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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Multi-device systems for cable television

Requirements for platform functionalities on the integration of cable STB and mobile second screen devices

Recommendation ITU-T J.230

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Requirements for platform functionalities on the integration of cable STB and mobile second screen devices

Summary

With the increasing availability of sophisticated mobile devices that include broadband Internet access services, cable operators, broadcasters and consumer electronics manufacturers have started taking advantage of this trend by providing connected devices that work as companion devices to enhance the experience of watching television (TV). This technology creates several opportunities for players in all segments involved in delivering enriched and customized content and user experiences.

The integration of these companion mobile devices, also known as second screens with TV and cable set top box (STB) platforms, support several scenarios based on content sharing, synchronization, user interaction and customized presentations. This integration also offers opportunities for the inclusion of intuitive and convenient user interfaces and additional areas for the presentation of information.

Recommendation ITU-T J.230 defines high level requirements for the cable STB and mobile platforms involved in these scenarios. This Recommendation also describes some useful application cases to illustrate the ideas behind the requirements.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Requirements for platform functionalities on the integration of cable STB and mobile second screen devices

1 Scope

The incorporation of companion mobile devices, also known as second screen devices, into the experience of watching television (TV) is a recent and rapidly evolving trend. The integration of these companion devices with digital cable set top box (STB) or TV terminals support several scenarios based on content sharing, synchronization, user interaction and customized presentation. This integration also offers opportunities for the inclusion of intuitive and convenient user interfaces and additional areas for the presentation of information.

This Recommendation defines high-level requirements for functionalities of platforms consisting of digital cable television (CATV) reception equipment and mobile second screen devices.

2 References

None.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 common agent service: One of the particular resident applications which is specific to the mobile-set top box (STB) cooperation. Common agent service equips the common application program interfaces (APIs) to enable each application to utilize its mobile-STB cooperation function. Therefore, many application developers can realize the mobile-STB cooperation application easily and quickly.

3.2.2 resident application: Application that is stored in the storage area of a terminal device, and is not tied to any broadcast programme. For example, a pre-installed application is classified as a resident application.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACR Automatic Content Recognition

API Application Program Interface

CATV Cable Television

DSMCC Digital Storage Media Command and Control

DTV Digital Television

EPG Electronic Programme Guide

HAN Home Area Network

HDD Hard Disc Drive

IP	Internet Protocol
mDNS	multicast Domain Name System
QR	Quick Response
SNS	Social Network Service
STB	Set-Top Box
TCP	Transmission Control Protocol
URL	Uniform Resource Locator

5 Conventions

None.

6 System model

System models for a cable set top box (STB) or television (TV) set and mobile devices are derived from several scenarios. In this clause, each scenario is discussed in detail. This Recommendation distinguishes scenarios based on the point where the process is initiated either on the STB or TV set or mobile devices.

6.1 Scenarios considered

6.1.1 Scenario 1: Integration initiated by broadcast services on a STB or TV set

In this scenario, there are two cases distinguished by the point of the interaction between a STB or TV set and mobile devices. The first case is by communication of these devices directly over a home network so that broadcasters can initiate and manage the integration directly. The second case is by communication over server(s) in a wide area network. In this case, the integration is achieved by the servers managed by the service provider(s) and broadcasters do not have direct interaction with end-users. Broadcasters need to have some relationship with service provider(s) to provide content and receive feedback.

6.1.1.1 Integration by direct communication between the devices on a home network

Conceptually, the STB/TV receiver is the broadcast network's boundary for delivering content. This may not be true in the case of digital television (DTV) systems that enable the execution of interactive content (or applications) in the STB/TV receiver and provide a rich set of APIs for general network and Internet access.

In these cases, a broadcaster can send, multiplexed with its main content, an interactive application, capable of communicating with other devices connected to the same home network to which the STB/TV receiver is connected. Given this, such an application provided by a broadcaster/operator can act as an integration enabler of STB/TV sets and second screen devices by controlling execution and delivery of secondary screen content. See Figure 1.

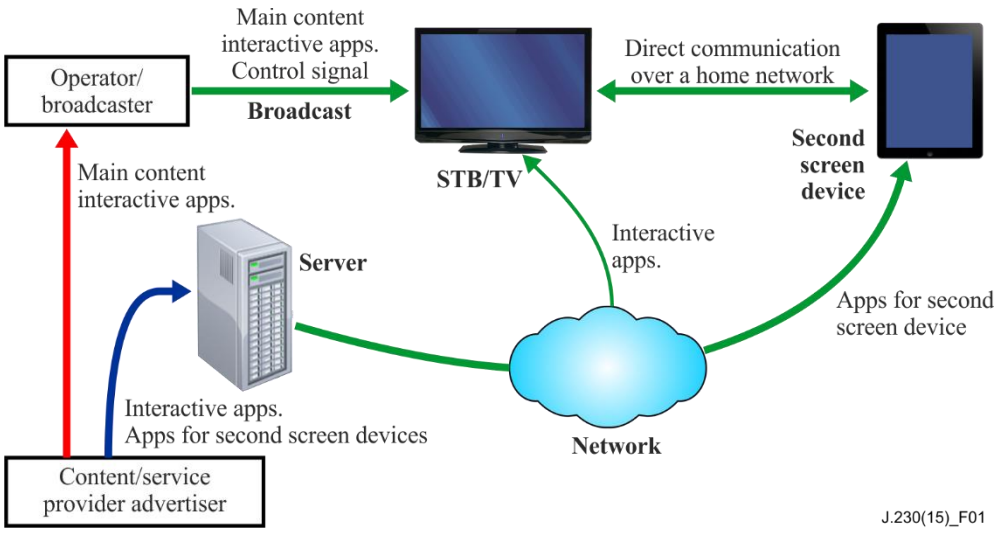

Figure 1 – Integration by direct communication between the devices

1. Content/service providers/advertisers provide the main content/advertisement to the broadcaster.
2. Content/service providers/advertisers provide second screen content.
3. Some second screen content may be delivered multiplexed into the main content.
4. The broadcaster delivers the main content/advertisement with applications for STB/TV sets or control signals for them. Additionally, some second screen content may also be broadcast multiplexed with the main content.
5. The STB/TV receiver executes the applications that cooperatively work with content on second screen devices. The applications control content on second screen devices and inform them of necessary information, such as when to start or stop, and other synchronization information through the home area network (HAN).

6.1.1.2 Integration by communication between the devices over a server outside a home network

In addition to the model described in clause 6.1.1.1, integration can be achieved by communication between STB/TV and second screen devices over a server outside a home network. In this case, the integration of devices is still initiated by interactive applications delivered to STB/TV that provide features to establish the communication, e.g., showing identification information of STB/TV on a screen by which a second screen device identifies an STB/TV to communicate with.

Figure 2 shows an example of how the integration is achieved. An application provided by a broadcaster/operator shows identification information on a screen. The application also communicates the information to the management server. A user starts an application for integration on a second screen device. The second screen device obtains the information shown on the screen by some means. Display of quick response (QR) codes or numeric code on the screen is frequently used for this purpose. The second screen device itself communicates the information and identification information obtained to the management server. The management server compares the information submitted by both devices. When the management server recognizes the proper combination, the server relays the information for communication between them.

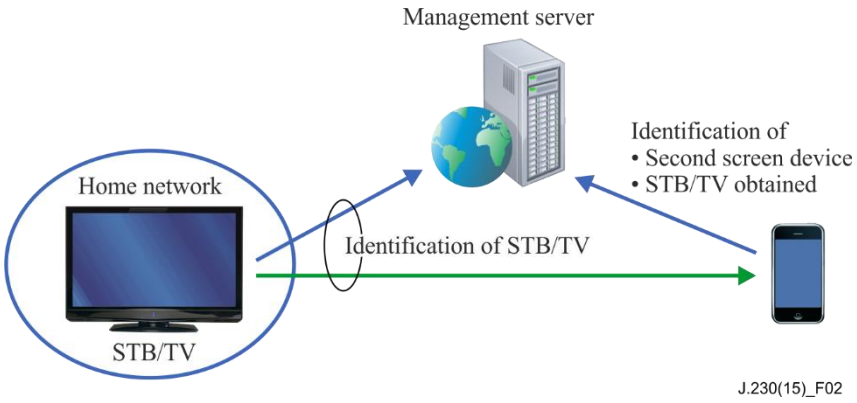

Figure 2 – Integration by a server outside a home network

6.1.1.3 Consideration of synchronization aspect

In Scenario 1, as the integration between STB/TV and second screen devices is initiated by applications from broadcasters/operators, synchronized presentation between these devices is important. There are two possible points to control synchronization; by a server on a network or by an application on a device.

