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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: Overall
aspects of audience measurement for IPTV
services**

Recommendation ITU-T H.741.0



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Recommendation ITU-T H.741.0

IPTV application event handling: Overall aspects of audience measurement for IPTV services

Summary

Recommendation ITU-T H.741.0 defines a foundational platform for audience measurement (AM) of Internet Protocol television (IPTV) services. This Recommendation focuses on the interface between terminal devices (TDs) 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 ITU-T H.741.0 allows the implementation of audience measurement for IPTV services, its mechanism may be equally applicable to non-IPTV services.

The audience measurement mechanism specified here provides additional benefits when compared to traditional audience measurement. Such benefits include, in particular, a larger audience population sample, more detailed engagement metrics, passive data collection, and feedback for the enhancement of services.

The design philosophy in ITU-T H.741.0 is focused on scalability, on minimizing the use of resources, on optimizing security, on flexibility to support a variety of service provider deployments, and on a rich set of privacy settings to meet emerging regulations and legislation.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.741.0	2012-03-22	16

Keywords

Audience measurement, audience rating service, contents rating, distributed content service, end-user permission, engagement metrics, interactive services, IPTV application event handling, linear TV, personalized service, privacy protection.

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

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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.741.0

IPTV application event handling: Overall aspects of audience measurement for IPTV services

1 Scope

This Recommendation describes the overall aspects of audience measurement for Internet Protocol television (IPTV) services. It specifies the requirements and architecture for IPTV audience measurement and describes configuration, measurement reporting, and privacy.

This Recommendation presents the functions related to audience measurement (AM) that are distributed over the IPTV architecture. Audience measurements are constrained to the communication interface(s) between terminal device audience measurement functions (TD-AMFs) and measurement aggregation functions. Subsequent Recommendations are anticipated to address communication interface(s) with audience measurement functions that are located within other functions of the IPTV architecture.

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.740 Amd.1] | Recommendation ITU-T H.740 (2010) Amd.1 (2011), <i>Application event handling for IPTV services, Amendment 1: New video handling sensor event scenario in Appendix II.</i> |
| [ITU-T X.1191] | Recommendation ITU-T X.1191 (2009), <i>Functional requirements and architecture for IPTV security aspects.</i> |
| [ITU-T Y.1901] | Recommendation ITU-T Y.1901 (2009), <i>Requirements for the support of IPTV services.</i> |
| [ITU-T Y.1910] | Recommendation ITU-T Y.1910 (2008), <i>IPTV functional architecture.</i> |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

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

3.1.2 application event [ITU-T H.740 Amd.1]: An application event is every user interaction or occurrence related with multimedia contents in IPTV applications. It includes an emergency event from event notification services.

3.1.3 authorization [b-ITU-T X.800]: The granting of rights, which includes the granting of access based on access rights.

3.1.4 confidentiality [b-ITU-T X.800]: The property that information is not made available or disclosed to unauthorized individuals, entities, or processes.

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

3.1.6 electronic program guide (EPG) [b-ITU-T H.721 Amd.1]: A service navigation application which is used especially for scheduled linear programs.

NOTE 1 – in some traditional Broadcast Services, EPG is defined as an on-screen guide used to display information on scheduled live broadcast television programs, allowing a viewer to navigate, select, and discover programs by time, title, channel, genre. This traditional definition does not cover "catalogues" for on-demand and download services (sometimes called Electronic Content Guide (ECG), Broadband Content Guide, BCG) and bi-directional interactive service (sometimes called Interactive Program Guide, IPG) for end-user interaction with a server or head-end.

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

NOTE 2 – The end user consumes the product or service. An end user can optionally be a subscriber.

3.1.8 integrity [IEC/ISO 27001], [IEC/ISO 27002]: Safeguarding the accuracy and completeness of information and processing methods.

3.1.9 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.

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

3.1.11 IPTV terminal function (ITF) [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.

3.1.12 key [b-ITU-T X.800]: A sequence of symbols that controls the operations of encipherment and decipherment.

3.1.13 linear TV [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.

3.1.14 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 3 – 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.

3.1.15 peer-entity authentication [b-ITU-T X.800]: The corroboration that a peer entity in an association is the one claimed.

3.1.16 privacy [b-ITU-T X.800 Amd.1]: 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.

3.1.17 repudiation [b-ITU-T X.800]: Denial by one of the entities involved in a communication of having participated in all or part of the communication.

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

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

3.1.20 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.

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

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

3.1.23 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.

3.1.24 terminal device (TD) [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.

3.1.25 video-on-demand (VoD) [ITU-T Y.1901]: A service in which the end user can, on demand, select and view a video content and where the end user can control the temporal order in which the video content is viewed (e.g., the ability to start the viewing, pause, fast forward, rewind, etc.).

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 aggregation function: 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.

3.2.2 audience information: The overall information about end-user behaviour, and the related end-user information, during the time that IPTV audience measurement is inactive.

3.2.3 audience measurement: The measurement of people's engagement with IPTV services.

3.2.4 audience measurement data: End-user behaviour data which is related to a service and content consumption, combined or not with end-user information.

3.2.5 audience measurement function (AMF): 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.

3.2.6 audience measurement service provider: A service provider providing audience measurement services. An audience measurement service provider configures an audience measurement system to control what audience information the system collects.

3.2.7 audience measurement system: 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.

3.2.8 audience rating: The quantitative measurement of the size and composition of an audience that viewed content for given periods of time, throughout transmission of that content. Derived metrics include average audience rating, total audience rating, rating points, and cumulative (unduplicated) audience rating.

