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This TD contains the draft of new Recommendation H.IPTV-TDES.5 "*IPTV Terminal Device: Interworking-enabled model of multiple devices*", as discussed at the Q13/16 meeting during IPTV-GSI, Geneva, 8-12 July 2013. This text is based on TD 60/WP2 (January 2013).

NOTE – Editorial adjustments were performed by TSB prior to publication of this TD. Inconsistencies were observed and noted, attention of editors and contributors is required.

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Draft new Recommendation H.IPTV-TDES.5

IPTV Terminal Device: Interworking-enabled model of multiple devices

AAP Summary

[To be added before Consent]

Summary

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1 Scope

This Recommendation describes and specifies the functionalities of support interworking capabilities among the IPTV terminal devices. . The expected types of terminal devices are H.721, as well as full-fledged terminal device and mobile terminal device, which are defined in [ITU-T H.722], [ITU-T H.IPTV-TDES.4].

[Editor Note: The scope is going to be modified as the discussion on IPTV-GSI 14,Feb,2012 Geneva.]

2 References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Supplement. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Supplement are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.720] ITU-T Recommendation H.720 (2008), *Overview of IPTV Terminal Devices and End Systems*.

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

[ITU-T H.722] ITU-T Recommendation H.722, *IPTV terminal device: Full-fledged model*.

[ITU-T H.IPTV-TDES.4] ITU-T draft Recommendation H.IPTV-TDES.4, *IPTV terminal device: mobile model*.

[ITU-T Y.Sup5] ITU-T Y.1900-series, *Supplement on IPTV service use case*.

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

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

[IEC 62481-1 2010-11] *Digital living network alliance (DLNA) home networked device interoperability guidelines*.

[ISO/IEC 29341:2011] *Information technology – UPnP Device Architecture*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

TBD

3.2 Terms defined within this Recommendation

This Recommendation defines the following terms:

3.2.1 Multi-device service: an IPTV service for which all related IPTV functions are distributed among two or more devices.

NOTE - The word “Multi-screen” is used synonymously with “Multi-device” in this document.

3.2.2 Multi-device Interworking: inter-connected and interactive information is able to be exchanged between or among multiple terminal devices.

3.2.3 Multi-device application: is a kind of interworking enabled application which could add multi-device service feature into IPTV service.

3.2.4 Multi-device enabler: is a set of functional components which provides capabilities for device interworking.

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4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

TBD TBD

5 Conventions

In this Recommendation:

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

– The keywords “is prohibited from” indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

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

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

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

6 Overview

Basically, IPTV service provider provides the end-to-end solution to distribute content to users by their terminals. In modern society, more and more people are intending to carry several TDs with them at the same time, such as laptop, tablet, and mobile phone. IPTV service could also be provided on those terminals besides the conventional STB. Each terminal device has its nature advantage to give customers to enjoy their life with different life style. For example, STB+TV give people more conventional watching experience. Mobile phone and tablet give people flexibility of watching TV in anywhere by taking advantage of their mobility. PC may give the more computing power and precisely control capability by using mouse and keyboard.

Therefore, more and more people wish to enjoy the multimedia service more convenient and comfortable, by using any terminal device independently or collaboratively.

Y.1910 has defined the entire IPTV functional architecture and H.720 series defines the terminal device functions which have already given the basic hardware and software specification to support IPTV service can be consumed over multiple terminal devices. To support multi-device service features in some scenarios, such as streaming pushing, remote control for any type of terminal device, the communication between/among terminal device should be defined.

The relationship between this Recommendation and other IPTV terminal device Recommendations is shown in Figure 1.

Based on the general ITU-T's H.720 series terminal functional architecture, the domain for interworking model form Terminal devices is shown in Figure 2.