(a) Synchronization control by a server

This approach requires a server which controls applications on a second screen device in accordance with progress of a broadcast programme. This server is an additional element to broadcast systems but the server does not get any information from broadcast systems themselves. In other words, the server requires the obtaining of information on the broadcast programme by other means, such as proprietary formatted information handover to the server, information given by users or some specific information in the content, like audio recognition by watermarking. Figure 3 shows information interchange in this approach. Clauses II.1 and II.2 describe how the systems work in detail.

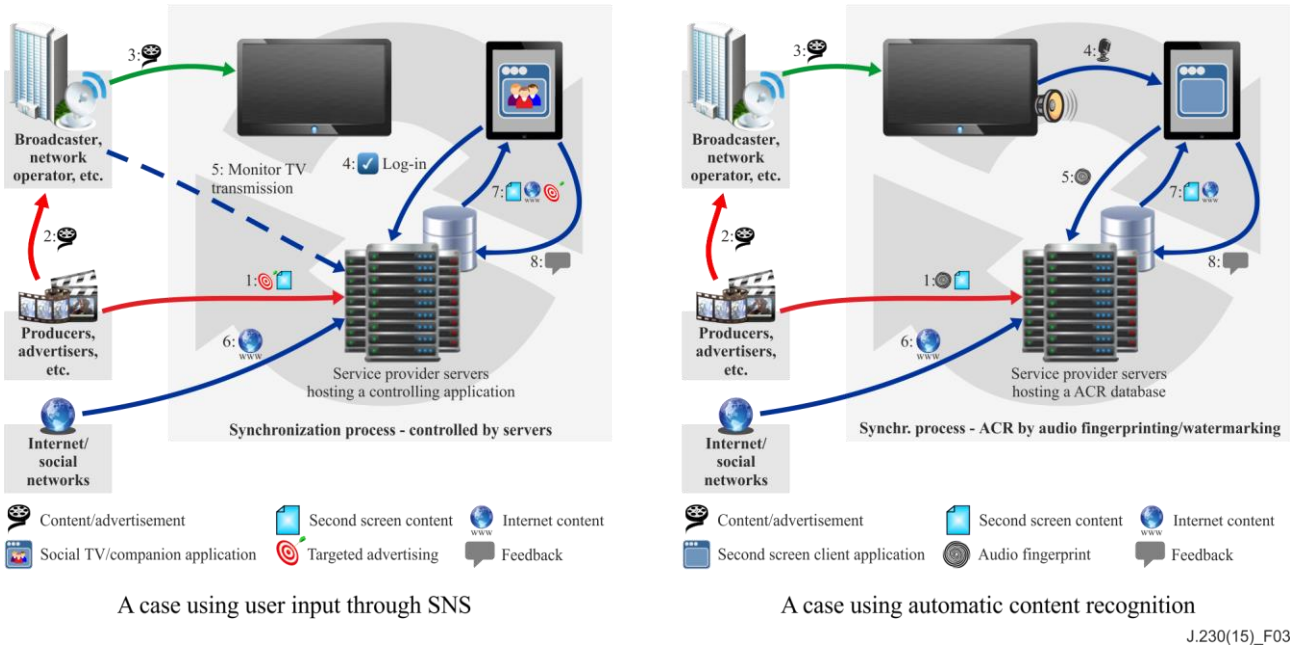

Figure 3 – Information interchange in server-based synchronization

(b) Synchronization control by an application on STB/TV

In contrast to the previous case, if explicit information in broadcast signals can be used to control synchronization, synchronization errors and instability are improved. In this approach, an application on STB/TV that is provided by a broadcaster/operator can work as a synchronization agent. That is,

the application identifies and recognizes an indication in broadcast signals and takes appropriate actions to control applications on a second screen device. Figure 4 shows the interaction of elements of a system in this case. Clauses II.4 and 6.3 describe how the system works in detail.

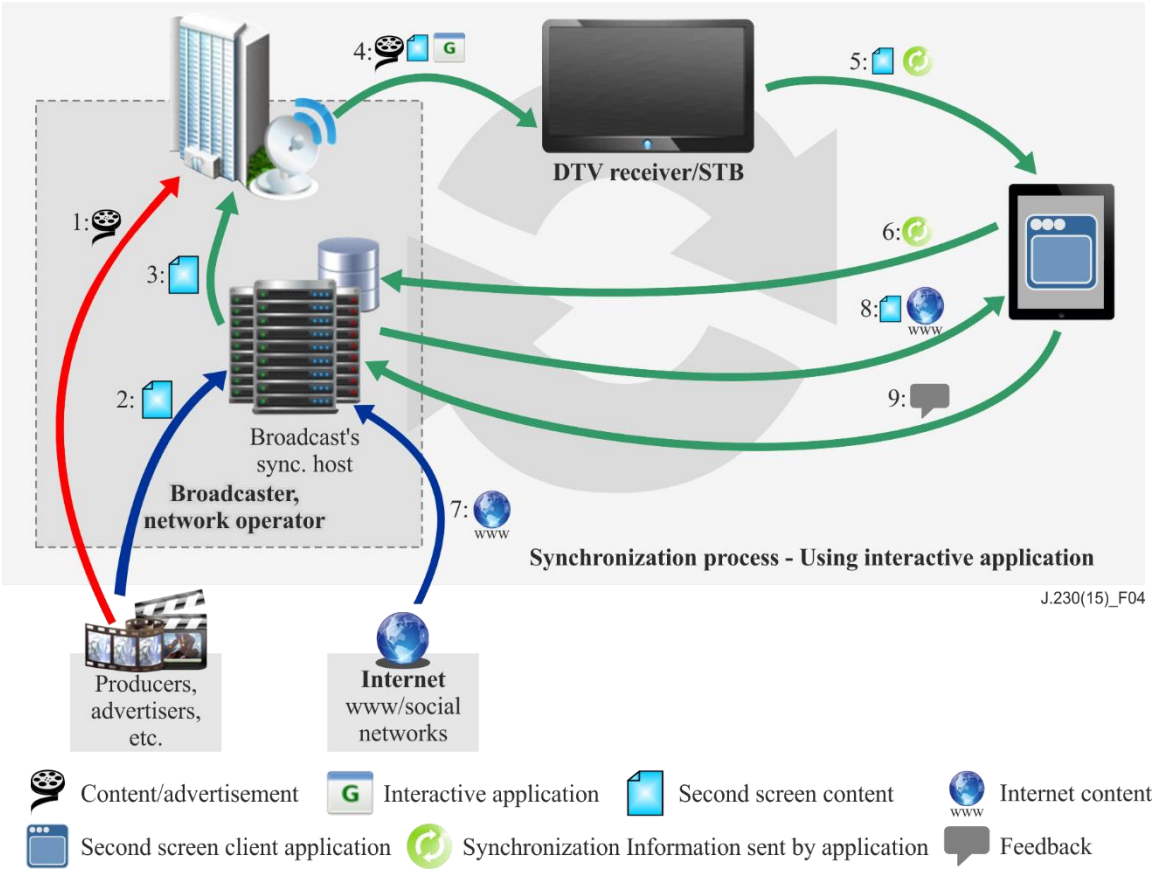

Figure 4 – Interaction of elements of a system using a "synchronization agent"

6.1.2 Scenario 2: Integration initiated by mobile devices

In this scenario, tablet and cable STB provide the cooperative resident applications and smart television experience is enhanced by the tablet. Figures 5 and 6 show examples of the relationship between the tablet and STBs in this scenario. In Figure 5, the tablet and STB are connected by the Wi-Fi home network and the tablet application receives electronic programme guide (EPG) information from the cable head-end through the Internet. By using "Remote controller application", "EPG application" or "Text input application" on the tablet, a user can send control commands to the STB. Also, the tablet can be used as the second screen device to watch the content as shown in Figure 6. In this case, the tablet application shows the information to choose content (either stored on the HDD drive of the STB or received in real-time). Then, when a user chooses any content, the tablet will play it by streaming from the STB. See Appendix I for more details.

