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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

IPTV multimedia services and applications for IPTV – Digital Signage

Digital signage: Service requirements and IPTV-based architecture

Recommendation ITU-T H.780

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Recommendation ITU-T H.780

Digital signage: Service requirements and IPTV-based architecture

Summary

Recommendation ITU-T H.780 describes a general framework for digital signage (DS) services based on IPTV architecture from the viewpoint of technical and service aspects. First, DS domains, a generic DS architecture and the classification of DS services are introduced. As technical IPTV specifications are close to those of DS, a brief comparison between the two services is provided (e.g., structure of a functional group and detailed media processing). Subsequently, high-level requirements concerning DS services are described. In addition, this Recommendation contains content delivery methods and details of functionalities of both server- and client-side applications for DS services.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.780	2012-06-29	16

Keywords

Content delivery, content management, digital signage, DS, DS services, playlist, terminal devices.

FOREWORD

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1 Scope

This Recommendation addresses the high level requirements, architecture and mechanisms for dealing with aspects of digital signage contents, network, metadata and terminal devices on the basis of IPTV architecture [ITU-T Y.1910]. It is expected that requirements and relevant specifications identified in this Recommendation can be applied appropriately according to the digital signage services and their business models.

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 G.1080] Recommendation ITU-T G.1080 (2008), *Quality of experience requirements for IPTV services*.

[ITU-T G.1081] Recommendation ITU-T G.1081 (2008), *Performance monitoring points for IPTV*.

[ITU-T H.720] Recommendation ITU-T H.720 (2008), *Overview of IPTV terminal devices and end systems*.

[ITU-T H.721] Recommendation ITU-T H.721 (2009), *IPTV terminal devices: Basic model*.

[ITU-T H.750] Recommendation ITU-T H.750 (2008), *High-level specification of metadata for IPTV services*.

[ITU-T H.760] Recommendation ITU-T H.760 (2009), *Overview of multimedia application frameworks for IPTV*.

[ITU-T H.770] Recommendation ITU-T H.770 (2009), *Mechanisms for service discovery and selection for IPTV services*.

[ITU-T X.1191] Recommendation ITU-T X.1191 (2009), *Functional requirements and architecture for IPTV security aspects*.

[ITU-T Y.1541] Recommendation ITU-T Y.1541 (2002), *Network performance objectives for IP-based services*.

[ITU-T Y.1901] Recommendation ITU-T Y.1901 (2009), *Requirements for the support of IPTV services*.

[ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture*.

[ISO/IEC 15938-5] ISO/IEC 15938-5:2003, *Information technology – Multimedia content description interface – Part 5: Multimedia description schemes*.

[ISO/IEC 15938-5 Amd.2] ISO/IEC 15938-5:2005/Amd.2:2005, *Multimedia description schemes user preference extensions*.

[ETSI TS 102-822-3-1] ETSI TS 102 822-3-1 V1.7.1 (2011), *Broadcast and On-line Services: Search, select and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 1: Phase 1 – Metadata schemas*.

[ETSI TS 102 822-3-3] ETSI TS 102 822-3-3 V1.5.1 (2011), *Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime"); Part 3: Metadata; Sub-part 3: Phase 2 – Extended Metadata Schema*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

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

3.1.2 distribution [ITU-T Y.1910]: In the context of IPTV architecture, "distribution" is defined as sending the content to appropriate intermediate locations to enable subsequent delivery.

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

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

3.1.4 functional architecture [b-ITU-T Y.2012]: A set of functional entities and the reference points between them used to describe the structure of an NGN. These functional entities are separated by reference points, and thus, they define the distribution of functions.

NOTE 1 – The functional entities can be used to describe a set of reference configurations. These reference configurations identify which reference points are visible at the boundaries of equipment implementations and between administrative domains.

NOTE 2 – This definition is taken from [b-ITU-T Y.2012] and therefore relates to NGNs. However, it is also valid for other networks, e.g., networks supporting digital signage terminal devices.

3.1.5 functional entity [b-ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.6 media [b-ITU-T Y.2012]: One or more of audio, video, or data.

3.1.7 multimedia [b-ITU-T T.174]: The property of handling several types of representation media.

3.1.8 service provider [b-ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider can optionally operate a network. A service provider can optionally be a customer of another service provider.

NOTE – Typically, the service provider acquires or licenses content from content providers and packages this into a service that is consumed by the end user.

3.1.9 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.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 content: A combination of audio, still image, graphic, video, or data.

NOTE – A variety of formats is classified as the "data" (e.g., text, encoded values, multimedia description language introduced by [ITU-T H.760]).

3.2.2 delivery: Sending of contents to terminal devices.

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

3.2.4 network provider: The organization that maintains and operates the network components required to support a service or set of services.

3.2.5 playlist: Composed of a list of contents.

NOTE 1 – This data is created and provided by digital service providers.

NOTE 2 – This data can be selected by an end user when interactivity is supported in a digital signage terminal device.

NOTE 3 – This data may indicate an order of playing contents.

3.2.6 playlist schedule: Composed of a list of playlists indicated by a specific play date and/or time.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DS	Digital Signage
DVI	Digital Visual Interface
DVI-A	Digital Visual Interface Analogue
DVI-D	Digital Visual Interface Digital
DVI-I	Digital Visual Interface Integrated
FLUTE	File delivery over unidirectional transport
FTP	File Transfer Protocol
HDMI	High Definition Multimedia Interface
HTTP	Hyper Text Transfer Protocol
HTTPS	HTTP over SSL/TLS
IPTV	Internet Protocol Television
LAN	Local Area Network
LCD	Liquid Crystal Display
LVDS	Low Voltage Differential Signalling
MAC	Media Access Control
OLED	Organic Light Emitting Diode display
PC	Personal Computer
PDA	Personal Digital Assistant
PDP	Plasma Display Panel
PII	Personally Identifiable Information
QoE	Quality of Experience

QoS	Quality of Service
RAM	Random Access Memory
RGB	Red-Green-Blue colour model
RTP	Real-time Transport Protocol
SADS	Service and Application Discovery and Selection
SMS	Short Message Service
SSL	Secure Socket Layer
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security
TS	Transport Stream
TV	Television
USB	Universal Serial Bus

5 Conventions

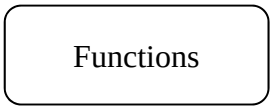
In this Recommendation:

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

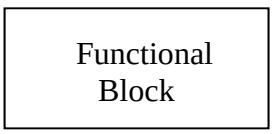
– The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

– The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

– The keyword "functions" are defined as a collection of functionalities. It is represented by the following symbol in this Recommendation:



– 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 this Recommendation:



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

Frame borders of "functions" and "functional block", and relational lines among "functions" and "functional block" are drawn with solid lines or dashed lines. The solid lines mean required

functionalities or relations. On the other hand, the dashed lines mean optional functionalities or relations.

6 Overview

6.1 Digital signage domains

Digital signage (DS) is a system that sends information, advertising and other messages to electronic devices (e.g., displays and loudspeakers) in accordance with the time of day and the location of the display, or the actions of audience. Contents and their relevant information, such as display schedules, are delivered over networks. The services are to be closer to people's lives with the advent of broadband and mobile network infrastructures.

Figure 1 shows the main domains that are involved in the provision of DS services based on [ITU-T Y.1910]. These domains do not define a business model. This decomposition does not preclude that one provider be involved in the support of any given DS services across more than one domain.

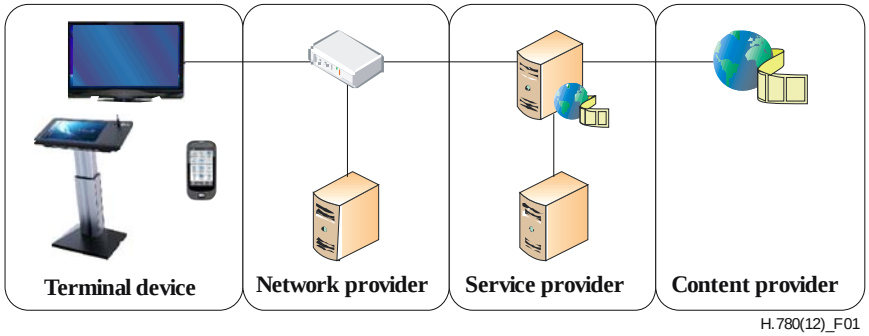


Figure 1 – Generic digital signage domains as per [ITU-T Y.1910]

The four digital signage domains, the definitions of which are provided in clause 3, are:

– Content provider
– Service provider
– Network provider
– Terminal device.

Many of the basic technologies for digital signage are similar to those for IPTV, e.g., image processing and data delivery. There are, however, differences between IPTV and DS.