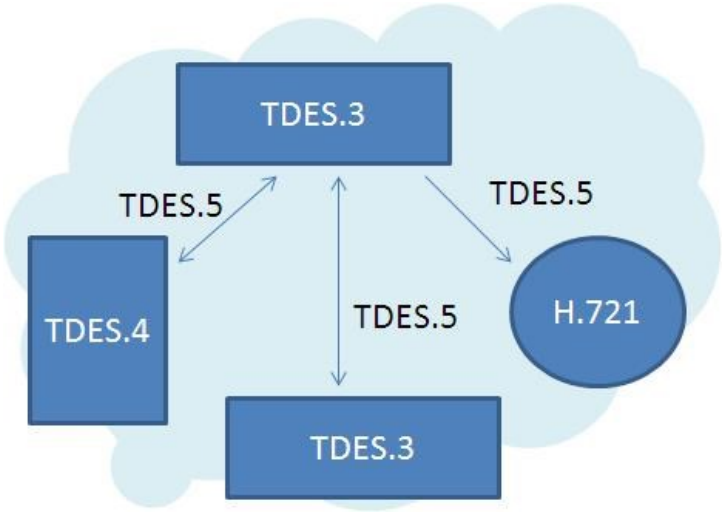

Figure 1: The relationship between TDES.5 and other TDES Recommendations

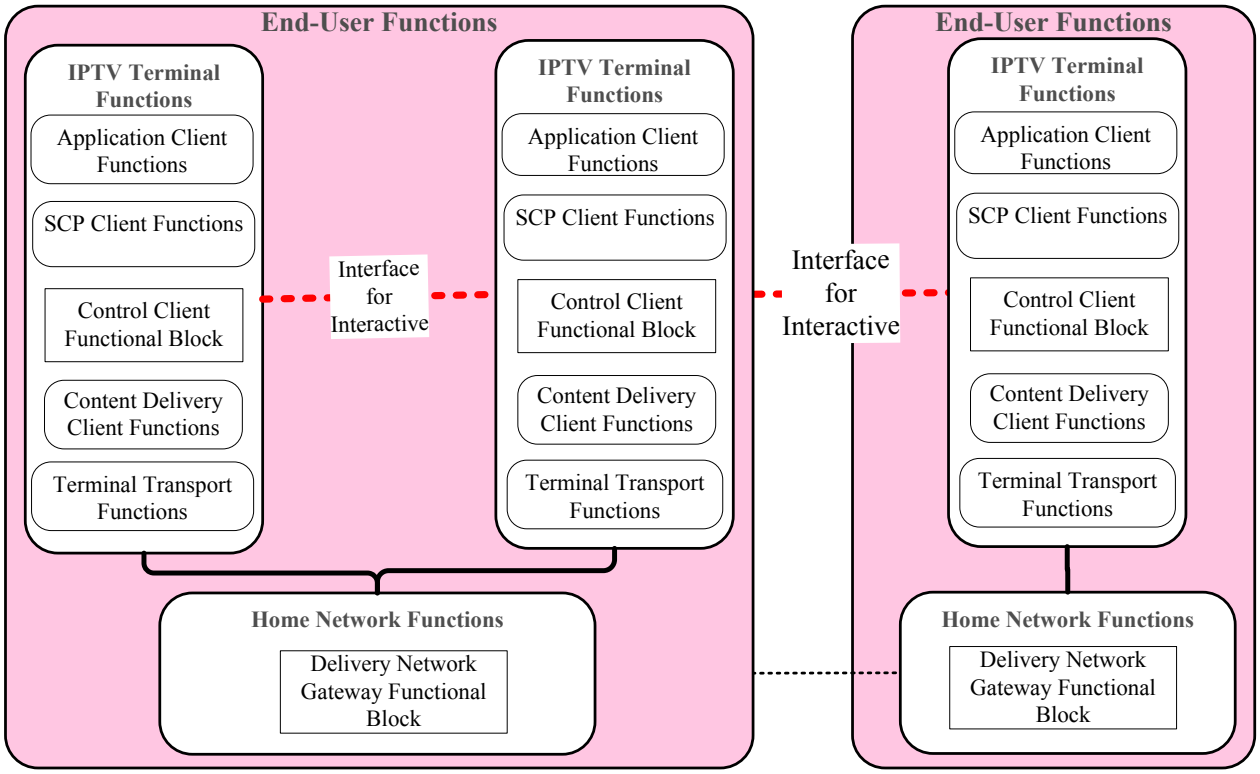

Figure 2: High-level overview for interworking between terminal devices

There are three possible environments for support interactive for terminal devices:

– All terminals are connected directly, especially for two devices direct connection

– All terminals are connected together within a home network

– All terminals are connected together via different home network or transport network

With the support of connection environment, the main functions for implement multi-device service interaction are showed as follows:

– Terminal device connection establishment

– Terminal device discovery and selection

– Authentication

– Capability discovery

– Content resource discovery and selection

– Service interaction

The data connection is recommended to be IP-based and relayed on either fixed network connection or wireless or hybrid connection. Especially in device-to-device connection, the DLNA [IEC 62481 DLNA]/UPnP [ISO/IEC 29341] specifications are widely used to support the above scenarios.