NOTE – Traditionally, ratings have been extrapolated from audience sample surveys. However, passive measurement from digital systems can provide a larger audience sample. Examples of use include support to financial negotiations, determination of estimated costs to reach sizes of audience segments, and scheduling of content distribution.

3.2.9 configuration package: 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.

3.2.10 content consumption: A series of valid operation actions to complete selecting an IPTV service and consuming the related content based on the procedure flow within the IPTV system.

3.2.11 content rating: Actively asserted opinions evaluating aspects of content, using a position assigned on a defined scale, to communicate those aspects to others. Scales may be industry standard, or not. Example scales include, among others, the Motion Picture Association of America (MPAA), a number of stars, and thumbs up or down.

NOTE – Examples of use include the indicating of suitability for audience segments, censorship, and levels of entertainment, quality, popularity; content optimization and targeting across audience segments, and content recommendation.

3.2.12 controlled information: A classification of end-user information that can be used alone or easily in combination with other information to uniquely identify, contact, or locate an end user or subscriber, in line with Annex A of [ITU-T X.1191].

3.2.13 digital destination: The result of navigation across services, including channels, applications, or portals.

3.2.14 directive(s): Instructions that are input as part of an order from stakeholders to the AM system regarding target audiences, what and how to measure, and what to report back to stakeholders.

3.2.15 end-user behavioural information: A part of audience measurement information which includes "application events" and/or "end-user context". An "application event" is information reflecting the behaviour of an IPTV service end user. "End-user context" is information relating to the situation when an "application event" was generated.

3.2.16 end-user information: "End-user info" is information about an IPTV service end user. It includes "identifying end-user information" and "non-identifying generic user information".

3.2.17 engagement metric: A measure of the level of involvement, interaction, sentiment, and promotion that an end user has with content. It provides a more holistic view of end users than audience ratings. Examples of involvement metrics include time spent or frequent watcher. Examples of interaction metrics include replay and requests for information. Examples of sentiment metrics include associated amount of chat and words used. Examples of promotion metrics include forwarding to friends or posting to a blog.

NOTE – Example uses include focus on acquisition of evangelists, finer granularity audience targeting, and emerging uses.

3.2.18 identifying end-user information: Information including, for example, biographics (birth date, birth location, gender, address, etc.).

3.2.19 measurement report: The data that the audience measurement function (AMF) generates from an end-user behaviour event or sample.

3.2.20 non-identifying generic end-user information: Information such as demographics (race, income, disabilities, education, home ownership, and employment status) and psychographics (interests, activities, opinions, attitudes, and values).

3.2.21 sample: A sample is a periodic action occurring on a configurable schedule time interval, during a service period, which captures specified information values.

3.2.22 sample time: 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.

3.2.23 sample value: 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.

3.2.24 subscriber information: Similar to the definition of end-user information, it includes the "user info" of the person responsible for concluding contracts for the services subscribed to and for paying for these services.

NOTE – The subscriber information may be used as a proxy for another associated user's information.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AM	Audience Measurement
AMF	Audience Measurement Function
BCG	Broadband Content Guide
CD-AMF	Content Delivery Audience Measurement Function
c-PVR	consumer Personal Video Recorder
EPG	Electronic Program Guide
HN-AMF	Home Network Audience Measurement Function
IPG	Interactive program guide
IPTV	Internet Protocol Television
ITF	IPTV Terminal Function
N-AMF	Network Audience Measurement Function
n-PVR	network Personal Video Recorder
PC	Personal Computer
PVR	Personal Video Recorder
QoE	Quality of Experience
QoS	Quality of Service
SC-AMF	Service Control Audience Measurement Function
SP	Service Provider
STB	Set-Top Box
TD	Terminal Device
TD-AMF	Terminal Device Audience Measurement Function
VoD	Video on Demand
VoIP	Voice over Internet Protocol

5 Conventions

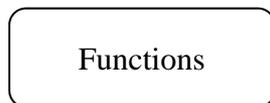
In this Recommendation:

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

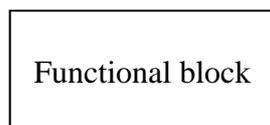
The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

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 that the feature can be optionally enabled by the network operator/service provider. Rather, it means that 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 have 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) measures end-user behaviour with end-user permission in IPTV services.

Service providers may use audience measurement data themselves, and choose to provide audience measurement services to others. Measurement services may be provided in real-time or offline. Users of these services may use the audience measurement data to forecast advertising opportunities within content and digital destinations, forecast audience segment visits across digital destinations, craft and optimize programs and playlists, and craft and optimize target-specific advertisements and advertising campaigns for particular audience segments across devices. Offline uses include lead generation, impact analysis (sales uplift due to number of engaged advertisements), and media content planning.

Audience measurement is implemented by an IPTV application associated with a subset of IPTV services that collects the data of end-user behaviours of these services. For example, in linear TV, audience measurement may inform an audience rating service about the audience presence and engagement during a content provider's content. The targeted IPTV services for audience measurement include:

- 1) Distributed content services [b-ITU-T Y.Sup5]: examples include linear TV, video on demand (VoD), network personal video recorder (n-PVR), and consumer personal video recorder (c-PVR).
- 2) Interactive services [b-ITU-T Y.Sup5]: examples include games, learning, commerce, and information access.

Measurement is passively obtained without special end-user interaction as these services are consumed, or it may be actively obtained by requesting end-user interaction (e.g., survey).

Specific audience measurement requirements and functions for distributed content services are described elsewhere (e.g., see [b-ITU-T H.741.3]).

The primary audience measurement functions, when permitted by end users, include:

- 1) collecting end-user behaviour information, as observed by application events related to IPTV services
- 2) collecting end-user information, as disclosed by end users and end-users' devices.