A linear TV service, which is one of the typical IPTV services, is premised on broadcasting. On the other hand, DS may be referred to as "digital-out-of-home", "in-store media", "narrowcasting" and "electronic billboards" – reflecting the nature of the DS services. For example, the meaning of narrowcasting is delivery of information to specified audiences as defined by certain values, preferences, or demographic attributes. In analogy with narrowcasting, DS services can offer timely local promotional campaigns through displays aimed at impacting on an audience. In this case, a DS system creates and/or delivers different playlists and contents to individual devices, or to groups of them, according to their detailed geographic attributes. Examples would be device location and region by using audience or location profiles: contents varying depending on the area within a complex; distinction between indoors and outdoors; different contents displayed at the entrance and at the exit of a shopping centre; and differentiation for screens at eye-level and for those above eye-level. In addition to the profile, the delivered contents are played at designated times according to the playlists. As it can be seen, key features of DS are an elaborated, geographic-based content tailoring control, and a detailed scheduling for content delivery and playout (temporal control).

In addition, particular events may change the contents of DS services along with the geographical and temporal controls. Important examples of this category are alert services for natural disasters and public/building security announcements.

NOTE 1 – [b-ITU-T TechWatch] provides an outline of DS (e.g., the overview of digital signage relevant technologies and their major applications in the market).

NOTE 2 – For reference, Appendix of [b-ITU-T E.106] describes the criteria for selection of audience that a national authority may wish to consider for emergency and disaster relief operations (e.g., information on transportation, medical and public utilities).

From a revenue model viewpoint, there is another difference between IPTV and DS. While IPTV services are mainly provided according to a business-to-consumer subscription-based business model, the DS services are basically offered based on a business-to-business model.

DS services are categorized into four classes by the number of potential audiences in the services:

– Class A: services in public spaces (e.g., railways and convention centres)

– Class B: services in major distributors and service industry (e.g., banks and supermarkets)

– Class C: services in relatively small offices and retailer shops; and

– Class D: services in the home as communication tools.

NOTE 3 – In Classes A and B, services are mainly used for advertisements or information services, and these use cases are relatively clear. On the other hand, a variety of other use cases is expected to emerge in Classes C and D (e.g., effective sales promotion, novelty space production, and communication tools in communities). Common specification of the services in each class, which mainly consist of contents delivery and presentation methods, can be based on the first two classes.

This Recommendation describes requirements and functionalities of basic DS services (i.e., in the Classes A and B) in order to be used as a foundation for deployment of the services. The functional elements constituting these domains are described in more detail in clause 8.

6.2 Architecture overview

Figure 2 depicts a general digital signage architecture based on ITU-T IPTV architecture [ITU-T Y.1910]. Major technologies of IPTV services allow a DS system to use methods of contents delivery over a network.

Figure 2 identifies the principal functional groups for DS services. These functional groups provide a more detailed breakdown of the digital signage domains that are defined in clause 6.1. The content provider and terminal device domains remain the same as in Figure 1. The service provider and network provider domains in Figure 1 are not used in the architecture since commercial and operational boundaries are not appropriate to an architectural decomposition.

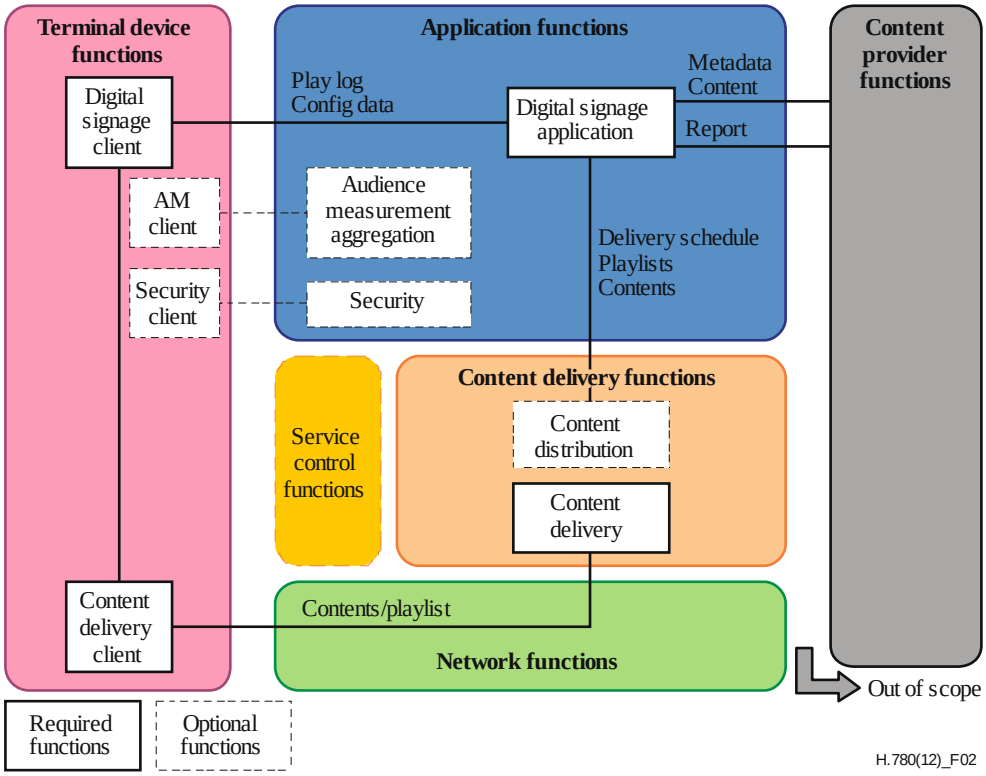


Figure 2 – Overview of digital signage architecture (based on [ITU-T Y.1910])

6.2.1 Functional groups

The following functional groups in the architecture are derived by grouping-related functions referring to [ITU-T Y.1910]:

– **Terminal device functions**: Perform mediation between a DS terminal device and a DS service infrastructure.

– **Application functions**: Enable the terminal device functions to select and present a content item.

– **Content delivery functions**: Receive content from the application functions, store, process and deliver it to the terminal device functions using the capabilities of the network functions and the service control functions.

– **Network functions**: Provide IP layer connectivity between the terminal device functions and the other functions. The network functions are shared across all services delivered over IP to the terminal devices. The network functions contribute to the provision of the quality of service (QoS) required by the DS services.

– **Content provider functions**: Are provided by the entity that owns or is licensed to provide contents (i.e., sell, rent or give free usage permission), or content assets (i.e., owner of the content, metadata and usage rights).

The following is an *optional* functional group in the DS architecture:

– **Service control functions**: Can request the allocation of system/network/service resources to support DS services. The service control functions can optionally obtain terminal device location information.

6.2.2 Functional blocks

Many functional blocks for the DS services, except digital signage application functions and digital signage clients, are also derived from [ITU-T Y.1910]. Explanations of each functional block are as follows:

– **Digital signage application functions**: Manage and/or create content delivery schedules and playlists and playlist schedule (i.e., the functions that control the order and the timing of contents), ingest and distribute contents;

– **Content delivery functions**: Deliver contents to the DS terminal devices. Content delivery depends especially on the schedules in push mode (see clause 8.3);

– **Digital signage client**: Store, decode and display contents. Contents are shown depending on the playlists;

– **Content delivery client functions**: Receive contents over an IP network.

Optional functional blocks relevant to digital signage are as follows:

– **Content distribution functions**: Send contents to multiple entities of the content delivery functions;

– **Security functions**: Control the protection of the services and content. Content protection includes control of access to contents and the protection of contents using methods such as encryption. Service protection includes authentication and authorization of access to services;

– **Security client functions**: Interact with the security functions to provide service protection and content protection. The client functions verify the usage rights and decrypt content. It is also necessary to consider physical security of the terminal devices under unmanned conditions.

– **Audience measurement aggregation functions**: Aggregate audience measurement information, such as viewership, audience interaction information, and audience related information. They may summarize and report the information to organizational entities in a content provider domain;

NOTE – Main targets of audience measurement in digital signage are the general public; therefore, identification capabilities for each audience are not always required. For example, there may be a technique that identifies passers-by in order to avoid counting them more than once.

– **Audience measurement client functions**: Analyse audience information and report to the audience measurement functions (e.g., the number of people in the audience).

6.3 Examples of services

DS services are deployed in a huge variety of fields. The following list is a summary of DS services:

1) Information services:
   – schedule of transportation, map/directory;
2) Advertisements/Promotion:
   – commercial messages, details of products and services;
   – shopping coupons
3) Space decoration:
   – ornaments/coordination of product samples
4) Interactive services:
   – user interaction for service navigation such as finding the nearest restaurant;
   – information presentations based on audience measurement;

NOTE – Interactive digital signage service is a type of service provided by a service provider to enable audiences to interact with a content provider.