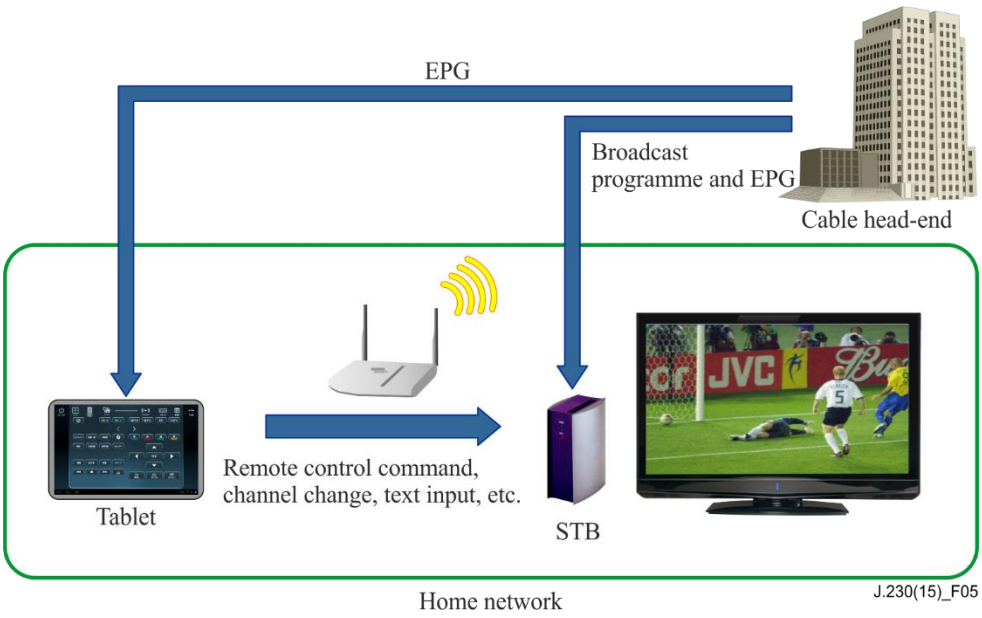

Figure 5 – Overview of tablet remote controller scenario

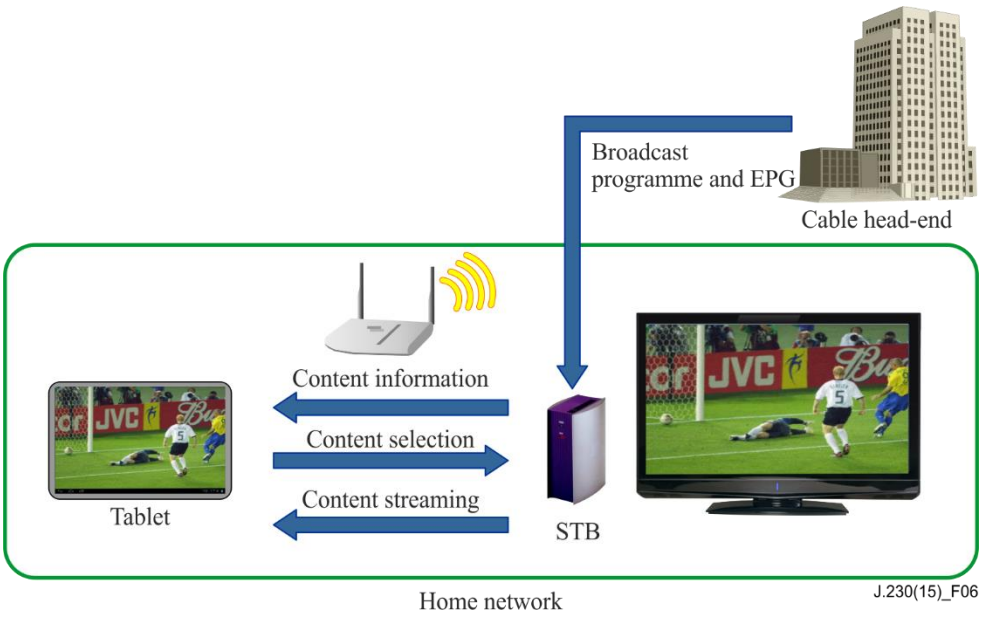

Figure 6 – Overview of second screen content watching

6.2 Elements that should be considered

6.2.1 Content

Basically, anything to be delivered to the user for consumption or interaction is considered to be content. Content can be classified as follows:

- **main content**: the content of the programme content delivered to the STB/TV receiver by the broadcaster or cable network operator;
- **second screen content**: any content (video, audio, text, scripts, web pages, services, etc.) intended to be presented on a second screen device. This kind of content can be classified according to its origin:
  - **broadcaster content**: provided by the same content provider as the main content or controlled by the broadcaster,

- **web content**: provided by a third-party service that searches the web for content (web pages, information, posts, etc.) related to the main content and aggregates and adapts it for presentation on a second screen device,
- **user-generated content**: also known as social TV content and services; it is generated by users and aggregated by a third-party service provider.

The broadcaster/operator can have full control of what is presented on the second screen device only in the case of broadcaster content. In the other cases, this control may be in the hands of third-party service providers or resident applications.

Second screen solutions usually focus only on one type of second screen content. In most cases, the solutions originate from the Internet and, for this reason, they are mainly focused on Internet content and user-generated content. They act as second screen content curators, bypassing the control of the broadcaster/operator.

Usually, content is the key part of the strategy that backs the business model for second screen solution providers.

6.2.2 Synchronization process

The process of synchronizing the main content with the secondary content rendered on the secondary screen device comprises of the following steps.

1. **Main content recognition**: the discovery of what is the main content being rendered on the main screen. This can use automatic mechanisms, called automatic content recognition (ACR), or manual mechanisms, such as requiring the user to indicate which TV programme or channel is currently being watched.
2. **Secondary content search and selection**: the finding and aggregation of the most relevant secondary content associated with the main content.
3. **Secondary content delivery**: the adaptation, delivery and rendering of the secondary content on the second screen device.

These steps can be accomplished in very different ways, according to the technologies adopted by the second screen solution.

The technologies chosen usually have a direct impact on the user experience and on the ease of getting the content synchronized.

6.2.3 Interaction

Once the synchronization is completed and the secondary content is rendered on the secondary screen, the user can navigate to it or make use of the services and the additional features provided.

This is usually a personal experience that exclusively occurs on the second screen device. As such, it is possible that each one of several users sharing the same TV set will follow completely different interaction paths on their separate second screen devices at the same time.

Examples of interaction include browsing web pages, playing back video or audio streams, and reading/posting feeds or messages from/to blogs, microblogs, social networks, forums.

6.2.4 User feedback

Conceptually, this is the positive acknowledgment that the user is watching a certain programme. Additionally, richer feedback can be obtained from more complex user interaction, like comments and polls.

Another important aspect of the feedback is the possibility of immediate user engagement related to advertising.

Usually, this feedback from the user occurs implicitly with the user interaction.

6.3 Communication between applications on the devices

Conceptually, the STB/TV receiver is the device which consumes content and the broadcast network's boundary for delivering content. This may not be true in the case of DTV systems that enable the execution of interactive content (or applications) in the STB/TV receiver and provide:

– a rich set of APIs for general network and Internet access;

– a set of APIs for accessing the files in the DSMCC data/object carousel; and

– optionally, a set of APIs for filtering MPEG2 private data sections.

NOTE – Sets of APIs for interactive content mentioned above are available in implementations of [b-ITU-T J.202]. Details and behavioural examples are described in Appendix II.

In these cases, a broadcaster can send, multiplexed with its main content, an interactive application, capable of communicating with other devices connected to the same home network to which the STB/TV receiver is connected. Given this, such an application can act as a broadcaster-/operator-controlled synchronization agent that sends synchronization information and secondary screen content to secondary screen devices.

The synchronization agent can indicate that the secondary screen content is to be retrieved from a broadcaster-/operator-controlled synchronization host. This synchronization host can then deliver broadcaster-/operator-aggregated content to secondary screen devices.

Finally, valuable information, such as audience feedback, can be directly collected by the broadcaster/operator.

Figure 4 also indicates the steps in the process that are under broadcaster/operator control. The process comprises the following steps.