7 Services and key features of interacting among IPTV terminal devices

7.1 IPTV service over multiple Terminal Devices

The services mentioned above are not only being able to be consumed on each independent terminal device, but also to be consumed collaboratively over multiple inter-connected terminal devices, such as a small network consists of multiple terminal devices. Those terminals can be connected

together with various access methods, e.g. Wi-Fi, Ethernet cable, Bluetooth, etc. commonly, they can be connected directly with each other or connected via a central service.

A full-fledged IPTV terminal device, which supports multi-device service features, is supposed to share the service over other terminal devices. For example, a media center in a home network environment. Any terminal device which can be connected together is able to be discovered and exchange information with each other. Therefore, any authorized TD can share or transfer the IPTV service with/into other TDs. In addition, one terminal device may handle the media pushing, transferring, and/or control requests from connected TDs, process requested services and then feedback the result.

To support the above features, a full-fledged IPTV terminal device should have the following capabilities:

– Provision of connection and authentication mechanism for other terminal devices such as mobile phone, PC,

– Provision of the capability for the various types of device to discover by each others.

– Provision of protocol for communication among multiple TDs aforementioned

– Provision of media information navigation over the connected TDs.

– Provision of media stream from/to another connected TD to play, an adaption mechanism is optionally used. Supporting mirror mode, content sharing mode and coordination mode stream transferring.

– Provision of remote control over the connected TDs, including legacy remote controller and remote EPG mode, mirror controller.

– ***Editor notes: Detailed service modes above mentioned refer to H.IPTV-MDS.***

– Provision of transferring file-based media between the local storage of connected TDs.

– Provision of authorization used for sending control instructions via full-fledged TD to control another TD, like play, fast forward, rewind etc.

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TBD

7.2 Feature of multiple Terminal Devices

7.2.1 Devices connection for interworking

The following modes are recommended to support Multi-device service:

– **Directly connection mode:** the source device can initiate a communication channel directly to another target device. E.g. Infrared, Bluetooth, Cable, wireless ad hoc, etc.

– **Indirectly connection mode:** the source device can initiate a communication channel indirectly to another target device. There are examples of Indirection connection mode:

  o **Bridge mode:** the source-target devices can exchange information by bridge device while the devices cannot be physically connected to each other, e.g. Both STB and tablets can connect to home gateway to exchange control message by using wire and wireless connection. In bridge mode, the exchanged information doesn't need to be modified and pass through the bridge device directly. Bridge mode is suitable with home networks. In this mode, terminal devices can connect through bridge device by using level-2 protocol.

- **Route mode:** Both source and target devices are connected to a routing-enabled device and exchanged information indirectly. E.g. STBs can register to a media server, the control message from source device can be multicast to group of target devices by media server. In route mode, the exchanged information can be optionally modified for interpreting. Route mode is suitable for both home and public networks. In this mode, terminal devices can connect through the network by using level-3 protocol.

Basically, device inter-connection in most home network situations should follow home network configurations. Therefore, any home network connection mechanism is out of scope in this recommendation. Instead, ITU-T's home network related Recommendation can be referenced.

[*Editor Note: Home network Recommendation could be put here as reference. (14, Feb, 2012 Geneva)*]

[*Editor Note: we need to add a note on device aware content. (14, Feb, 2012 Geneva)*]

[*Editor Note: The word "interpreting" should be replaced as a better word. (12, July, 2013 Geneva)*]

7.2.2 Terminal devices discovery and selection

Terminal device discovery is usually based on the network infrastructure which each terminal device locates on. And terminal device selection can be implemented by application with UI and also can be atomically implemented by relationship which pre-defined in User Profile. Terminal devices discovery and selection is the first step for the devices interoperation and interworking.

7.2.2.1 Terminal devices within home network

ITU-T Recommendation [H.622.1] has defined the architecture and functional requirement for home network to support IPTV service. Devices discovery and selection are based on specific device discovery protocol where devices are located within home network. For example, DLNAare based on UPnP [b-UPNP] and Wi-Fi Miracast is based on Wi-Fi Peer-to-Peer (P2P) [b-Miracast].

[NOTE: Add reference to new work item H.IPTV-TDD]

7.2.2.2 Terminal devices in public network

In general, devices discovery and selection are based on IP address location where devices are located in public network. From the application layer point of view, devices discovery and selection can also be based on User ID, account name, device ID and other identifier. IPTV service platform can assist one device to locate another device in public network. In addition, device can find other device by searching the device information which is previously store locally or remotely in service platform, such as a friend list in database. In real implementation, the application-based terminal devices discovery and selection usually are designed as Server-Client mode. The server provides the capability to maintain the relationship of devices and users, the presence states of device, message transfer (proxy) and other functions such as security, authentication, etc.