5) Advanced services:
   – Context awareness: Messages are delivered to the terminal devices according to the attributes of an audience (e.g., subscribed specific services, location, date, age, etc.)

6.4 Types of terminal devices

It is assumed that various types of terminal devices can be used as digital signage terminal devices. Expected types are as follows:

1) Wall screen: wall-mounted/ceiling-mounted/projector.

   NOTE 1 – There is a set of physical displays that are made up as one logical screen.

2) Self-standing screen.

   NOTE 2 – This type of terminal is often with casing for outdoor installation

3) Mobile terminal:
   – Mobile phone/smartphone.
   – Portable information terminal.

4) Wall screens and self-standing screens can also be categorized in terms of installation:
   – Separated type: The terminal device is separated from the display screens.
   – All-in-one (embedded) type: The display screen includes terminal device functionalities.

7 Requirements

7.1 General requirements

General requirements for DS architecture are as follows:

– The DS architecture is required to support a mechanism to configure the DS terminal device and set up a sequence of contents to be displayed.

– The DS architecture is required to support a mechanism to allow the service provider to update the sequence of contents to be displayed.

– The DS architecture is recommended to support a mechanism for the delivery of the same sequence of contents to many DS terminal devices.

– The DS architecture is recommended to support a mechanism for the display of information and contents from different sources (e.g., the architecture receiving detailed exact data such as time tables of transportation schedule and stock exchange information from other systems).

– The DS architecture, when displays are installed in public spaces, is recommended to simultaneously provide emergency alert information in case of disaster (e.g., earthquakes and weather hazards).

  NOTE 1 – See R6.7.2-01, RR6.7.2-04 in [ITU-T Y.1901].

– The DS architecture is recommended to support the ability to control audio volume considering the characteristics of the surroundings where DS terminal devices are installed (e.g., in certain areas, regulation may require the audio volume to be less 80 than dB).

– The IPTV architecture is recommended to support the discovery of DS services by terminal devices.

  NOTE 2 – The DS architecture may be used in addition to the ordinary IPTV architecture. If an IPTV service provider wants to apply this Recommendation (i.e., the IPTV service provider

becomes a DS service provider), then this requirement may become required in addition to the requirements of an ordinary IPTV architecture. [ITU-T H.770] describes general aspects of IPTV service discovery.

– The DS architecture can optionally provide specific user interfaces (e.g., touch-panels and mobile-phone linking) in order to enable two-way communications with audiences.

– The DS architecture can optionally support QoS network services to avoid latency in case of emergency or specific real-time services (e.g., receiving data through both fixed TCP/IP networks and broadcast communications).

NOTE 3 – A network in this requirement is assumed to support IP QoS classes specified by [ITU-T Y.1541]. See clause 7.5.

– The DS architecture can optionally support countermeasure techniques for delivery latency (e.g., buffering, scheduling of sending contents).

– The DS architecture can optionally support audience measurement.

NOTE 4 – Appendix III introduces general privacy issues of the audience measurement in DS services.

7.2 Content management

The following requirements of the content management in the DS architecture should be fulfilled:

– The DS architecture is required to satisfy associated performance requirements when the requirements are specified (e.g., data handling time, total storage size).

– The DS architecture is required to support the ability to create, change and delete the sequences of contents to be presented (e.g., playlist schedules).

– The DS architecture is required to support the ability to register, change and delete content.

NOTE 1 – See RR6.1.1-04, R6.6.1-01 in [ITU-T Y.1901].

– DS metadata, if used in DS services, is required to be able to describe information concerning contents (See clause 9).

NOTE 2 – See ITU-T Y.1901 R6.6.3.1-03 in [ITU-T Y.1901].

– The DS architecture, when content consists of multiple media, can optionally support independent schedule play time for each of the media.

7.3 Content delivery

The following are requirements regarding contents delivery in the DS services:

– The DS architecture is required to provide the DS services with the problem-free performance of content delivery in case of large number deployment of terminal devices.

NOTE 1 – This requirement assumes the condition supporting more than thousands of terminal devices.

– The DS architecture is required to support at least a pull or a push method of content delivery.

NOTE 2 – See RR6.6.4.1-04, RR6.6.4.1-08 in [ITU-T Y.1901].

– The DS architecture is required to support at least streaming or contents downloading in the case of providing video services.

NOTE 3 – See RR6.6.4.1-01 in [ITU-T Y.1901].

– The DS architecture is required to provide a re-transmission of contents in case of content delivery trouble (e.g., network failure).

– The DS architecture is recommended to support various standardized encapsulation types, including MPEG-2 TS [b-ITU-T H.222.0].

– The DS architecture is recommended to support unicast protocol to deliver different sets of contents and playlist schedules to each location setting terminal devices.
– The DS architecture can optionally support multicast protocols for simultaneous data delivery.
– The DS architecture can optionally deliver a set of contents and playlist schedules to individual terminal device or groups of terminal devices.

7.4 Security requirements

This clause describes security requirements in DS services.

NOTE 1 – Requirement levels can be stricter depending on the service environments (e.g., characteristics of usage rights of contents and networks and number of terminal devices).

NOTE 2 – Refer to [ITU-T Y.1901] and [ITU-T X.1191] for security requirement details and security-related issues, respectively. R6.3.2-01, R6.1.4-03, R6.3.1-01, R6.3.5-02, and R6.3.4-02 of [ITU-T Y.1901] are especially relevant to requirements mentioned-below.

– The DS architecture is recommended to protect against illegal access to the terminal devices and illegal copying and/or alteration of content.
– The DS architecture is recommended to support a means to authenticate the digital signage terminal devices.
– The DS architecture is recommended to support associating contents with content management metadata to permit the expression of its usage rights.

  NOTE 3 – There may be no content rights issues in the services under a certain situation (e.g., rights waiver, self-creation of contents and internal use only).
– The DS architecture is recommended to support the provision of security means to block illegal or unwanted traffic (e.g., controlling the TCP port access).

7.5 Network requirements

The requirements as to network aspects in the DS services are as follows:

– A network for the DS services is required to support IP QoS classes and to satisfy associated performance requirements specified in [ITU-T Y.1541].

  NOTE 1 – [ITU-T Y.1541] recommended the selection of relevant QoS classes based on application requirements.

  NOTE 2 – See R6.2-02, RR6.2-01 and R6.2-04 in [ITU-T Y.1901].
– The DS architecture is recommended to facilitate the ability to detect network failure.

  NOTE 3 – See R6.1.4-03 in [ITU-T Y.1901].
– The DS architecture can optionally support a combination of fixed and wireless networks.

7.6 Terminal device requirements

7.6.1 Terminal functions

The requirements regarding storing/playback of content, physical resistance of the DS terminal devices (e.g., against dust, temperature and humidity) are as follows:

– The DS terminal device is required to facilitate standardized interfaces between the terminal devices and displays when the terminal devices and displays are physically separated.
– The DS terminal device is required to support the decoding of at least one audio or video format.
– The DS terminal device is recommended to support input interfaces to load contents.

– The DS terminal device, when content is stored in the device before being played, is required to provide high-reliability storage (e.g., 99.999% availability).
– The DS architecture can optionally select any type of DS terminal device (e.g., dedicated terminal device, personal computer, personal digital assistant, and terminal-embedded-display), depending on the characteristics of the service.

7.6.2 Display functions

The following are requirements on displays for the DS architecture:

– Displays in DS services are required to support environment-compatible specifications for their installation and operation (e.g., power-consumption, heat-release, structure strength and maintenance-ability).
– Outdoor displays for DS services are required to support brightness control in order to keep visibility under their environment.
– Outdoor displays for DS services are required to support specifications against their particular operational conditions (e.g., withstand shock and vibration; dust-proof, water-proof; and appropriate range of temperature and moisture).
– The DS architecture is recommended to provide an ability to support a wide variety of displays fitting with its service, including: display type (liquid crystal display, plasma display panel, organic light emitting diode display), size, casing and standing/wall-hanging multi-screens.

7.6.3 Management functions

Management functionalities in the DS architecture and terminals are as follows:

– The DS architecture is recommended to support the terminal device operation without any user action, except for switching on the terminal device.
– The DS architecture is recommended to facilitate a mean to confirm the results of content delivery.

  NOTE 1 – See R6.1.4-03 in [ITU-T Y.1901].
– The DS terminal device is recommended to support log functions (e.g., creation, storing, reporting play logs).