1) Content producers/advertisers provide the main content/advertisement to the broadcaster.

2) Content producers/advertisers provide second screen content to the broadcaster synchronization host.

3) Some second screen content may be delivered multiplexed into the main content (such as live video or real time information).

4) The broadcaster airs the main content/advertisement, including an application that acts as a synchronization agent. Additionally, some second screen content may also be broadcast multiplexed with the main content (by using a DSMCC object/data carousel or MPEG-2 private data sections).

5) The TV receiver executes the synchronization agent. The synchronization agent sends the information required for the synchronization process described in clause 6.2.2 and the second screen content multiplexed with the main content to the device through the HAN.

6) The second screen client application sends the synchronization information to the synchronization host of the broadcaster/operator, which matches the synchronization information in its database, and:

   a) may look for related content on the Internet, social networks, etc. and adapt it to be presented in the second screen;

   b) sends the related content/advertisement or adapted Internet content to be rendered on the second screen.

7) From the user interaction perspective, the broadcaster/operator (synchronization host) collects the user's feedback.

6.4 Scenario 2: Communications across resident applications in the devices

In some cases, cooperative operation across the devices by resident applications is effective. These applications can be invoked at any time under the instruction of users. Figure 7 shows what

components communicate in the devices. In Figure 7, "Device discovery and communication function" is the general function to realize communication including audio and video across multimedia devices. DLNA is the typical scheme used for this function. By utilizing the combination of "Common agent service" and "Device discovery and communication function", various services will be realized as shown in Appendix I.

In Figure 7, case (a), when any application on the tablet requests communication with the STB, the application uses the software component named "Common agent service for Tablet". Then the common agent service transmits the communication signal to the STB. Based on its request, "Common agent service for STB" invokes the required STB function (e.g., channel change) or runs any application. Note that there are several ways for the implementation of "Common agent service". As shown in Figure 7, case (b), it is also possible to implement it on the application layer. This Recommendation does not limit the implementation method itself.

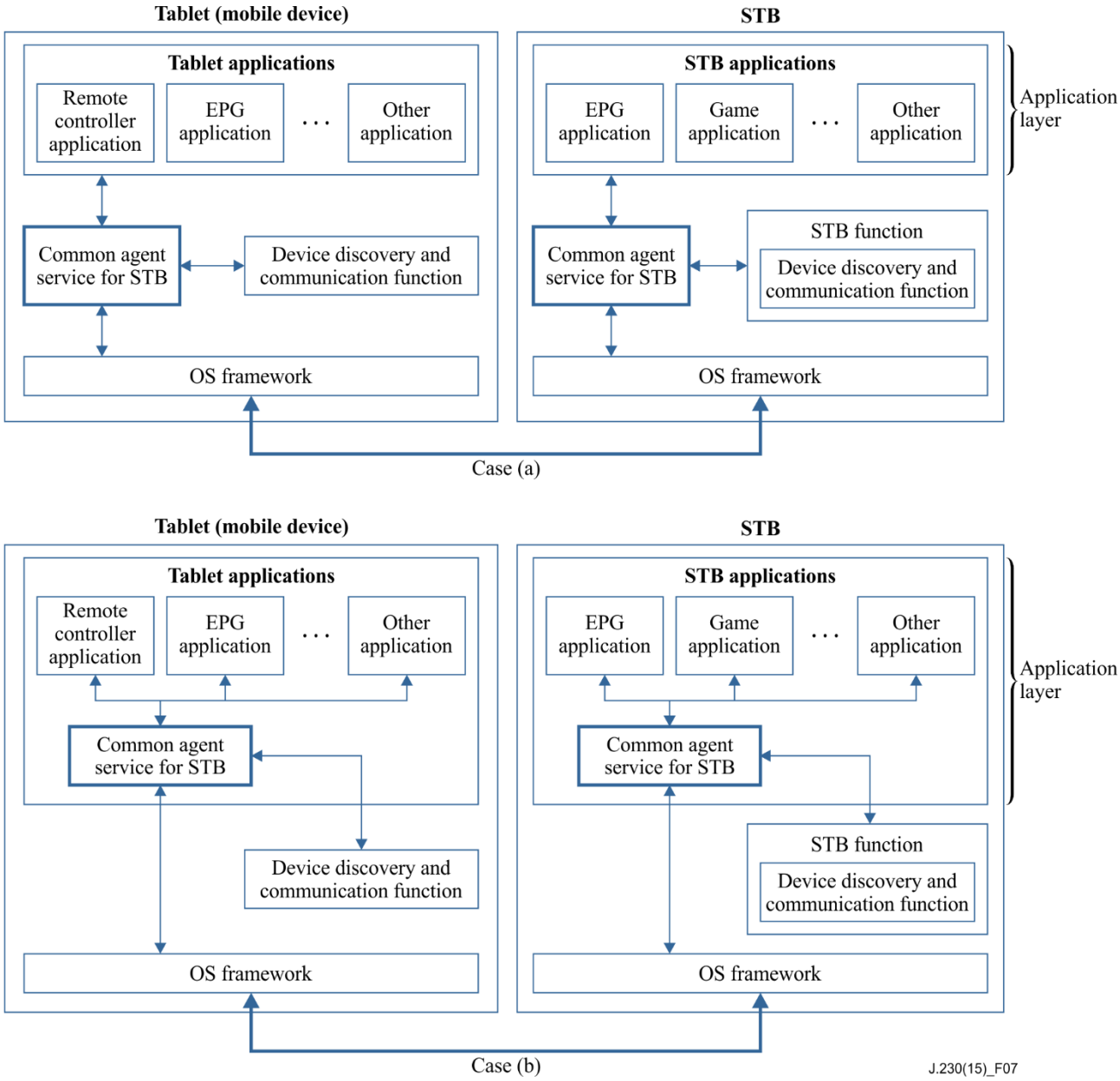

Figure 7 – Functional block diagram for multi-device cooperative service experiences

7 Requirements

7.1 General requirements

a) Communication between the devices should be reliable and stable.

b) A user's action for pairing should be minimum.

c) The system shall be capable of re-establishing communication between the devices when they lose communication with each other.

d) The system shall support multiple types of second screen devices, e.g., various resolutions and screen formats, as much as possible.

7.2 Required functions for integration initiated by broadcast services on STB or TV set

a) The system should provide broadcasters/operators with a communication path to companion devices so that they can:

   i) have control over what secondary content associated to their main content is delivered to companion devices;

   ii) deliver secondary content to companion devices, including data, uniform resource locator (URL) links, images, text, scripts, audio, video and captions;

   iii) precisely synchronize the display of secondary content on companion devices with the main content.

b) The system should allow the broadcast signal to be used as a communication path to the devices whenever possible.

c) The system must be based on sufficiently widespread open standard technology that can effectively reach a mass audience, independently of the solution provider or the manufacturers of the TV receiver and devices, in order to avoid fragmentation.

d) The system should allow broadcasters/operators to push secondary content to companion devices.

e) Whenever it is possible, the system must grant that the user experience, secondary content delivery and synchronization between the main content and companion devices are not dependent on the quality and available bandwidth of the user's Internet connection.

f) The system should be scalable and robust in order to allow handling of massive concurrent usage during very popular events.

g) The system should be able to seamlessly work with live or recorded events.

h) The system should allow the mirroring of the display of the main content on companion devices.

7.3 Required functions for integration initiated by mobile devices

To realize the application cases described in clause 6.1.2 and Appendix I, the following functions are required to the common agent service:

Terminal discovery and STB power/status management

a) Common agent service of mobile device is required to have terminal discovery capability to discover/connect to STBs which have mobile–STB cooperation capability.

b) Common agent service of mobile device is required to have a capability to check the power on/off status of the STB.

c) Common agent service is required to have a capability to check whether the targeted STB(s) is/are ready to process the command initiated by the mobile device to avoid resource conflict.

d) Common agent service is required to have a capability to establish and maintain sessions between mobile device(s) and STB(s) to transfer the control signals.

System information

e) Common agent service is required to have a capability to acquire the service provider (e.g., cable operator) information or location information stored in the STB.

f) Common agent service is required to have a capability to acquire the terminal identification (e.g., ID of conditional access, MAC address, etc.) of the STB.