7 Requirements

7.1 Audience measurement architecture requirements

IPTV architecture with audience measurement is called AM architecture.

- 1) The AM architecture is required to support the audience measurement of IPTV services as permitted by end users.
- 2) The AM architecture is required to have the ability to receive and process multiple audience input orders from multiple stakeholders (content providers, advertisers, audience rating companies, and IPTV service providers).
- 3) The AM architecture is required to have the ability to create requested audience measurement reports for stakeholders, and send those reports to the corresponding stakeholders.
- 4) The AM architecture is required to have the ability to measure audience behaviour by selection of IPTV terminal devices to be measured.
- 5) The AM architecture is required to have the ability to measure audience behaviour by selection of IPTV services to be measured.
- 6) The AM architecture is required to have the ability to measure audience behaviour by selection of behavioural events to be measured.
- 7) The AM architecture is required to have the ability to measure audience behaviour by selection of periodicity for periodic measurements.
- 8) The AM architecture is required to support mechanisms to support policies associated with multiple end-user permission levels which permit disclosure of incremental sets of their audience measurement information.
- 9) The AM architecture is required to support monitoring or communications with IPTV services, for audience measurement.
- 10) The AM architecture is required to support communications with other applications, for audience measurement.
- 11) The AM architecture is required to support an internal configuration procedure for all AM components which directs measurement, reporting, control and processing operations.
- 12) The AM architecture is required to support distributed measurement filtering and summarisation.
- 13) The AM architecture is required to support traffic shaping of measurement reporting.
- 14) The AM architecture is required to ensure confidentiality of end-user's AM data in transit.
- 15) The AM architecture is required to ensure the integrity of AM information communicated between AM entities.
- 16) The AM architecture is required to ensure that there is no direct or indirect leakage of end-users' privacy, protecting against violation of information through leakage to unintended parties while performing AM operations.
- 17) The AM architecture is required to ensure that peer-entity authentication precedes communication between AM peer entities.

- 18) The AM architecture is required to ensure that there is no unauthorized access to end-user's AM data.
- 19) The AM architecture is required to provide a non-repudiation property to AM information communicated between AM entities.
- 20) The AM architecture is required to ensure that the algorithms or mechanisms for authentication, authorization, confidentiality, privacy, integrity, and repudiation are built using publicly available and standardized cryptographic algorithms.

7.2 Recommendations for audience measurement architecture

- 1) The AM architecture is recommended to have the ability to create requested audience measurement reports for other IPTV applications, and to send those IPTV application reports to the appropriate IPTV applications.
- 2) The AM architecture is recommended to support stakeholder input orders, measurements, and stakeholder and other IPTV application reports having measurements of viewing behaviour specified by combinations of:
 - a) time of day
 - b) end-user behaviour
 - c) sample times
 - d) end-user information
 - e) end-user device information
 - f) end-user device location.
- 3) The AM architecture is recommended to support end-user permissions applicable to sets of IPTV devices used by an end user (e.g., all TVs, all PCs, all mobiles, and all devices).
- 4) The AM architecture is recommended to support at least daily or less frequent changes to configuration without measurement service interruption.
- 5) The AM architecture is recommended to support scheduling of configuration changes.
- 6) The AM architecture is recommended to support mechanisms which react to more restrictive end-user permissions being set online within one hour.
- 7) The AM architecture is recommended to support selection of end users to be monitored for audience measurement.
- 8) The AM architecture is recommended to support a broad granularity of measurements.
- 9) The AM architecture is recommended to support recovery from storage congestion.
- 10) The AM architecture is recommended to support recovery from network congestion.
- 11) The AM architecture is recommended to minimize the acquisition, locations and duration of storage, and transmissions of end-user's personal data necessary for delivering the AM services.
- 12) The AM architecture is recommended to classify the end-users' personal data into data that requires control and data that does not require control.
- 13) The AM architecture is recommended to ensure that any end-user's personal data acquired can be completely deleted either by an end user or a service provider.
- 14) The cryptographic algorithms, used in AM architecture, that require use of cryptographic keys are recommended to have sufficiently large key entropy to effectively protect the AM data from cryptanalysis.
- 15) The choice of cryptographic algorithms, used in AM architecture, is recommended to be efficiently implementable for both hardware and/or software implementations.

- 16) The cryptographic algorithms, used in AM architecture, are recommended to be scalable and future-proof, i.e., cryptographic parameters (such as key-length, key-renewal periods, etc.) or cryptographic modes (such as CBC, OFB, ECB, etc.).

7.3 Optional requirements for audience measurement architecture

- 1) The AM architecture can optionally support input orders, measurements, stakeholder and other IPTV application reports having measurements of viewing behaviour specified by combinations of:
 - a) day of week
 - b) end-user information
 - c) distributed content services (linear, VoD, etc.)
 - d) content
 - e) interactive services (applications).
- 2) The architecture can optionally support the ability to configure on a per user basis, a per content basis, or a combination of both.

NOTE – Derived from RR.6.1-11 in [ITU-T Y.1901].
- 3) The architecture can optionally support the ability to ask for the end user's permission or to check with already captured end-user permission prior to starting measurements.
- 4) The AM architecture can optionally support downloading, installation, updating, and removal of any audience measurement software.
- 5) Audience measurement data can optionally include identification of end users (given end-user permission).
- 6) The AM architecture can optionally support presence detection.