  NOTE 2 – See RR6.1.4-01, RR6.5.2.7-02 in [ITU-T Y.1901].
– The DS architecture is recommended to support the monitoring of the status of the terminal devices by a management server through a network.
– The DS terminal device is recommended to support a self-diagnostic function.

  NOTE 3 – See RR6.5.2-18 in [ITU-T Y.1901].
– The DS architecture is recommended to support terminal management in case there is a change in the number of terminals devices, or a terminal device is replaced.

  NOTE 4 – A certain type of the terminal devices in a specific DS service may automatically acquire the contents like a TV accesses to terrestrial broadcast services. In the case, terminal management can be optionally supported.

7.6.4 Accessibility requirements

This item is for further study.

NOTE – For reference, see [b-ITU-T F.790].

8 Functional architecture and key features

This clause illustrates details of functionalities in clause 6. The key functionalities of DS applications (i.e., server-side functionalities) are described in clause 8.1, and terminal device functions (i.e., client-side functionalities) are described in clause 8.2.

8.1 Functionalities of digital signage applications

This diagram shows details of the server-side digital signage applications in Figure 2. The following sub-clauses describe the functional blocks contained in DS applications.

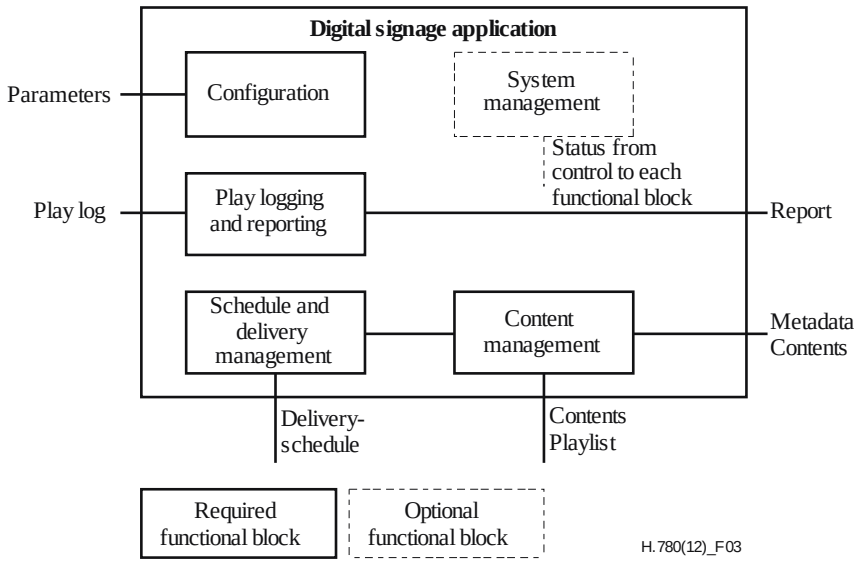


Figure 3 – Details of the server-side digital signage applications

8.1.1 Configuration

The installation location of DS terminal devices is usually far from the DS applications, and the number of terminal devices may be large; therefore, functionalities for remote configuration and/or status monitoring of the terminal devices are key components for DS services.

The ability of changing system parameters provides the DS system with a way to adapt to a wide variety of service environments (e.g., number of terminal devices, network conditions, and operational restrictions). Typical parameters are terminal devices' properties (e.g., hardware settings or terminal devices identifiers) and transmission-related parameters (e.g., port numbers, available network bandwidth).

In the case of addition of terminal devices to the system, it is expected that the system provide simple operations for registering terminal devices, without need to reboot or shutdown servers.

8.1.2 System management

This functional block monitors and records remotely the operating status of other functional blocks (e.g., delivery servers, networks, terminal devices and connected displays), which is necessary for high system availability and operational efficiency.

The terminal devices and network equipment may be capable of monitoring and reporting IP performance parameters. These parameters are used for administration of the network status.

NOTE – These parameters can be used to estimate the perceived quality of video and audio by checking the status of QoS/QoE. Details of QoE issues are discussed in [ITU-T G.1080] and [ITU-T G.1081].

It is preferable to have the ability of checking afterward both the communication results among functionalities and the status of each individual terminal device.

When server, terminal device and network malfunction is detected, the functionality should alert system administrators.

8.1.3 Play log aggregation and reporting

Play logs are used to verify whether designated contents are presented at proper times according to playlists. Therefore, a play log aggregation function should be provided. The logs can also be treated as performance reporting to other business entities (e.g., an advertiser).

8.1.4 Content management

This functional block manages content life-cycle in compliance with commercial agreements with the content owner. Examples of content management functionalities are: data registration and import of multimedia contents, export of contents to the content delivery functions, data processing ability and searching/reviewing contents.

8.1.5 Schedule and delivery management

This functional block manages schedules for content export to the delivery function and schedules for content delivery to the terminal devices. In particular, timings of content delivery in push-mode to the DS terminal devices are handled in this functionality. There are various combinations of delivery timings and play timings (e.g., differential content delivery and immediate or scheduled presentation after delivery).

It is also important to support mechanisms regarding aggregation and management of logs of the individual terminal devices. This allows checking whether designated contents are delivered to the intended terminal devices according to the delivery schedules or not.

Almost all DS service content presentations orders are designated with playlist schedules and playlists. Therefore, functionalities for inputting and creating schedules and lists may be provided as operation through server consoles, as they impact on total system operation efficiency.

Playlists, playlist schedules and delivery schedules managed by this functionality may differ from time to time, depending on each terminal device.

In addition, this functionality may have:

– a group delivery function that simultaneously delivers contents to multiple terminal devices, according to terminal device installation location information; and

– an interrupted presentation function that terminates the current presentation and indicates presentation of high-priority contents (e.g., emergency notifications of accident). There are also various types of interruption modes (e.g., interruption of a set of contents and appointment of detailed interruption timing).

8.1.6 Summary of system logs

The DS architecture has administration and management functions that use several types of log data, as described before. Data is recorded on equipment (e.g., delivery servers and terminal devices), gathered and analysed by the management functionalities. Data can be classified from the viewpoint of its purpose as follows:

– System administration and troubleshooting:
  - Status of servers and terminal devices.
  - Status of a network.
  - Results of contents delivery recorded within the delivery functionalities.

– Evidence of service:
  - Results of playing contents.

8.2 Functionalities of terminal devices

8.2.1 Digital signage clients

Figure 2 details a DS client in terminal devices. Digital signage client functions correspond to the integration of "application client functions" and the "media client function" of the IPTV functional architecture in [ITU-T H.720] and [ITU-T H.721]. The relationship between DS and IPTV clients are shown in Table 1.

The following clauses describe the functional blocks contained in DS clients.

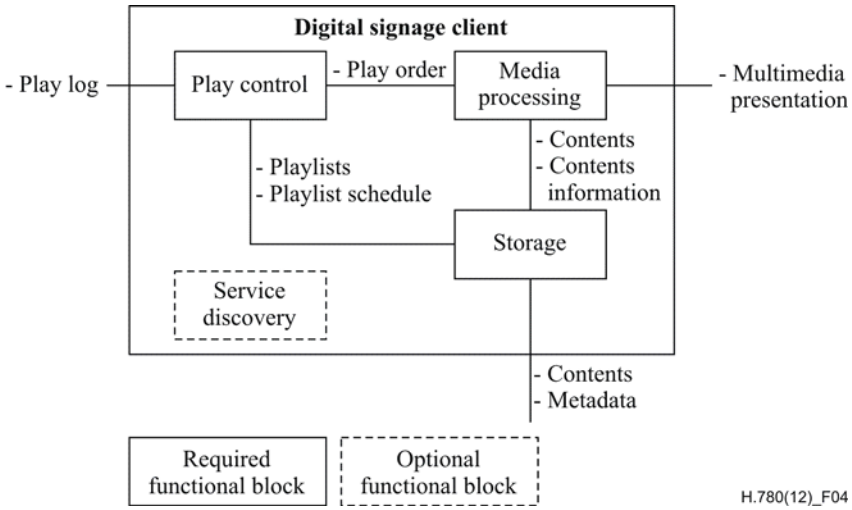


Figure 4 – Details of digital signage client

Table 1 – Relations of functional blocks among ITU-T Recommendations

Digital signage clients functional blocks	IPTV clients functional blocks (function name: functional block name)
Play control	Application client functions: IPTV application client
Media processing	– Media client functions: Codecs – Media client functions: Media control – Media client functions: Metadata management – Application client functions: IPTV application client
Service discovery	Application client functions: Service and application discovery and selection (SADS) client
Storage	Media client functions: Storage

8.2.1.1 Play control

The play control functional block controls the play order of multimedia contents, including video, audio and data according to playlist schedules and playlists. Results of play control processes as play logs are sent to the play log aggregation and reporting function (clause 8.1.3).