Programme guide and channel control

g) Common agent service is required to have a capability to acquire the channel information that the STB currently tunes to.

h) Common agent service is recommended to have a capability to acquire the programme guide information of the permitted channels obtained by the STB.

i) Common agent service is required to have a capability to change the channel of the STB.

Input emulation

j) Common agent service is required to have a capability to handle input signals equivalent to hardware input devices, such as remote controller, mouse and keyboard.

k) Common agent service is required to have a capability to handle text inputs on the STB sent from the mobile device.

Management of schedule recording

l) Common agent service is recommended to have a capability to acquire the list of schedule recording of the STB.

m) Common agent service is recommended to have a management capability for schedule recording of the STB such as adding/modifying/removing the scheduled event.

Application control

n) Common agent service is required to have a capability to launch and control specific STB applications which have STB–mobile cooperation capability.

NOTE – Figure I.4 is a relevant application case of this requirement.

Content push from the mobile device to the STB

o) Common agent service is required to have a capability of synchronized presentation of content on the STB with the user's operation on the mobile device.

Security

p) Common agent service is required to provide a security mechanism to prevent the abuse of its functions by inappropriate applications.

7.4 Required functions for the use of the network outside the home network

To realize the "Remote recording" described in Appendix I, the following functions are required.

a) The system shall support secure communication between an STB and management server(s).

b) The system shall support secure communication between management server(s) and mobile device(s).

c) The system shall provide content protection mechanism that complies with each regional regulation or requirements from stakeholders.

d) The management server shall handle the pairing between STB and mobile devices.

Appendix I

Application cases and possible technologies

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

Application case 1: Pairing and session management

In response to the request of a tablet application, the common agent service of the tablet establishes the transmission control protocol (TCP) session with the STB. Then, the common agent service of tablet sends the control command through the session. The session establishment between tablet and STB will be executed as follows.

(1) When a user runs any tablet application to operate the STB, the common agent service of the tablet checks whether a current session exists.

(2-a) If a TCP session is already established with STB, the common agent service informs so to the application.

(2-b) Conversely, if there is no session between the tablet and the STB, the common agent service of the tablet executes the discovery of the STB in the home network, e.g., by using a multicast domain name system (mDNS) protocol. When the tablet finds the STB that was connected to the tablet the last time, the tablet automatically establishes the TCP session. If the tablet finds a new STB, the common agent service of the tablet displays a dialogue box asking users whether they wish to connect to it.

Application case 2: Tablet remote controller

When a tablet is used as the input device for the STB, various input methods can be considered. Some examples are given in the following.

(a) Button input emulation: By displaying the software buttons of the conventional remote controller, the user can use the tablet as the alternative to such a controller (see Figure I.1, left).

(b) Touch pad input emulation: In this application case, the STB displays the mouse cursor on the TV screen. Then, by transmitting the input position information ("Touch event") and input vector information ("MouseEvent") of the tablet to the STB, the touch pad input emulation is realized (see Figure I.1, right).

(c) Keyboard input emulation: When the user inputs any text to the STB (e.g., password or search query), the user can use the text input function of the tablet (see Figure I.2). The text input is transferred from the tablet to STB. To avoid the risk of hacking/leak of privacy information, it is preferable to encrypt the text information during the transmission.

Figure I.1 – Image of tablet remote controller (left: remote controller button emulation, right: mouse emulation)

Figure I.2 – Tablet remote controller (Text input)

Application case 3: Social media assisted TV watching

Figure I.3 depicts an application case titled "Social media-assisted TV watching", in which a mobile device sends a control signal to the STB and the STB sends channel information about the programme for viewing to the mobile device. In consequence, the STB and mobile device work cooperatively in real-time, and value-added information is provided to the mobile device.

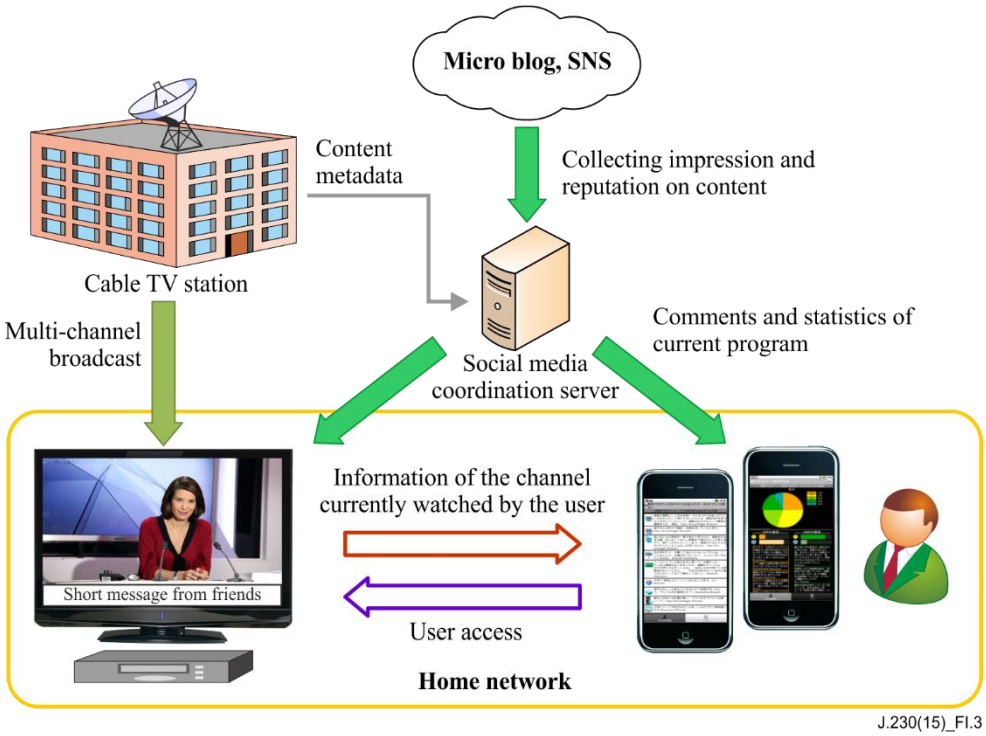

Figure I.3 – Social media-assisted TV watching

In contrast, the ITU-T Focus Group SmartCable TV meeting held in December 2012, discussed other cooperative services between the STB and tablet (see http://www.itu.int/en/ITU-T/focusgroups/smartcable). As an example, the gaming service is explained as shown in Figure I.4.

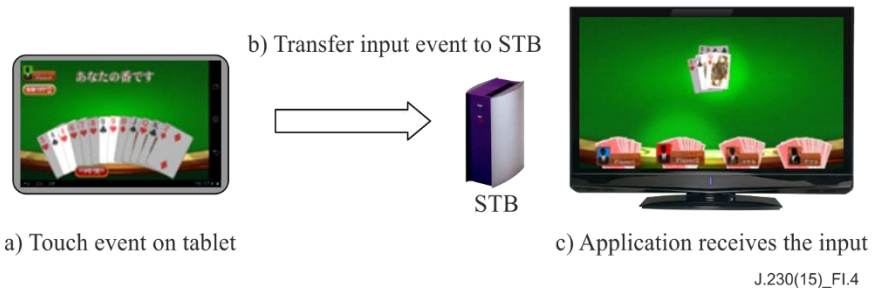

Figure I.4 – STB–tablet cooperative gaming service

Also, the following application case can be realized with a tablet and an ITU-T J.296 compliant STB:

(1) using the tablet as the remote control of the STB;

(2) EPG and programme search running on the tablet.

Application case 4: Remote recording

Figure I.5 shows an example of a remote recording application case, in which STB users can run the "Remote recording application" on their smartphones. The application shows a programme guide and a list of existing scheduled recording. Then, if users want to add a new scheduled recording or maintain any existing scheduled recording, they can input it from the smart phone and it will be transmitted to the STB via a management server. The transmitted requests are processed by a built-in function of the STB.