7.4 Recommended requirements for end-user permits

- 1) End-user permits are recommended to be granted for a specific duration.
- 2) End-user permits may optionally be based upon:
 - a) distributed content services (e.g., linear, VoD, PVR)
 - b) content type (e.g., children's TV, adult TV, religious, political, etc.)
 - c) event type (e.g., channel change, record, etc.)
 - d) interactive application type (e.g., games, educational, informational, commercial, etc.)
 - e) end-user type (e.g., children under 13, adults, etc.)
 - f) end user (if the AM system is able to confidently distinguish end users)
 - g) device (which TVs, computers, mobile phones, etc.)
 - h) day-parts (e.g., morning news, morning, day-time, early fringe, early news, access, prime, late news, late fringe, late night, etc.);
 - i) end-user context (e.g., at work, location, etc.)
 - j) correlation with an operator's subscriber information
 - k) correlation with an end-user's voluntarily provided profile information.

7.5 Recommended requirements for operators

Operators of AM are recommended to provide end users with clear disclosure and information about data collection and use practices if and when they request end-user permission.

7.6 Recommended requirements for IPTV architecture

1. The IPTV architecture is recommended to support a mechanism for audience measurement service discovery.
2. The IPTV architecture is recommended to support multiple audience measurement service providers.
3. The IPTV architecture is recommended to allow the IPTV service providers to choose their audience measurement service provider.
4. The IPTV architecture is recommended to allow the end users to choose an audience measurement service provider.
5. The IPTV architecture is recommended to support monitoring or communications with AM functions for audience measurement.

8 IPTV architecture and audience measurement

Audience measurement components consist of audience measurement functions and aggregation functions.

The audience measurement functions measure the end-user behaviour and may optionally collect end-user information. This information is transferred to aggregation functions.

The aggregation functions collect and aggregate the data from the audience measurement functions, optionally enrich data with additional end-user information, and perform data analytics.

Figure 1 shows the high level architecture of audience measurement within a derivative of IPTV architecture (defined in [ITU-T Y.1910]), including different audience measurement components and their possible locations.

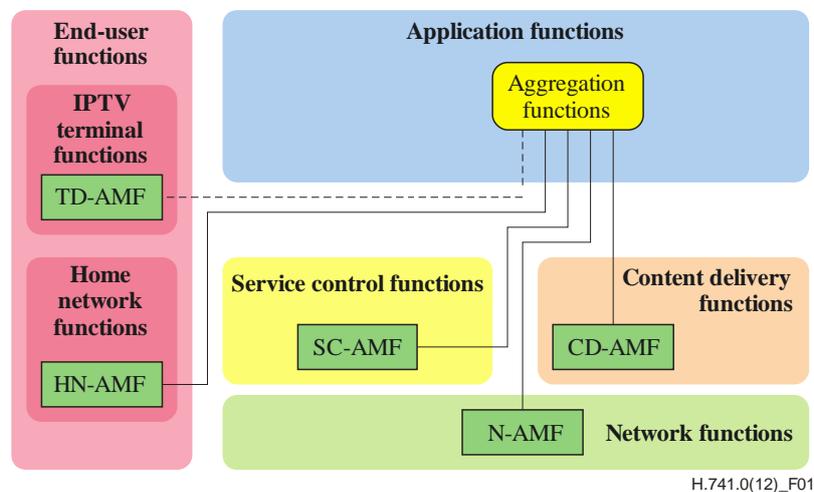


Figure 1 – Audience measurement components within IPTV architecture

The terminal device audience measurement functions (TD-AMFs) are responsible for audience measurement in IPTV terminal functions.

The home network audience measurement functions (HN-AMFs) are responsible for audience measurement in home network functions.

The network audience measurement functions (N-AMFs) are responsible for audience measurement in network functions.

The service control audience measurement functions (SC-AMFs) are responsible for audience measurement in service control functions.

The content delivery audience measurement functions (CD-AMFs) are responsible for audience measurement in content delivery functions.

This Recommendation specifies IPTV audience measurement for TD-AMFs.

Audience measurement data sent from multiple audience measurement functions may be aggregated by aggregation functions. Those multiple audience measurement functions may be co-located in a home and/or geographically distributed.

In both cases, certain audience measurement functions may have relationships among them that may cause them to be treated as sets by the aggregation function. In certain circumstances, sets of audience measurement functions may span multiple aggregation functions.

9 Audience measurement lifecycle

The audience measurement lifecycle consists of eight stages:

- 1) Input of pre-configuration data:
 - a) "Discovery" inputs from the service provider (SP) and AM discovery to TD-AMFs. Includes the available and preferred configuration and permission modes of aggregation functions
 - b) "Permission" inputs from end user or SP to TD-AMFs
 - c) "Orders" input from content providers, advertisers, audience rating companies, and SPs to aggregation functions
 - d) "Terminal devices online" input from SP "server applications" to aggregation functions.
- 2) Aggregation functions configure TD-AMFs per pre-configuration inputs.
- 3) IPTV client applications (e.g., linear TV) provide input to TD-AMFs per configuration.
- 4) TD-AMFs generate audience measurement data per configuration and client applications input.
- 5) TD-AMFs deliver audience measurement data to aggregation functions per configuration.
- 6) IPTV server applications provide input to aggregation functions in order to augment audience measurement data, per "orders".
- 7) Aggregation functions process audience measurement data per "orders".
- 8) Aggregation functions send aggregated reports per "orders" to IPTV server applications and/or content providers, advertisers, audience rating companies, and SPs.

Figure 2 illustrates the information interfaces associated with the operation of the audience measurement functions and the aggregation functions.

