 hours through 2155 hours.

6) At 2000 hours, aggregation functions pull the report package (6), which contains the previously stored channel start measurements from 0905 hours and 1115 hours.

7) At 2159 hours, the device is powered down and a channel stop report is stored. It will be delivered when the device is powered up, which may cause long reporting latency. The use of time sampling reported the check-pointed ChannelPlaying values in real-time (6).

The contents of the six example AM report packages are as follows.

AM report package (1) is delayed one minute after service start of service period A, due to ChannelStart event and ChannelPlaying T0 sample value change (see Figure II.3).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 01:58:00.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 0 (up/down arrow)
| | | ServiceInstanceID (1) = 1
| | | ServiceIdentifier (1) = "Channel48"
| | | ViewMode (0-1) = 1 (fullscreen)
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 2
| | MeasurementReportTriggerTime (1) = 01:58:00.0
| | ChannelPlaying (0-*)
| | | ServiceIdentifier (0-1) = "Channel48"
| | | | ServiceInstanceID (1) = 1
```

Figure II.3 – Example report package 1

The series of similar AM report packages (2) is delayed one minute after each sample time from 0158 hours to 0428 hours (see Figure II.4).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 01:58:00.0 to 4.28:00.0
| | ChannelPlaying (0-*)
| | | ServiceIdentifier (0-1) = "Channel48"
| | | | ServiceInstanceID (1) = 1
```

Figure II.4 – Example report package 2

AM report package (3) is delayed one minute after service stop of service period A (see Figure II.5).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 04:32:00
| | ChannelStop (0-1)
| | | StopNavMethod (0-1) = 0
| | | ServiceInstanceID (1) = 1
```

Figure II.5 – Example report package 3

AM report package (4) is delayed one minute after service start of service period D, due to ChannelStart event and ServiceIdentifier T0 sample value change (see Figure II.6).

```
AMReportPackage (1)
| SubscriberID (0-1) = WorldspGold012345678
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 17:05:00.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 0 (up/down arrow)
| | | PreviousServiceInstanceID = 3
| | | ServiceInstanceID (1) = 4
| | | ServiceIdentifier (1) = "Channel54"
| | | ViewMode (0-1) = 1 (fullscreen)
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 17:05:00.0
| | ChannelPlaying (0-*)
| | | ServiceIdentifier (0-1) = "Channel54"
| | | | ServiceInstanceID (1) = 4
```

Figure II.6 – Example report package 4

The series of similar AM report packages (5) is delayed one minute after each sample time from 1710 hours to 2155 hours (see Figure II.7).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 17:10:00.0 to 21:55:00.0
| | ChannelPlaying (0-*)
| | | ServiceIdentifier (0-1) = "Channel54"
| | | | ServiceInstanceID (1) = 4
```

Figure II.7 – Example Report Package 5

AM report package (6) that is pulled at 20:00 hours includes stored measurements from 0905 hours and 1115 hours (see Figure II.8).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 2
| | MeasurementReportTriggerTime (1) = 09:05:00.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 0 (up/down arrow)
| | | ServiceInstanceID (1) = 2
| | | ServiceIdentifier (1) = "Channel50"
| | | ViewMode (0-1) = 1 (fullscreen)
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 2
| | MeasurementReportTriggerTime (1) = 11:15:00.5
| | ChannelStop (0-1)
| | | StopNavMethod (0-1) = 0 (up/down arrow)
| | | ServiceInstanceID (1) = 2
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 2
| | MeasurementReportTriggerTime (1) = 11:15:01.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 0 (up/down arrow)
| | | ServiceInstanceID (1) = 3
| | | ServiceIdentifier (1) = "Channel53"
| | | ViewMode (0-1) = 1 (fullscreen)
```

Figure II.8 – Example report package 6

NOTE – If the remote control's up-arrow had been held down instead of being pushed three times, then StopNavMethod and StartNavMethod would have indicated channel surfing for the second and third measurement reports above. The switch time between channels would be determined by the IPTV system.

II.3 Picture-in-picture (PIP) example

Assume the configuration package in Figure II.9.