8.2.1.2 Media processing

This functional block is a software or hardware process that includes contents decoding to generate a multimedia presentation combining visual and/or audio contents. The process may also include creation of a layout for the visual contents. The results of processing as multimedia presentations are signalled to displays or other electronic signage devices.

8.2.1.3 Video and audio processing

The DS client is expected to support standardized video and/or audio formats.

NOTE – For reference, see Appendix II "Codecs and data formats for digital signage services".

8.2.1.4 Processing of other data formats

The DS client is expected to support standardized multimedia formats for data such as text and graphics.

8.2.1.5 Storage

The storage functional block is responsible for the caching (e.g., temporary storage in volatile memory such as random access memory) and storage (e.g., persistent storage in non-volatile memory) of contents and other application data. The storage function can be internally or externally implemented. Contents and metadata are stored through the content delivery client functions described in clause 8.2.2, or are input from storage interfaces (see clause 10.1).

8.2.1.6 Service discovery

Service discovery is an important function when terminal devices can dynamically change a connection to a content delivery server. Details of service discovery in DS are for further study.

8.2.2 Content delivery client functions

The content delivery client functions receive contents from the content delivery functions, and can request control of the content delivery by co-operating with the delivery functions.

8.3 Transport and control mechanisms

There are several classifications of the characteristics of content delivery functionalities. This Recommendation pays attention to the initiation of control of content delivery, content delivery timings and delivery protocols in series.

8.3.1 Mode of content delivery

There are two modes for requesting content delivery:

– **Push mode**: Content delivery servers deliver contents, playlists and playlist schedules to DS terminal devices according to the server's orders.

– **Pull mode**: DS terminal devices request content delivery when the terminal devices allow to request. The contents would be downloaded if contents to be shown or updated are in a delivery server.

NOTE – In case of updating content, the two modes can be combined (e.g., different content updates are delivered in pull mode, while emergency information is delivered in push mode)

8.3.2 Content delivery timing

Content delivery methods can be classified according to delivery timing. Video contents are relatively larger than other types of contents; therefore, efficient delivery methods are to be selected based on the details of the DS services.

– **Real-time delivery (streaming)**: Video streaming servers deliver contents to DS terminal devices. The terminal devices continuously receive and decode the contents, and transform them into video signals in real-time.

  NOTE – This includes options as such dynamic adaptive streaming in HTTP (DASH) [b-ISO/IEC 23009-1], live streaming, and static streaming.

– **Pre-stored**: The contents sent from a delivery server are stored in the terminal device in advance of playing. The terminal devices continuously read from the storage and decode

the contents. This delivery method can be advantageous for stable presentation services since it is independent of network bandwidth and quality.

– **Event-driven**: High-priority contents can replace or be overlaid on the current presentation, e.g., to notify the audience of significant events. Notification-specific contents such as simple text and/or images can be delivered in this mode.

8.3.3 Content delivery methods over IP networks:

– **Unicast**: Protocols in this category allow direct one-to-one sessions among a delivery server and terminal devices. HTTP, HTTPS and FTP are well-known protocols for IP unicast delivery.

– **Multicast**: Protocols in this category allow contents to be simultaneously sent to multiple terminal devices. A merit of multicast delivery is the efficient use of network bandwidth when compared to unicast. RTP and FLUTE are well-known protocols for IP multicast delivery.

NOTE – Content delivery methods are used independently from content delivery timing.

8.4 Security

There are many security concerns and requirements that need to be addressed and supported by a DS system. Details of security mechanisms in DS are for further study.

8.5 Audience measurement

Handling viewership information is a value-added feature for DS services.

There are however many security concerns and requirements need to be addressed and supported by a DS system. Details of audience measurement for DS services are for further study.

9 Metadata

Metadata can present details of contents and service information in DS. [ITU-T H.750] summarizes metadata specifications for IPTV services defined by various standards development organizations, and those specifications are applicable to DS services. In particular, MPEG-7 of [ISO/IEC 15938-5] and [ISO/IEC 15938-5 Amd.2], and TV Anytime of [ETSI TS 102 822-3-1] and [ETSI TS 102 822-3-3] introduce generic and exhaustive specifications concerning audio and visual services.

This Recommendation selects basic elements/attributes from these specifications that are applicable to DS services. Names of elements/attributes are quoted as they are in the specifications, in order to keep clear the relationship between the standards.

NOTE – Just semantics of metadata are illustrated in this clause. Details of metadata specifications, such as schema, are for further study.

In the tables provided in the sub-clauses below, requirement levels are indicated as mandatory (M) or optional (O), if the metadata is used in the services.

9.1 Content information

Metadata can treat detailed content information such as title and genre. Many elements/attributes for content handling can be selected from [ISO/IEC 15938-5], [ISO/IEC 15938-5 Amd.2] and [ETSI TS 102 822-3-1]. A set of elements/attributes for DS services are shown in Table 2.

Table 2 – Common content elements/attributes

Element / Attribute	Description	Level
ContentId	An identifier of content.	M
Title	Titles, e.g., in different languages. (Defined as an MPEG-7 datatype, TitleType. See clause 9.2.2 in [ISO/IEC 15938-5] for a detailed specification).	M
Synopsis	A simple textual description of the content.	O
Explanation	A detailed textual description of the content.	O
Keyword	A list of keywords for the programme. A keyword can be a single word or an entire phrase made up of multiple words.	O
Genre	A genre for the programme (The thesaurus in annex B in [ETSI TS 102 822-3-1] defines the normative TV-Anytime set of genres).	O
PreferenceCondition	A combination of time, place and/or specific parts of contents that can be associated with a particular set for usage restriction.	O
Language	Describes one spoken language for the programme. There may be more than one spoken language specified for the content.	O
RelatedMaterial	A reference to any other material related to the content.	O
ProductionDate	The date or time period when the content was produced (defined as a tva:TVATimeType).	O
Release	Information about the region and date of release of the content.	O
Duration	Indicates the approximate duration of the programme.	O
Availability	This provides information about when the content is scheduled to start or end.	O
ContentType	This provides type of media of contents (e.g., video, still image).	O
FileSize	Indicates the size, in bytes, of the file where the programme instance is stored.	O
PromotionalInformation	Information on the products/service in the content when the content is presented as promotion, advertisement.	O
CreationInformation	Information concerning the content creation (e.g., title, creator, classification).	O

9.2 Terminal device information

Information regarding terminal devices is necessary for system maintenance/administration. [ETSI TS 102 822-3-3], [ISO/IEC 15938-5] and [ISO/IEC 15938-5 Amd.2] introduce generic specifications concerning terminal device information. The metadata in Table 3 is the basis for DS services. "TerminalId", "AmbientIdRef" and "InstallationDate" are defined in this Recommendation.

Table 3 – Common terminal device elements/attributes

Element/Attribute	Description	Level
TerminalId	An identifier of a terminal device.	M
AmbientIdRef	A reference identifier of ambient information (see Table 4).	O
Keyword	A list of keywords for the terminal device. A keyword can be a single word or an entire phrase made up of multiple words.	O
DisplayInformation	Information of display connected to a terminal device.	O
InstallationDate	Describes date of installation of the terminal device.	O

9.3 Ambient information

Information regarding terminal device locations is used for controlling of the delivery of DS services. [ETSI TS 102 822-3-3] introduces generic specifications concerning location and preference information. "AmbientId" is defined in this Recommendation.

NOTE – A mobility aspect of DS services can be also treated by using this information (e.g., the DS services in public transportations).

Table 4 – Common ambient information elements/attributes

Element/Attribute	Description	Level
AmbientId	An identifier of a ambient information.	M
AmbientDescription	Describes the spatial information such as name and/or characteristics of locations in which terminal devices have installed.	O
Keyword	A list of keywords for the location. A keyword can be a single word or an entire phrase made up of multiple words.	O
AgeGroup	Describes the age of the major audience in terms of range.	O
GenderGroup	Describes the gender of the major audience.	O
PreferenceCondition	A combination of time and/or specific parts of contents that can be associated with a particular set for usage restriction.	O

9.4 Results of playing contents

Table 5 contains the minimum set of information that can be used for recording and collecting the results of playing contents in DS services. TerminalIdRef, PlayDateTime and ContentIdRef are defined in this Recommendation.

Table 5 – Common elements/attributes regarding play-logs

Element/Attribute	Description	Level
TerminalIdRef	An identifier of a terminal device.	M
PlayDateTime	Describes the date and time of showing the contents.	M
ContentIdRef	Describes identifiers of the contents which are presented on a terminal device.	M

9.5 Schedule-relevant information

Metadata to represent time relevant information (e.g., playlist, play-schedule,) is for further study.