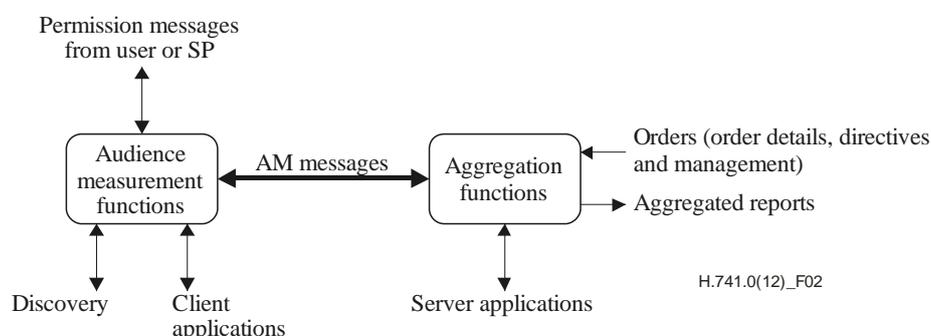


Figure 2 – Information interfaces associated with the operation of AM

10 Configuration of terminal device audience measurement functions

Configuration of terminal device audience measurement functions (TD-AMFs) drives the message sequences between the aggregation functions and the TD-AMFs. Configuration may be initiated by either the TD-AMF and/or the aggregation functions. Figure 3 shows how message types are used in configuration sequences. Message sequences starting with a request are termed as "pull", and those that are sent without a request are termed as "push".

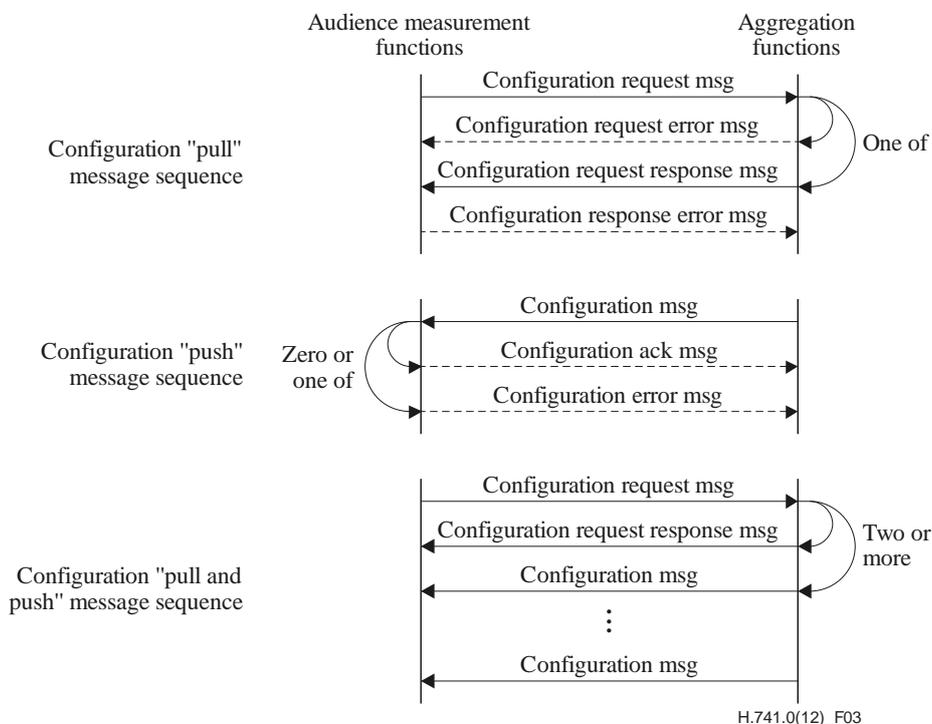


Figure 3 – AM configuration message sequences

NOTE – Error and acknowledgement messages are not shown for configuration "pull and push" message sequence

Error messages may be mandatory or configurable. Acknowledgements may be configurable.

As indicated in Figure 3, configuration may be done using pull, push, or pull and push (hybrid) sequences. The configuration modes supported and preferred by aggregation functions are discoverable by TD-AMF. The configuration modes supported by TD-AMF are made known to aggregation functions in a configuration request message.

- 1) Configuration Pull Mode: TD-AMF unicasts the configuration request message to aggregation functions, which responds with either a unicast or multicast configuration request response message. This uses pull message sequences.
- 2) Configuration Push Mode: Aggregation functions periodically send multicast configuration messages to a defined *address:port*. This uses push message sequences.
- 3) Configuration Pull and Push (hybrid) Mode: Subsequent unicast or multicast configuration messages follow the messages of configuration pull mode without subsequent configuration request messages. This uses pull and push message sequences.

The ITU-T IPTV audience measurement solution provides a rich set of event-driven and time-based measurements. The main features include measurements (if permitted by the end user) configurable by:

- time
- device type

- percentage of devices
- service
- restricted content genre.

11 Measurement reporting of TD-AMFs

The reporting of measurements drives message sequences between the aggregation functions and the terminal device audience measurement functions (TD-AMFs). Reporting may be initiated by either the TD-AMF and/or the aggregation functions. Figure 4 shows how message types are used in reporting sequences. Message sequences starting with a request are termed as "pull", and those that are sent without a request are termed as "push".