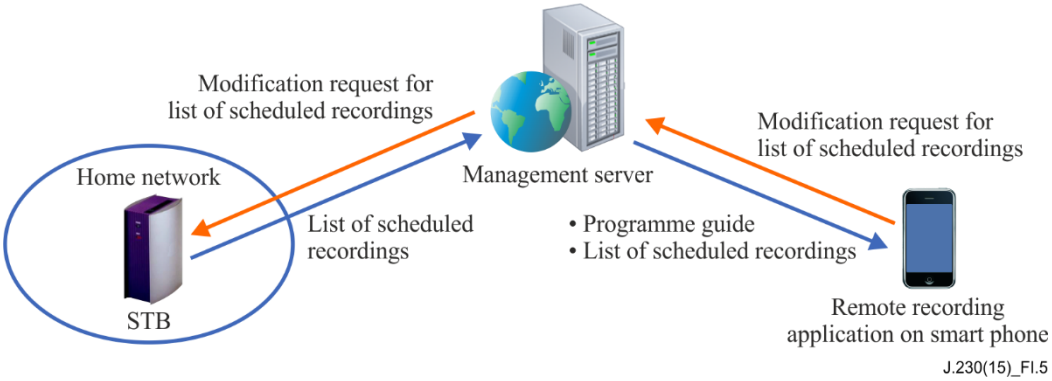

Figure I.5 – Remote recording from mobile devices

Application case 5: Remote TV watching

Figure I.6 shows the example of a remote TV-watching application case. From the standpoint of conditional access, it is necessary to tie the user's mobile devices to the STB prior to use. When users run the remote TV-watching application, they can get the list of stored content and live TV programmes that are provided by built-in functions/applications of the STB. Then, if users select any content or programme from the list, the STB streams it via the Internet with content protection. To provide this function, the broadcaster's permission is required. Therefore, the system should provide the "inhibit list" function, which provides information on broadcasters who permit/decline remote TV watching. The remote TV-watching application should refer to this information and only provide functionality for the permitted channels/contents.

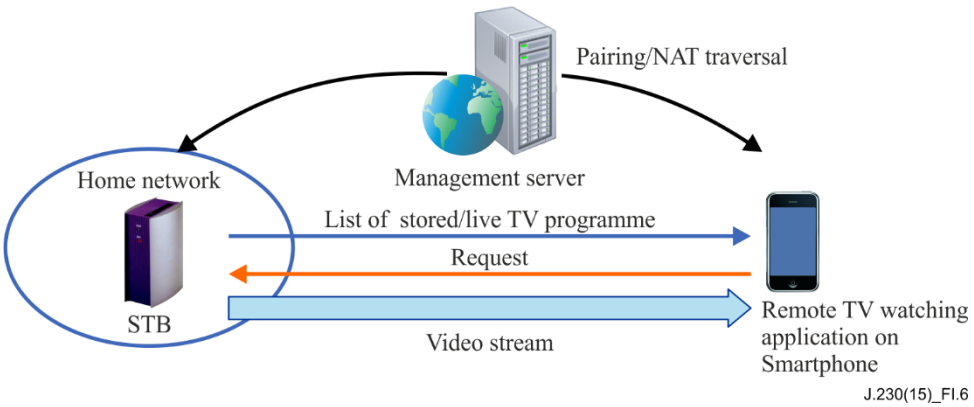

Figure I.6 – Remote TV watching

Application cases 1 to 5 above are intended as typical examples of STB-tablet cooperation and there are many other additional possibilities.

Appendix II

Technologies currently used for second screen services

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

II.1 Automatic content recognition based on main content

Solutions based on this strategy capture the part of the main content that is being rendered on the TV receiver and try to extract a pattern that can be matched in a database in order to retrieve the associated secondary content.

Most commonly used technologies uses the main content's audio in order to compute a fingerprint or to extract a watermark (a subliminal signal that has been previously imprinted in the audio by the content provider or the broadcaster). This is preferred over using the main content video to include synchronization signalling, such as QR codes or printing some numeric code in the screen, because these mechanisms can be highly intrusive. Figure II.1 depicts this process.

II.1.1 Process description

(1) Content producers/advertisers provide the audio fingerprint/watermark and second screen content to the ACR service provider.

(2) Content producers/advertisers provide the content/advertisement to the broadcaster.

(3) The broadcaster airs the content/advertisement.

(4) The second screen client application captures the audio from the TV and computes its fingerprint (or extracts the watermark).

(5) The second screen client application sends the fingerprint to the ACR service provider. The ACR service provider matches the fingerprint in its database and:

   a) the ACR service provider may look for related content on the Internet, social networks, etc. and adapts it to be presented in the second screen;

   b) the service provider sends the related content/advertisement or adapted Internet content to be rendered on the second screen.

(6) From the user interaction, the ACR service provider collects user's feedback.

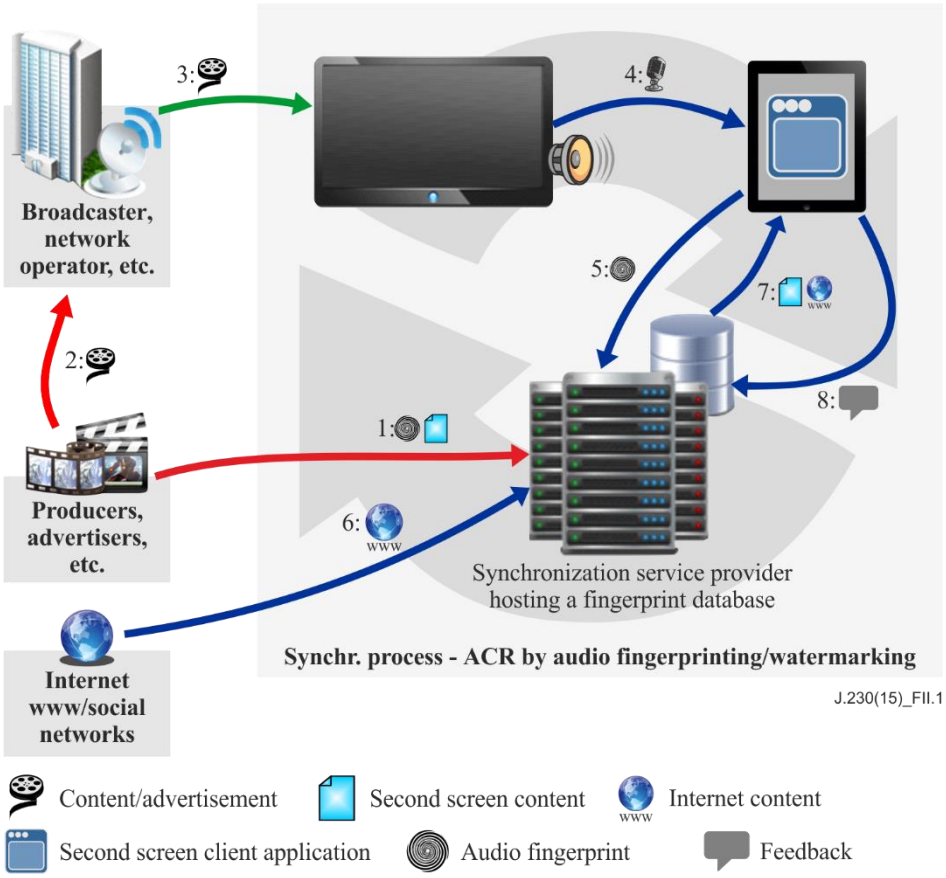

Figure II.1 – Synchronization process using ACR based on audio fingerprinting/watermarking

II.1.2 Major advantages

- This technology is relatively simple to use, allowing the user to get synced with very few simple steps.
- Works with recorded (on-demand) media and time-shifted content.
- Is already widely used by music searching and recognizing applications in several devices.

II.1.3 Major disadvantages

- Broadcasters, content providers or advertisers do not have direct access to the users' second screen devices. They all rely on the ACR service provider (the green arrow in Figure II.1 represents the broadcaster participation in this workflow scenario).
- ACR technologies based on audio are not yet mature enough. They usually require a silent environment and failures to recognize the fingerprint/watermark are very common. Additionally, they require the user to pause for some seconds to capture the audio in order to start the synchronization process. For this reason, the interface has to instruct the user on the use of such technologies.
- It is very hard to get audio-based solutions to work for live events.
- Even if content recognition using these technologies is to be considered ACR, they actually require a user's action to start the synchronization process.
- The audience feedback goes somewhere else, not to the broadcaster.

II.2 Manual content recognition process using social TV or TV companion applications

In this model, users login into a server (social TV service provider) and provide information such as where they are located, cable network operator, channel currently tuned and TV show being watched.