10 Terminal device interfaces

DS terminal devices are equipped with various standardized input/output interfaces. Details of specifications of the input interfaces are for further study.

NOTE – Appendix IV describe possible interface standards for DS.

10.1 Input interfaces

DS terminal devices have input interfaces for receiving digital data, terminal control and network access.

10.1.1 Network interfaces

DS terminal devices are required to support a wired network interface and/or a wireless network interface.

10.2 Output interfaces

DS terminal devices are required to support at least one of type of video or audio output interface. Video interfaces are supported if displays are separated from the terminal device. Terminal devices may support multiple video output interfaces. Specification details for output interfaces are for further study.

NOTE – For reference, [ITU-T H.721] has specifications for IPTV output interfaces.

Appendix I

Digital signage use cases

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

I.1 Screen for single content source

After initialization, a sequence of contents is displayed on the screen of a terminal device without any user interaction.

Use case 1A: DS within an organization

The use case illustrated in Figure I.1 delivers contents, which is mainly used to inform events and status relates to organization activities, to a relatively small number of terminal devices. A system in this type, which consists of functions of content creation, digital signage application and delivery mechanism, may be owned and operated by a single organization.

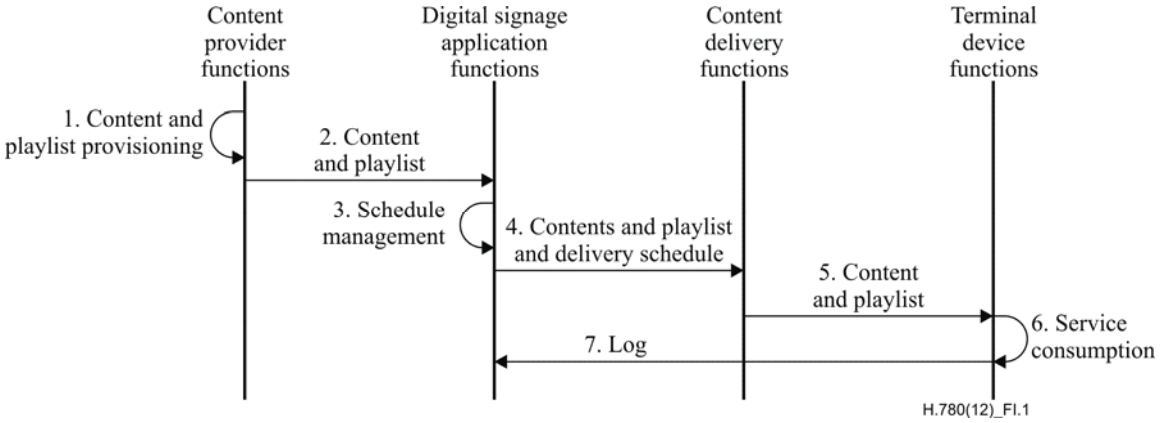


Figure I.1 – Use case 1A: Flow for DS within an organization

The following processes are assumed in this use case:

1) Content creation: digital signage contents, their relevant metadata and playlists are created.
2) Content setting: the contents and relevant data are sent to a digital signage application.
3) Schedule management: the digital signage application manages the contents and their delivery schedules.
4) Content and schedule setting: a content delivery system receives the contents and their delivery schedules.
5) Content delivery: the contents are delivered to digital signage terminal devices on the schedules.
6) Service consumption: Contents are shown on the display of the terminal devices based on the playlist.

   NOTE – Interactions among the audience, the terminals and other functions are omitted when interactive terminals are provided.
7) Log aggregation: service logs are gathered in the digital signage application.

I.2 Screen by using multiple content/data sources

There may be the case that multiple content providers (e.g., an independent information service provider, an advertiser, etc.) and data sources provide several contents or data to display on terminal devices.

Use case 2A: Linking different businesses

The use case illustrated in Figure I.2 shows a digital signage system that works with independent business sources including business relevant systems, and delivers signage contents that relate to the business sources' activities (e.g., a display shows a waiting list in a reservation desk; and sales promotion contents are altered according to requests from each tenant in a shopping mall).

NOTE 1 – A business system is different from a well-known term "business support system (BSS)". The role of a BSS is usually specific to telecommunication businesses such as the management of subscribers.

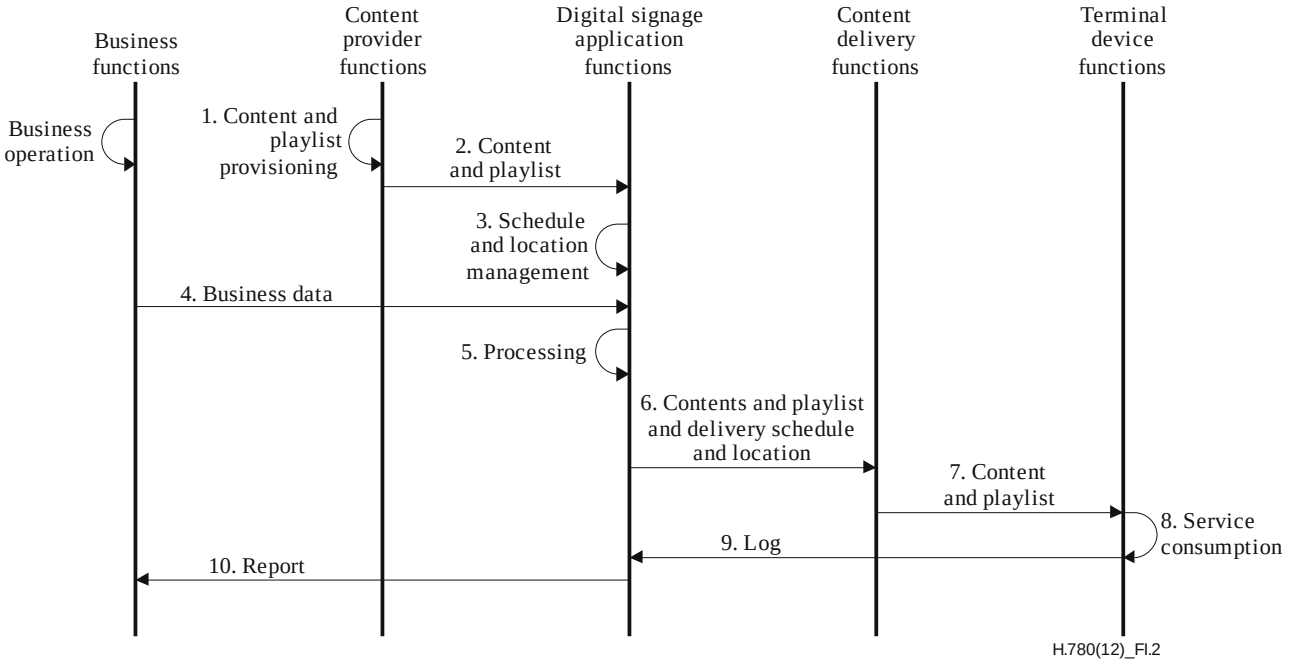


Figure I.2 – Use case 2A: Flow for linking different businesses

NOTE 2 – Playlists may be created by the DS application rather than being provided by the content provider.

The following processes are assumed in business-linking use case:

1) Content creation: digital signage contents, their relevant metadata and playlists are created. One of the contents is a template which has some blanked areas filled in the later process 5).
2) Content setting: the contents and relevant data are sent to a digital signage application.
3) Schedule and location management: the digital signage application manages the contents and their delivery schedules. The application also manages location data of terminal devices if there are lots of delivery points.
4) Business data sending: business-related data to be shown on the terminal devices are provided by business systems.
5) Content processing: the business data is embedded into blanked areas in the contents.
6) Content and schedule setting: a content delivery system receives the contents, their delivery location and schedules.
7) Content delivery: the contents are delivered to the digital signage terminal devices on the schedules.
8) Service consumption: Contents are shown on the display of the terminal devices based on the playlist.

   NOTE 3 – This use case omits details of interactions amongst the audience, the terminals and other functions when an interactive digital signage service is provided.
9) Log aggregation: service logs are gathered in the digital signage application.

10) Report sending: the application summarizes the logs as a report, and making and sending the report to the business systems.

Use case 2B: Advertisement services

Traditional advertising consists of broadcasting commercial advertising or public promotion of goods, services, company images and institutional messages. Every digital signage terminal device located in a certain region can receive such advertisements. Each advertising service can be provided on a national basis, or regionally/locally [b-ITU-T Y.Sup5]. This use case is illustrated in Figure I.3.