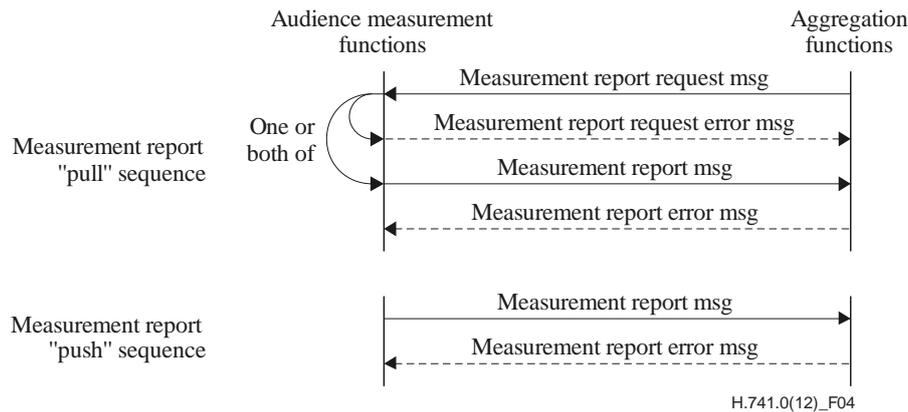


Figure 4 – AM reporting message sequences

Error messages may be mandatory or configurable.

One of four types of delivery modes is configured:

- 1) Immediate Push Mode: When a measurement is made, it is optionally grouped with a number of other measurements within a period of time before being sent in a measurement report package message. This uses push message sequences.
- 2) Delayed Push Mode: Measurements are stored until a TD-AMF randomly picked time during a configured delivery window. At that time the TD-AMF groups measurement reports and sends them in a measurement report package message. This uses push message sequences.

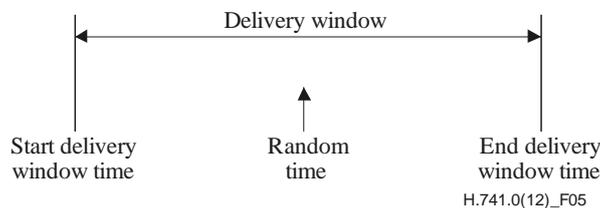


Figure 5 – Delivery window

- 3) Pull Mode: Measurements are stored until a measurement report request message is received from the aggregation functions. This message causes selected measurements to be grouped before being sent in a measurement report package message. A configured policy indicates what the TD-AMF should do in case of storage congestion. This mode uses pull message sequences.

- 4) Delayed Push and Pull Mode: Measurements are stored until either a report request message is received from the aggregation function, or a TD-AMF randomly picked time during the configured delivery window is reached. Whichever trigger is sooner causes measurements to be grouped before being sent in a measurement report package message. This mode uses both push and pull message sequences.

12 Privacy in audience measurement

End-user permission is required prior to measuring, collecting and using end-users' measurement information. After end-user permission, audience measurement follows defined end-users' privacy policies.

In addition, local and regional guidelines, specifications, and laws dictate how privacy is to be ensured [ITU-T H.740 Amd.1]. Examples of these include [b-OECD PPTFPD], [b-ISO/IEC 27001], [b-ISO/IEC 27002], [ITU-T X.1191] and [b-ITU-R BT.2052].

12.1 End-user permission levels

Four end-user permission levels are specified by audience measurement. These levels define sets of end-user information that are permitted by the end user to be used for audience measurement.

The end-user information classifications used to define the permission levels are:

- Permission level 0: No end-user information is included.
- Permission level 1: Only distinguishability from other end users is included.
- Permission level 2: Distinguishability and non-identifying generic end-user information are included.
- Permission level 3: Identifying user information and non-identifying generic end-user information are included.

Where:

- Distinguishability is supported by the use of anonymous user identifiers.
- Non-identifying generic end-user information has extensible value ranges without specifying the information values.
- Identifying end-user information may be the identifying information of the actual end user or of the subscriber. It may be easily combined to identify the end user. End-user information is classified either as personal data that require control or those that do not. Identifying end-user information requires control. It has extensible value ranges without specifying the information values, and is identifiable as "controlled" information.

Permission levels may optionally be used together with further end-user permissions regarding other aspects of audience measurement, e.g., constraining measurement to certain devices, services, and/or content. The default permission level, before end-user input for permission level is obtained for AM, is set to Level 0, which is not configurable by the service provider. End-users' privacy policies may be expressed within end-user permits in AM.

12.2 Permission modes

User permissions impact audience measurements depending upon one of three modes discovered during the AM discovery process:

- External permission mode: In this mode, the request and receipt of end-user permission occurs outside of the AM system. It relies upon end-user permissions being managed outside of AM. No end-user permits are used at TD-AMFs.

- Internal permission mode: In this mode, the request and receipt of end-user permission occurs within the AM system. It relies on AM to manage permissions. Permits are created at TD-AMFs and may be made available to other TD-AMFs. They are delivered to the TD-AMF separately from the configuration package and configuration package request response messages.
- Hybrid permission mode: In this mode, the request and receipt of end-user permissions occur within the SP system. The TD-AMF requests the permit from the SP system, and may use the permit for local filtering, or send it to the aggregation functions to filter configuration packages. It relies on a combination of AM and external entities to manage permissions. Permits are delivered to TD-AMF separately from configuration package and configuration package request response messages. They are delivered to the TD-AMF from the IPTV SP.

In the internal and hybrid permission modes, the TD-AMF has knowledge of the end-users' privacy policies and may restrict the measurement of certain information requested by configuration.

Appendix I

Potential relationships between end users, audience measurement service providers and content distribution service providers

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

I.1 Service provider offering both content distribution and audience measurement services

A service provider that provides content distribution services, e.g., linear TV, may also provide audience measurement services. One of the audience measurement applications may be a content rating service. The service provider may choose to provide audience measurement content rating services to stakeholders such as content providers. Figure I-1 shows this information flow.

Multiple end-users' IPTV terminal devices run an audience measurement function which reports "measurement data" to service provider A, which aggregates end-user's measurement data for a content provider.