```
AMFConfigPackage (1)
    PackageID (1) = 9345
      @PackageVersion (0-1) = 2
    EffectivityDateAndTime (0-1) = immediately
    MeasurementRequestSet (1-*)
       DefaultDeliveryAddress (0-*) = http://defaultdeliveryaddress.com
       DefaultRetransmitNumber (0-1) = 5
       DefaultControlDevice (0-1) = 0 (do not report)
       DefaultViewMode (0-1) = 1 (report)
       DefaultObscuration (0-1) = 1 (report)
       MeasurementRequest (1-*)
          MeasurementRequestID (1) = 1
          LinearTVQualifier (0-1)
             NavMethod (0-1) = 1 (report)
             ChannelQualifier (0-1) (all channels)
             ChannelChangeFilter (0-1) = 2000
          AllContentClassExceptList (0-1) (not filtered by content)
          MeasurementSchedule (1-*)
             MeasurementPeriod (0-*)
                DayOfTheWeek (0-*)= 0 (everyday)
                StartTime (0-*) = 00:00:00.00
                EndTime (0-*) = 23:59:59.99
             EventTrigger (0-*)
                Event (0-*) = VideoResize
                Event (0-*) = VideoObscure
                Event (0-*) = AudioVolume
          MeasurementDeliverySchedule (0-1)
             ImmediatePush (0-1)
                MeasurementReportNumberByPush (0-1) = 1
```

Figure II.9 – PIP example configuration package

The operation of PIP, including swapping the sub-picture and main picture, and resizing and moving the sub-picture, varies depending upon the implementation. In this example, it is assumed: that a new sub-picture is added at one-fourth screen size and muted, that the larger picture generates audio, that a swap operation is available, and that any PIP dialogue shown on the screen is ignored for simplicity.

Then the following end-user behaviours would result in AM report generation of three immediate reports.

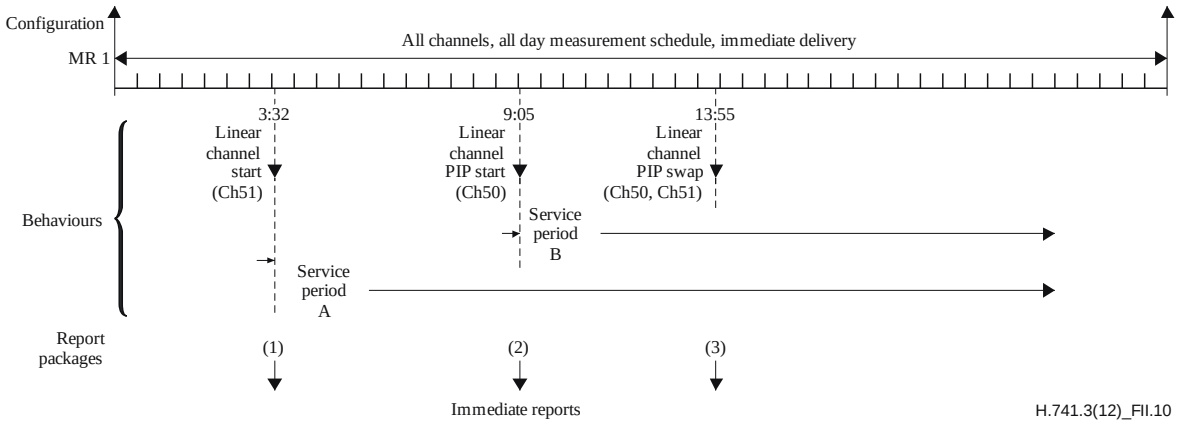


Figure II.10 – PIP example of end-user behaviours and measurement reports

Three reports packages indicated in Figure II.2 are delivered as follows, per measurement request 1:

1) At 0332 hours, the first measurement of a channel start event on channel Ch51 is taken and delivered two seconds later due to channel change filtering, as report package (1).

2) At 0905 hours, a second channel Ch50 started in PIP is measured with an auto-muted event, obscuring one-quarter of the screen of display Ch51. Measurements are delivered two seconds later due to channel change filtering, as report package (2).

3) At 1355 hours, an end user causes a swap of the sub-picture Ch50, with the main picture Ch51, causing video resize and video obscure events for both channels, and an audio focus event. Measurements are delivered immediately as report package (3).

The contents of the three example AM report packages are as follows:

The AM report package (1) is delayed two seconds after service start of service period A, due to ChannelStart event (see Figure II.11).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 03:32:00.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 0 (up/down arrow)
| | | ServiceInstanceID (1) = 1
| | | ServiceIdentifier (1) = "Channel51"
| | | ViewMode (0-1) = 1 (fullscreen)
| | | Obscuration (0-1) = 0.0 (not obscured)
```