Location of the digital signage terminals is one of the key factors for advertisement. Effectiveness of advertisement heavily depends on the number of viewers and location for setting up the terminal devices. Hence, an advertiser finds appropriate locations and makes a contract with owners of locations (e.g., a railway station managing company) to get permission to set up the terminals.

Location information provided by the location owners may contains a variety of attributes (e.g., physical address, type of location, demographic information of audience, etc.).

NOTE 4 – Details of advertisement in DS are for future study.

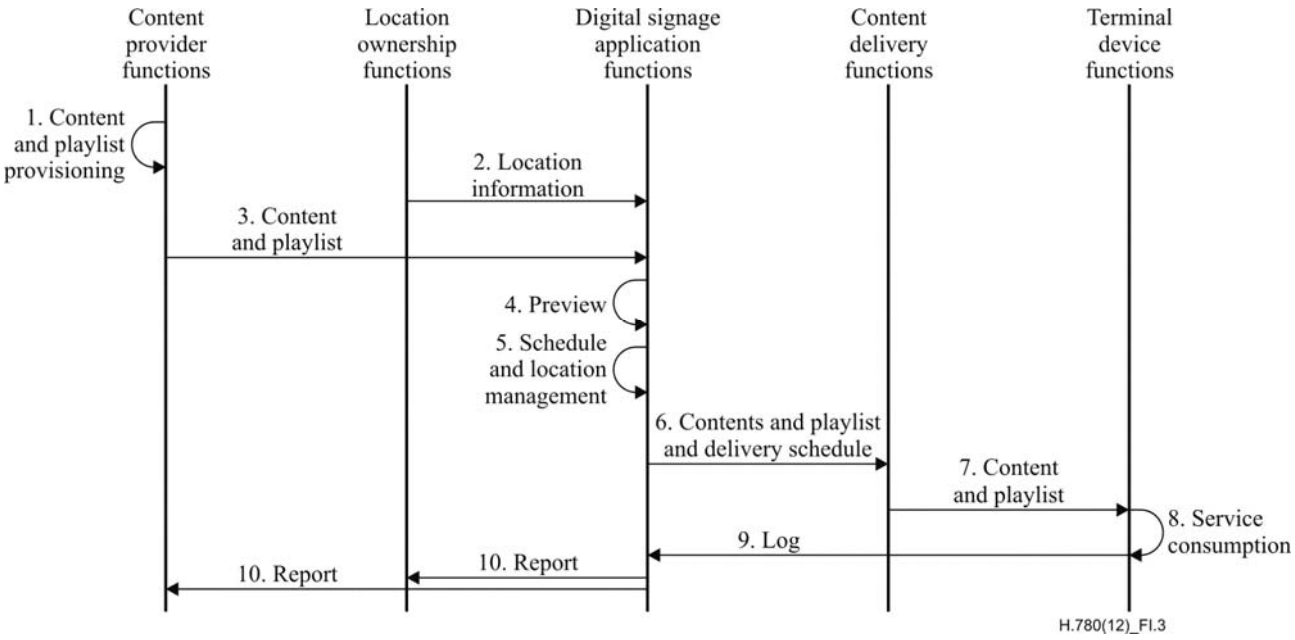


Figure I.3 – Use case 2B: Flow for advertisement services

The following processes are assumed in the advertisement use case:

1) Content creation: Advertisement contents, their relevant metadata and playlists are created by an advertiser as the content provider functions.

2) Location information aggregation: Information concerning candidate locations of advertisements are aggregated from location owners as location ownership functions in advance.

3) Content setting: The contents and relevant data are sent to a digital signage application.

4) Content preview: Usually advertisement contents are reviewed before delivering as a business manner.

5) Schedule and location management: The digital signage application manages the contents and their delivery schedules. The application searches and finds suitable locations to advertise the contents.

6) Content and schedule setting: A content delivery system receives the contents, their deliver location and schedules.

7) Content delivery: The contents are delivered to digital signage terminal devices on the schedules.

8) Service consumption: Contents are shown on the display of the terminal devices based on the playlist.

NOTE 5 – This use case omits details of interactions among the audience, the terminals and other functions when an interactive digital signage service is provided.

9) Log aggregation: Service logs are gathered in the digital signage application.

10) Report sending: The application summarizes the logs as a report, and making and sending the report to the location owners and the advertiser according to contracts between business entities.

I.3 Emergency communications

Public announcement services for disaster relief and early warning in case of major disasters are of paramount importance. Digital signage services can provide a way to deliver such information (e.g., display particular local/regional information to displaced people at different evacuation places, etc.). It is important to consider aspects of widely-adopted and instantaneous information services.

Such services need to collect accurate information on disaster from reliable sources and to ensure its timely delivery. Figure I.4 shows an example of digital signage service operation in case of disaster.

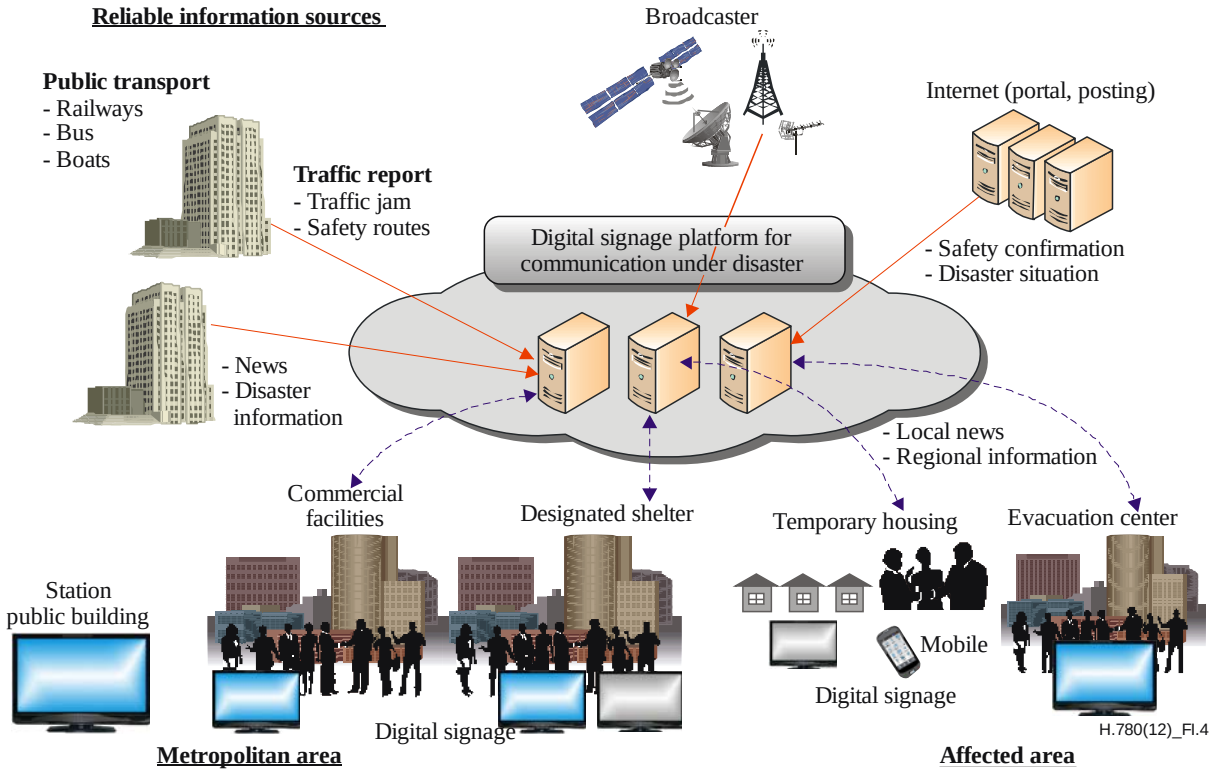


Figure I.4 – Use case 3: Disaster information service

I.4 Interaction amongst audience and terminals

Use case 4A: Service interactivity between mobile and digital signage

Mobile interactivity allows network operators to deliver promotional material to users' mobile phones when they send their text message to the screen.

One of the most basic mobile interactivities is to send text to a digital signage screen and text to vote. These applications allow viewers to send a text message or vote on a poll or question from their mobile phone to a digital signage screen. In this application, viewers send text messages with their opinion or vote for a number listed on the screen. Once the viewers' text messages are received, they are displayed on the digital signage screen.

I.5 High-level architecture expansion

An expanded architecture can contain the following new functional blocks according to the use cases mentioned-above: 1A, 2A and 2B.

– A "Business functions" block provides business data shown on the digital signage terminal devices.

– A "Location ownership functions" block provides location information for placing the terminals.

– A "Location Profile" block in service control functions group stores location information for setting up the terminals.

NOTE – Details of business functions and location ownership functions are out of the scope of this Recommendation.