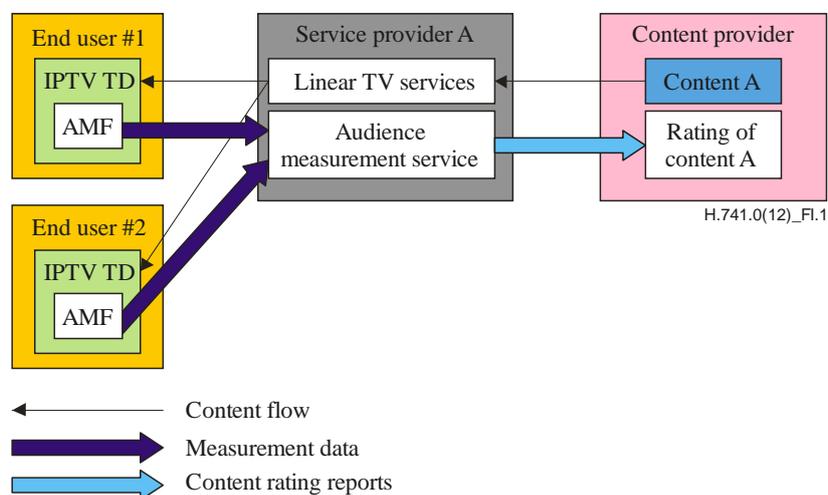


Figure I.1 – IPTV service provider with audience measurement service

I.2 Separate audience measurement service and content distribution service providers

A service provider may not offer audience measurement services itself. Audience measurement may be collected by another service provider having audience measurement capabilities. Figure I.2 shows this scenario.

Multiple end-users' IPTV terminal devices receive a linear TV service provided by content distribution service provider A. Each terminal device runs an audience measurement function which reports "measurement data" to the audience measurement service provider B, which aggregates end-user's measurement data for a content provider.

In order for the audience measurement service provider to properly report regarding the content of the content distribution service-only provider, it must gain access to the EPG of the content distribution service-only provider.

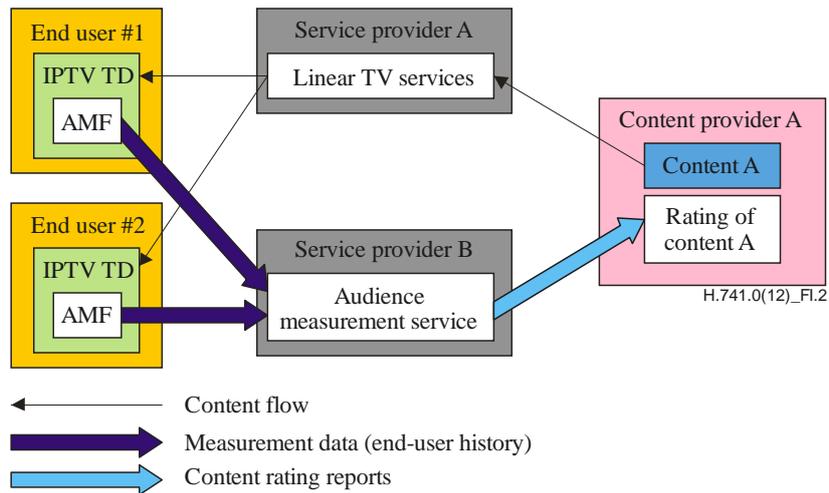


Figure I.2 – Separate audience measurement service and content distribution service providers

I.3 Multiple audience measurement service providers

A content distribution service provider may have relationships with more than one audience measurement service provider. In this case, end users may select an audience measurement service provider from among several. In Figure I.3, end user #1 selects an audience measurement service from service provider B, and end user #2 selects an audience measurement service from service provider C. Content distribution service provider A provides linear TV to the end users. In this scenario the content provider does the aggregation from multiple audience measurement service providers.

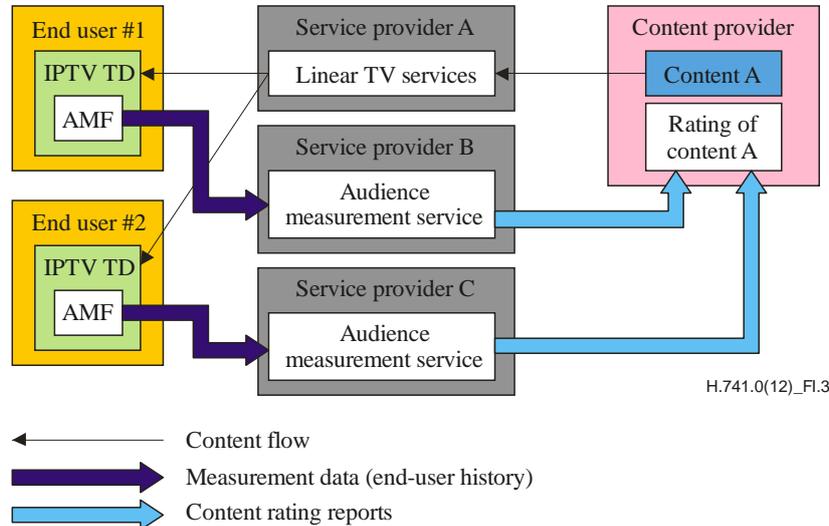


Figure I.3 – Two service providers provide audience measurement service

End users need not select a single audience measurement service provider for all their terminal devices. In Figure I.4, an end user has two IPTV terminal devices. One terminal device connects to service provider A to consume content A and report audience to service provider B. The same end user connects another terminal device to service provider C to consume the same content A and reports audience to service provider D. In Figure I.4, a content provider provides two or more content distribution service providers with contents and aggregates content rating reports from other audience measurement service providers.