Figure II.11 – PIP example report package 1

AM report package (2) is delayed two seconds after service start of service period A, due to ChannelStart event (see Figure II.12).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 09:05:00.0
| | ChannelStart (0-1)
| | | StartNavMethod (0-1) = 8 (other)
| | | PreviousServiceInstanceID (0-1) = 1
| | | ServiceInstanceID (1) = 2
| | | ServiceIdentifier (1) = "Channel50"
| | | ViewMode (0-1) = 2 (Picture-in-Picture)
| | | Obscuration (0-1) = 0.0 (not obscured)
| | AudioVolume(0-1)
| | | ServiceInstanceID (1) = 2(associated with Ch50 service)
| | | VolumeDirection (1) = "mute"
| | VideoObscure (0-1)
| | | ServiceInstanceID (1) = 1 (associated with Ch51 service)
| | | Obscuration (1) = 0.25 (25% obscured)
```

Figure II.12 – PIP example report package 2

AM report package (3) is delivered immediately after the PIP swap procedure (see Figure II.13).

```
AMReportPackage (1)
| SubscriberID (0-1) = "WorldspGold012345678"
| TerminalDeviceID (1) = 6233446
| MeasurementReport (1-*)
| | MeasurementRequestID (1) = 1
| | MeasurementReportTriggerTime (1) = 13:55:00.0
| | VideoObscure (0-1)
| | | ServiceInstanceID (1) = 1 (associated with Ch51 service)
| | | Obscuration (1) = 0.00 (0% obscured)
| | VideoObscure (0-1)
| | | ServiceInstanceID (1) = 2 (associated with Ch50 service)
| | | Obscuration (1) = 0.25 (25% obscured)
| | VideoResize (0-1)
| | | ServiceInstanceID (1) = 1 (associated with Ch51 service)
| | | ImageWidth (1) = 810
| | | ImageHeight (1) = 540
| | VideoResize (0-1)
| | | ServiceInstanceID (1) = 2 (associated with Ch50 service)
```

```
| | | ImageWidth (1) = 1920
| | | ImageHeight (1) = 1080
| | AudioFocus (0-1)
| | | ServiceInstanceID (1) = 2 (associated with Ch50 service)
| | | IPTVFocus (0-1) = true
```

Figure II.13 – PIP example report package 3

Appendix III

Audience measurement capability profiles

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

Table III.1 lists the capabilities of the terminal device audience measurement function (TD-AMF).

Table III.1 – TD-AMF capability list

Capability area	Capability	References
Measurement Triggers	Event	Table 2
	Time sampling	Table 3
Operational Management	Channels to be measured	Clause 7.1.1
	Channel change filtering	Clause 7.1.2
	Navigation method reporting	Clause 7.1.3
	Control device reporting	Clause 7.1.4

These capabilities are included in the capability data structure depicted in Table 2 of [ITU-T H.741.2].

A set of AM capability profiles as a quick way to identify sub-sets of capability options for TD-AMFs would be useful. Capability profiles would make it easier for vendors, integrators and service providers to understand product capabilities. TD-AMFs could be identified as having AM capability profile 1, 2, or 3, etc., which would relate to a specific sub-set of capability options from Table III.1 and service-common capability options listed in an appendix of [ITU-T H.741.1]. The definition of such capability profiles is for further study.

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