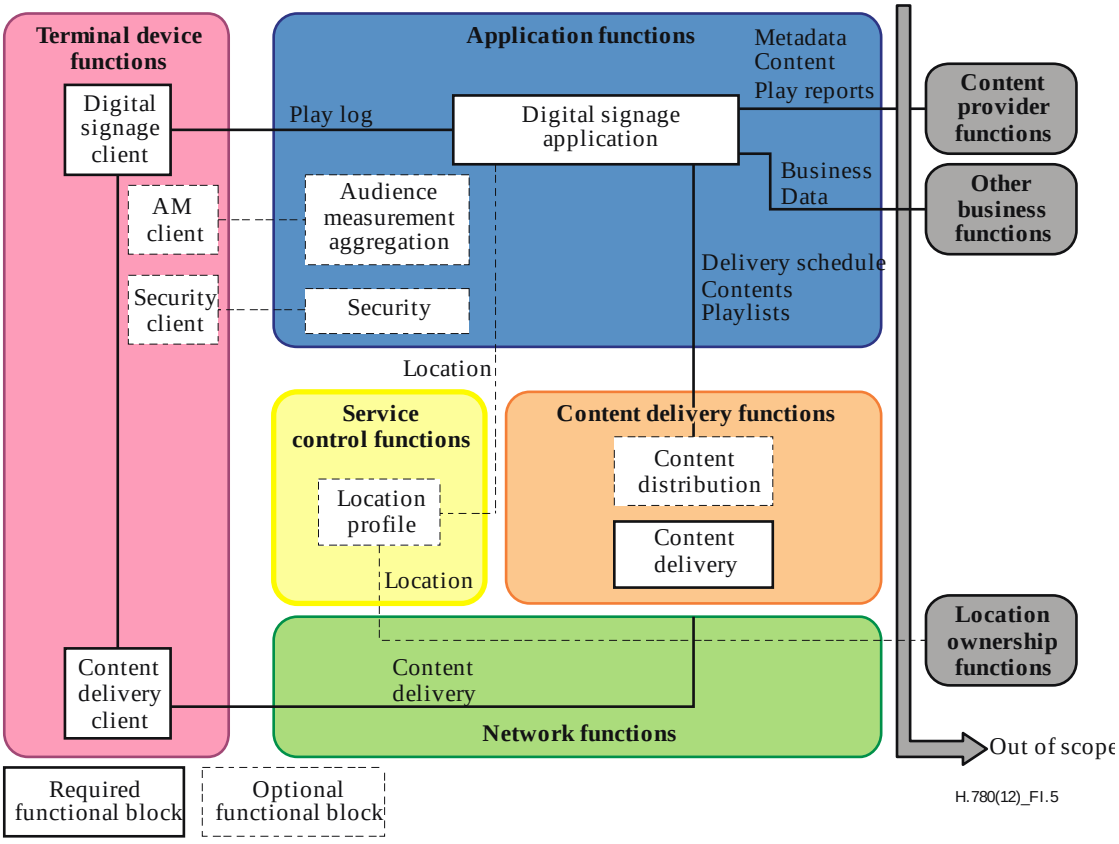


Figure I.5 – Expanded generic DS architecture

Appendix II

Codecs and data formats for digital signage services

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

Codecs and data formats of presentation media in digital signage services are described by several organizations (e.g., [b-POPAI]). The specifications listed in Table II.1 are provided for reference when considering media coding for use in digital signage services. It should be noted that the codecs and data formats for digital signage services are not limited to the ones listed in Table II.1.

Wrapper is a container of one or more encoded media files. The specifications listed in Table II.2, which may be used for digital broadcasting, typically contain multiple video and audio streams.

Table II.1 – Standards of codecs and data formats

Type	Standards
Audio	MPEG-1 Audio Layer-3 [b-ISO/IEC 11172-3], Dolby AC3 [b-ETSI TS 102 366], MPEG-2 AAC [b-ISO/IEC 13818-7], MPEG-4 HE AAC v1 [b-ISO-IEC 14496-3], A-law/μ-law [b-ITU-T G.711]
Still image	JPG [b-ITU-T T.81], PNG [b-ISO/IEC 15948]
Vector graphics (Note)	SVG [b-W3C SVG 1.1]
Video	MPEG-2 [b-ITU-T H.262], H.264 [b-ITU-T H.264]
NOTE – Vector graphics are a means to represent images in computer graphics based on mathematical equations (e.g., points, lines, curves, and shapes or polygons).	

Table II.2 – Standards of data wrapping

Type	Standards
Wrapper	MPEG-4 part 14 (MP4) [b-ISO/IEC 14496-14] MPEG-2 TS/PS [b-ITU-T H.222.0]

Appendix III

Privacy of digital signage services

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

III.1 Overview

Digital signage services can enhance their interactivity by using audience measurement technologies (e.g., facial recognition). Incorporating privacy into digital signage services becomes more important in this context.

Digital signage service entities may consider creating voluntary privacy guidelines.

The *OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* [b-OECD] can be considered as an introduction and general guidelines for privacy in audience measurement [b-ITU-T H.740].

The Federal Trade Commission [b-FTC] also proposes principles which can be applied broadly to companies engaged in online behavioural advertising, defined as activities for tracking consumers online in order to deliver advertising that targets the individual consumers' interests. The Federal Trade Commission [b-FTC] stresses the principles' applicability to different types of data and different advertising practices; not only for the collection and use of personally identifiable information (PII), but also of non-personally identifiable information (non-PII); collection and use of data; and the applicability to online contextual advertising.

NOTE 1 – Traditionally, PII has been defined as information that can be linked to a specific individual including, but not limited to, name, postal address, e-mail address, social security number, or driver's license number. Non-PII includes anonymous data that, without more, cannot identify a specific person.

NOTE 2 – The Digital Signage Federation [b-DSF] divides no-PII into audience measurement data and anonymous information used in other services (e.g., MAC address).

These audience measurements may be relevant to the scope of the principles (e.g., video recognition systems that identify and counting specific classes of individuals passing-by).

III.2 Principles for privacy

Digital signage service entities are encouraged to refer to the following general principles [b-FTC] for privacy and provide practical ways to avoid privacy issues:

– **Transparency and consumer control**: This is an important aspect in the services. When consumers' information is collected, the service entities should provide prominent notice to consumers about such practices and should offer consumers the ability to choose whether or not to allow such collection and use. The notice may include policies for collection (e.g., why/where/for what is data collected). [b-FTC] shows the following general principles for consent based on the privacy classes.

– **Choice for non-PII**: Service entities should notify consumers when they are collecting information about consumers' activities for services.

  NOTE – The report [b-FTC] does not specify whether this choice would be opt-in, which is an affirmative express consent, or opt-out, which is prohibition against the treatments. Opt-out has beneficial aspects as it is easy to use and accessible to consumers.

– **Consent for PII**: Opt-in for uses of data should be requested.

The report also addresses the principles for use data collection; reasonable security and limited data retention for consumer data; secondary use which is the use of collection data for purposes other than the digital signage services; and other relevant aspects.

Appendix IV

Terminal device interfaces

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

There are several industrial standards concerning input/output interfaces. This appendix makes efforts to introduce possible standards relating to the interfaces of the DS terminal devices.

IV.1 Input interface

IV.1.1 Storage interfaces

DS terminal devices are equipped with a communication port to connect among computers and peripherals (e.g., universal serial bus [b-USB Forum]) and/or a flash memory as a means of data storage.

IV.1.2 Control interfaces

RS-232 [b-TIA 232-F] can be used in DS as a means of terminal device control.

IV.1.3 Network interfaces

DS terminal devices may support a TCP/IP LAN/Wireless port [b-IEEE 802.3], [b-IEEE 802.11].

IV.2 Output interfaces

IV.2.1 RGB analogue interfaces

Analogue signal output can be handled through the following specifications:

– Analogue interfaces complying with the RGB colour codes model of [b-CEA-863].

  NOTE – RGBHV is a variant of RGB model applicable for DS displays as well as PC computer monitors, with five lines: red, green, blue, horizontal sync and vertical sync.

– Digital video interface analogue (DVI-A)/digital video interface integrated (DVI-I) interfaces [b-DDWG DVI].

IV.2.2 Digital video interfaces

The following standards are a means to handling digital video output:

– High-definition multimedia interface (HDMI) [b-CEA 861].

– Low-voltage differential signalling (LVDS) [b-TIA 644].

– Digital video interface digital (DVI-D)/DVI-I [b-DDWG DVI].

– DisplayPort [b-VESA DisplayPort].

IV.2.3 Digital audio interfaces

This item is for further study.

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