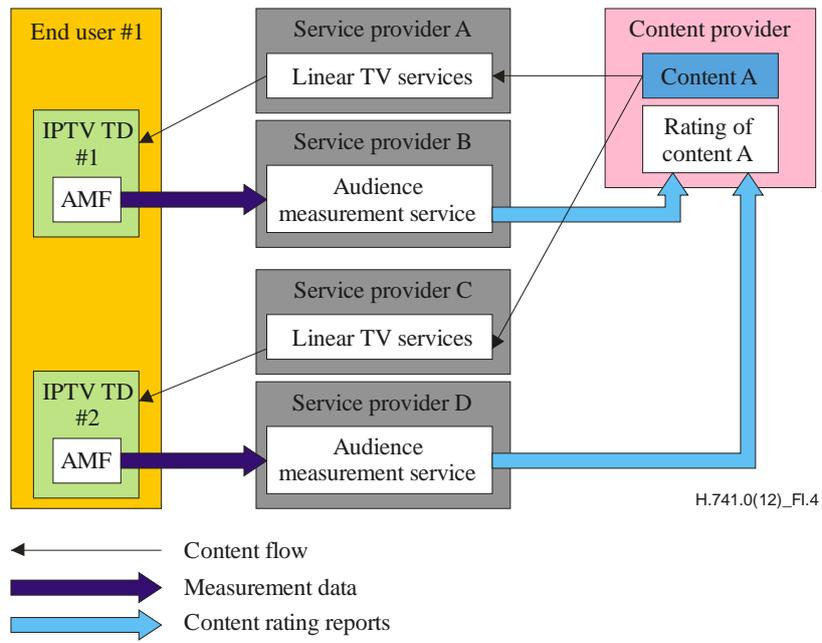


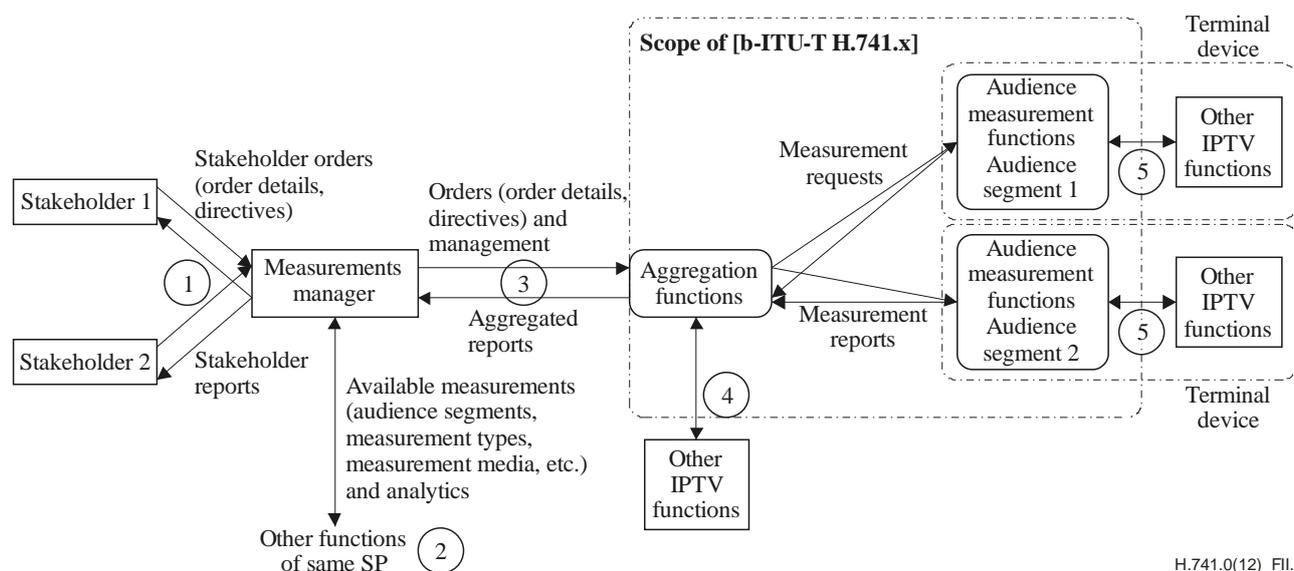
Figure I.4 – A single end user using multiple audience measurement services

Appendix II

Context of audience measurement

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

The following example shows how AM might fit into a larger context. Non-AM elements are shown as examples of a surrounding context. One should note that other non-AM elements and contexts are possible. Five interfaces are identified which are not within the scope of AM.



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Figure II.1 – Example context of audience measurement overview

Interface 1 – Stakeholders such as service providers, content providers, advertisers/agencies, programmers, and audience research companies may receive measurement offers, place orders for measurements, and receive reports by communicating with an audience measurement service provider via a measurements manager. A specification which includes the exchange of these orders and reports and that covers communications between a content provider and the SP is currently under study in ITU-T (see ITU-T H.IPTV-CPI at http://itu.int/ITU-T/workprog/wp_item.aspx?isn=7398).

Interface 2 – A measurements manager may perform many possible functions. It may include responsibility for fulfilment management, audience segmentation, and for managing privacy and permits. These functions could require communications with other functions of the same SP.

Interface 3 – The measurement manager could manage the orders sent to AM aggregation functions and the resulting aggregated reports.

Interface 4 – AM aggregation functions may communicate with other IPTV server functions to obtain inputs such as end-user profiles and terminal devices online, and provide outputs to a content recommendation engine, for example.

Interface 5 – AM audience measurement functions may communicate with other IPTV client functions to obtain inputs such as engagement events and/or permits, and provide outputs to a targeted advertising function, for example.

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