According to this information, second screen content is pushed into users' devices from the social TV service provider. Eventually, the social TV service provider may monitor the broadcaster transmission using some server side ACR method, in order to push "synchronized" content to their users.

This kind of solution explores the "social aspect" of their users' behaviour, assuming their desire to share their opinions and comments about the show with other users in their social network. Figure II.2 depicts this process.

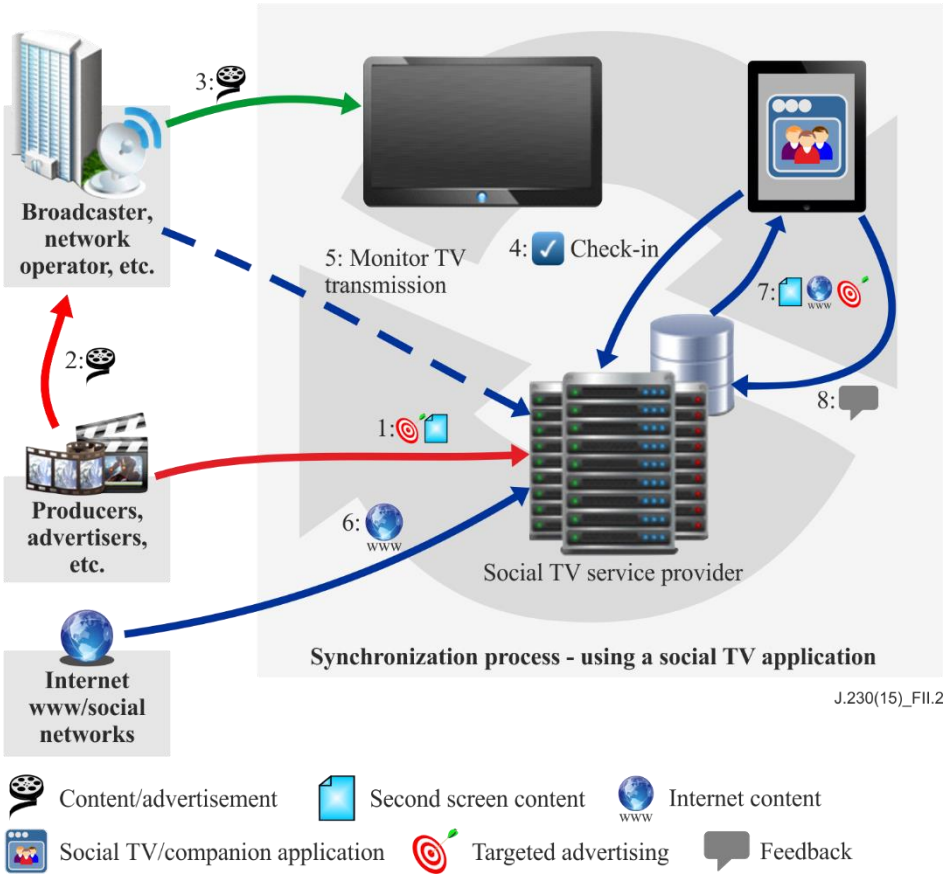

Figure II.2 – Synchronization process using a social TV/TV companion application

II.2.1 Process description

1. Content producers/advertisers provide the second screen content to the social TV service provider.
2. Content producers/advertisers provide the content/advertisement to the broadcaster.
3. The broadcaster airs the content/advertisement.
4. Users check in to the social TV service provider network (usually indicating what channel/programme they are watching).
5. The social TV service provider monitors the TV transmissions (it may use any server-side ACR mechanisms) for events to trigger the "push" delivery of associated second screen content when the social TV service provider detects in the TV transmission any content that has associated second screen content:
   a) the social TV service provider may look for related content on the Internet, social networks, etc. and adapt them to be presented on the second screen; and
   b) it pushes the related content/advertisement or adapted Internet content to be rendered on the second screen.
6. From the user interaction perspective, the social TV service provider collects user's feedback.

II.2.2 Major disadvantages of this approach

- Requires the user to login to a service and identify what TV show is being watched in order for the synchronization to occur. This is neither natural nor automatic and it is not completely reliable as it depends on updates from the user. It strongly depends on the application's "social" appeal to encourage users to keep their status updated.
- Broadcasters/operators, content providers or advertisers do not have direct access to the users' second screen devices. They all rely on the social TV service provider (the green arrow in Figure II.2 represents the broadcaster participation in this workflow scenario).
- Audience feedback goes somewhere else, not to the broadcaster.
- Does not work with recorded media (on-demand) and time-shifted content.

II.3 Unsolved questions on current second screen solutions

A summary of the problems in the solutions presented follows.

- Even if the main objective of second screen solutions is to enhance the user experience for consuming TV content, the major actors, such as broadcasters/operators, do not have direct control of the second screen content, and they can be completely bypassed. Lack of control may lead to missing new business opportunities or reducing advertisement effectiveness.
- Fragmented market: there are many solutions available and *none is standardized*: it is practically impossible to support syncing for each one of the solutions in the market at a low cost. Broadcasters/operators, content providers and advertisers will usually choose one, neglecting support for the others. This situation leads to the following problems.
  - User confusion: which application to use to receive the second screen content from the programme the user is currently watching?
  - Variations on user experience: given that for a certain programme multiple solutions are supported, how to provide a uniform user experience with the same content/services available across all of them?

All these conditions are unfavourable to building business opportunities based on mass delivery of second screen content.

II.4 A second screen solution based on an open standard based on [b-ITU-T J.202] (such as Ginga)

The following technical strategy can be used in order to address the main shortcomings of the solutions mentioned in clause II.3.

- Provide broadcasters/operators a direct communication to the second screen devices so they can have control over what secondary content is associated with their main content and delivered to the second screen devices.
- Base the solution on a widespread enough standard technology that can effectively reach a mass audience, independently of the solution provider or the manufacturers of the TV receiver and devices, in order to avoid fragmentation.
- Should not present drawbacks compared to the current solutions:
  - synchronization must be reliable, natural and should *not* require a user's action (the technology becomes transparent to the user);
  - pushing content to the second screen device enhances the facility of the solution.
- In some applications, delivery of second screen content multiplexed in the broadcast transport stream:
  - enables reliability of second screen content and the whole user experience to become not dependent on the quality and available bandwidth of the user's Internet connection;

– does not require additional investment on network infrastructure or content delivery network. This is especially relevant when broadcasting very popular events.

Clauses II.4.1 to II.4.4 describe how a solution meeting the above requirements can be built taking advantage of a standardized DTV middleware like Ginga.

II.4.1 Using a Ginga application as a synchronization agent

Conceptually, the STB/TV receiver is the broadcast network's boundary for delivering content. This may not be true in the case of DTV systems, like the ones based on [b-ITU-T J.202], including Ginga, that enable the execution of interactive content (or applications) in the STB/TV receiver and provide:

- a rich set of APIs for general network and Internet access;
- a set of APIs for accessing the files in the DSMCC data/object carousel; and
- optionally, a set of APIs for filtering MPEG2 private data sections.

In these cases, a broadcaster can send, multiplexed with its main content, an interactive application, capable of communicating with other devices connected to the same HAN to which the STB/ TV receiver is connected. Given this, such an application can act as a broadcaster-/operator-controlled synchronization agent that sends synchronization information and secondary screen content to secondary screen devices.

The synchronization agent can indicate that the secondary screen content is to be retrieved from a synchronization host controlled by the broadcaster/operator. This synchronization host can then deliver broadcaster-/operator-aggregated content to secondary screen devices.

Finally, valuable information such as audience feedback can be directly collected by the broadcaster/operator.

The green arrows in Figure II.3 indicate the steps in the process that are under broadcaster/operator control.

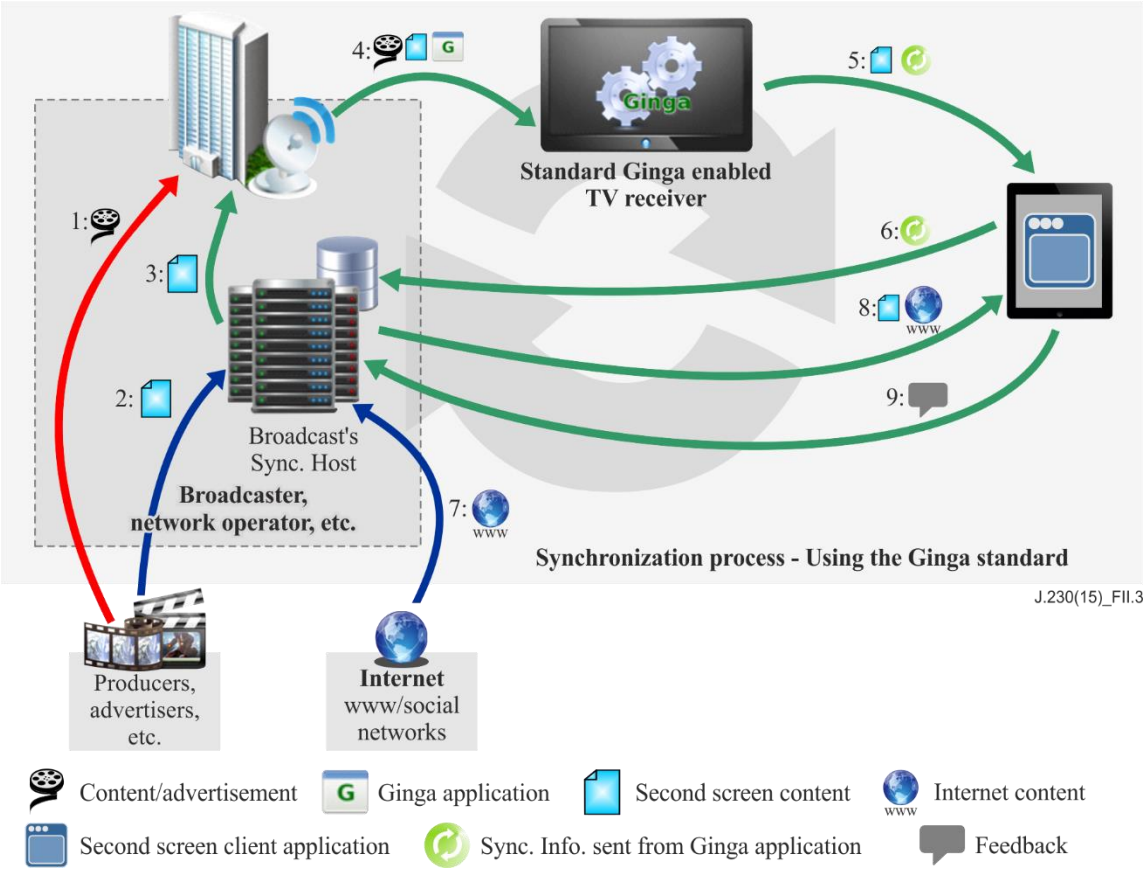

Figure II.3 – Synchronization process using a Ginga application

II.4.2 Process description

1. Content producers/advertisers provide the main content/advertisement to the broadcaster.
2. Content producers/advertisers provide second screen content to the broadcaster synchronization host.
3. Some second screen content may be delivered multiplexed into the main content (such as live video or real time information).
4. The broadcaster airs the main content/advertisement, including a Ginga application that acts as a synchronization agent. Additionally, some second screen content may also be broadcast multiplexed with the main content (using a DSMCC object carousel or MPEG2 private data sections).
5. The Ginga-enabled TV receiver executes the synchronization agent. The synchronization agent sends the synchronization information and the second screen content multiplexed with the main content to the device through the HAN.
6. The second screen client application sends the synchronization information to the synchronization host of the broadcaster/operator, which matches the synchronization information in its database, and:
   a) may look for related content on the Internet, social networks, etc. and adapt it to be presented in the second screen;
   b) sends the related content/advertisement or adapted Internet content to be rendered on the second screen.
7. From the user interaction perspective, the broadcaster/operator (synchronization host) collects the user's feedback.

II.4.3 Architectural details of the synchronization agent

The synchronization agent uses the API provided by the Ginga middleware specification:

- to announce to the second screen devices:
  - the information of the main content that is currently broadcast, and
  - the availability of second screen content;
- to serve to the second screen devices the second screen content that may be broadcast multiplexed:
  - in the object carousel, or
  - as MPEG2 private data sections.

As depicted in Figure II.4, the Ginga synchronization agent internal architecture is divided into two components.

- **Announcer**: this component is responsible for broadcasting on to the HAN messages (IP datagrams) at regular time intervals. All the devices in the HAN interested in second screen information, including all the connected second screen devices, receive those messages. Basically, there are two types of messages:
  - **main content information messages**: providing values retrieved using the service information API provided by Ginga;
  - **second screen content messages**: providing URL links to content a) present in the synchronization host of the broadcaster/operator; b) in the object carousel, accessible through the file server component (see next entry); or c) identifying a stream of data delivered as MPEG2 private data sections.
- **File server**: this component allows second screen devices to retrieve second screen content that may be included in the broadcast signal in the DSMCC object carousel.
- **Private data section forwarder**: this component uses the MPEG2 data section filter API available to the Ginga application to filter and retrieve MPEG2 private data sections that are multiplexed and delivered in the broadcaster's transport stream. Each retrieved MPEG2 private data section is forwarded to the second screen devices that have requested to receive such a content.

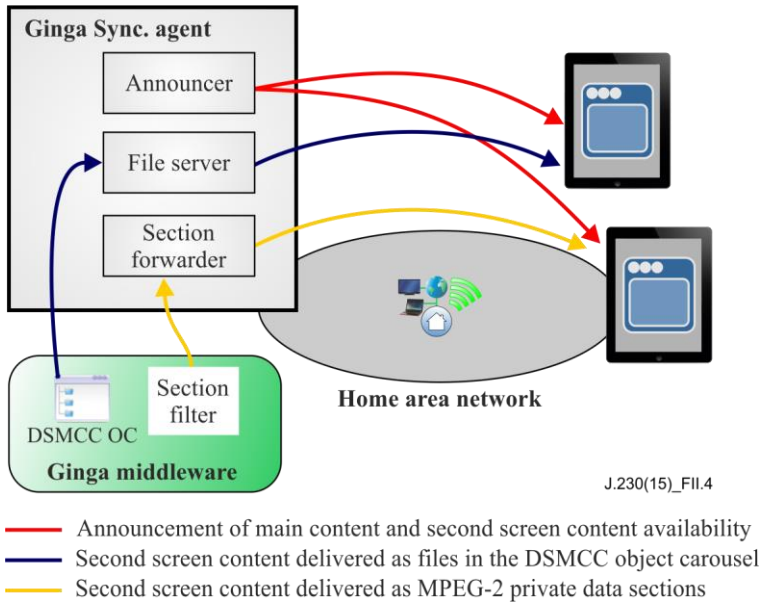

Figure II.4 – Internal architecture of the Ginga synchronization agent

The synchronization agent is not required to display any interactive content on the main screen. Usually, it can execute as a hidden/background application. So this solution can be used even when no interactive content is available for the main screen.

II.4.4 Advantages over other solutions

The solution discussed here has the following advantages:

- The broadcaster/operator has full control over the second screen content that is associated with its main content.
- It is independent from third-party service providers.
- It is based on an open standard, avoiding solution fragmentation. It will work in any STB/TV receiver that is in compliance with the Ginga standard.
- Synchronization is highly reliable and does not require any user action. Usability and synchronization experience is much richer and more natural.
- When using MPEG2 private data sections for delivering second screen content:
  - the synchronization delay between the main content and the display of secondary screen content on the user's device can be shorter than 1 s – this allows the delivery of alternate video, audio or data to second screen devices, in real time, even when broadcasting live events;
  - is not required for the user to have access to the Internet to receive second screen content;
  - the delivery is as reliable as the delivery of the main content – the user experience is not affected by the available bandwidth and quality of the user's Internet connection;
  - on the broadcaster's side, additional investment on network infrastructure or content delivery network is not required – this is especially relevant when broadcasting very popular events.
- Depending on the STB/TV receiver capabilities, it will work with time-shifted content.
- Audience feedback can be collected by the broadcaster/operator.

Bibliography

[b-ITU-T J.202] Recommendation ITU-T J.202 (2005), *Harmonization of procedural content formats for interactive TV applications*.

[b-ITU-T J.296] Recommendation ITU-T J.296 (2012), *Specifications for a hybrid cable set-top box*.

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