Therefore, it is recommended to include the following elements in device discovery message:

– IP address for multicasting from source device or IP address for indicates a special target device

– Target User ID

– Target Device ID

– User name, User ID

– Other optional element such as User name, device name, etc.

c.f. “Location-based service” in Wikipedia <http://en.wikipedia.org/wiki/Location-based_service>

TBD

7.2.3 Media codec

Each terminal device model defined by ITU-T supports variety of audio/video codec formats. All supported format can be referenced from [H.721], [H.722], [H.IPTV-TDES.4].

While a terminal device is working as a media server, it can optionally implement media transcoding for providing a suitable media format for other terminal device.

7.2.4 Media transmission

Media sharing service [7.1.1] are the typical service which is implemented by session transfer and media stream transmission, and both can be implemented within home network or public network. In most situations, on demand service is the major service which media shearing service can be added on.

Media stream can be directly pushed or pulled from one device to another device. It depends on which device initiates the media transmission request. But in public network, media stream may not be directly transmitted from device to device. Usually the information exchanged between devices is session related information.

Session transfer can be referenced from [HSTP.IPTV-SMTD], clause 9.2.1.

7.2.4.1 Media transmission in home network

Media content can be transmitted via directly connection between devices, or transport from intermediate device if they are located in a same LAN or home network.

If the terminal devices are DLNA-based devices, then the “2-box push/pull system usage” and “3-box system usage” can be referenced. By using those modes, the media transmission protocol is required to use HTTP, and optionally use RTP.

Sometime the content is prohibited to be transfer to other device, i.e. the media stream cannot be transferred out of the current presenting device directly. In this situation, the actual content transmitted between devices maybe:

– A copy of the original media session

– Initiate a new session but with the same content identifier.

In this situation, the actual media stream transmission is very similar to the transmission happened in public network. The next clause will gives the detail description. But the difference is, in home network, the transferring request can be sent from one device to another directly or through home gateway. In public network, that request may be sent via a proxy in IPTV platform.

7.2.4.2 Media transmission in public network

If media content cannot be transmitted directly between terminal devices but through a public network, such as IPTV network [Note: we need a definition], even the Internet, the IPTV service platform may manage the session transferring between source device and target device. And Content Delivery Function provides the same content stream to multiple target devices. [Note: it should be noted that content delivery function is part of IPTV network.]

The service platform receives the transfer request which indicates an on demand service need to transfer form one device to another. That request can be initiated from the source device or the target device. The transfer request message at least contains:

– An identifier of the current playing content

– An identifier of the terminal device in/from which content to be transferred

– The current playing time if synchronization is required

With the identifier of content, the IPTV service platform can locate the content in Content Delivery Function. In addition, for content adaption in multi-device service, the IPTV service platform will locate an index of the content first. Then, with the target device identifier, the IPTV service platform is able to determine an adaptive content URL for the target device. That information will be forward to the target device with the current playing time and then the target device will request the actual media streaming from Content Delivery Function.

Content adaption can be referenced from [HSTP.IPTV-SMTD] clause 9.1.

TBD

7.2.5 Synchronization among terminal devices

In general, synchronization mechanism is used to guarantee the QoS of IPTV media service when media stream is transmitted on an unreliable network. Audio and video packets may be lost because of jitter or delay on the network. Other factors such as terminal device capability, jitter buffer may also delay the playing of audio or video packet. Therefore, in general, synchronization mechanism may be used to sort those issues. Currently, most of media synchronization solutions are based on RTP/RTCP reports.

In this Recommendation, there is possibility for audio and video streams to be transmitted separately by two network connections into two different IPTV terminal devices. Moreover, if multi-device service requires displaying the same content on multiple terminal devices in the same time with same playing status, synchronization mechanism is recommended to be provided to guarantee the QoS among multiple end-users.

Basically, the synchronization satiation can have those types:

– **Audio and Video synchronization:** it also means audio, video synchronization. In multi-device service, the movie content may separate video and audio as two different streams and transmit onto two different terminal devices, and played as co-ordination mode. Audio and Video synchronization is applied for mapping audio packets with the correct video packets.

– **Presentation synchronization:** it also means display synchronization. In general, this situation means the content (or couple content) displayed on an IPTV terminal device should be keep in the same progress with the other terminal devices if it is required. This synchronization mechanism could provide the same watching experience for two end-users which may locate in different places.

7.3 Application framework

The diagram in Figure 7 presents the application framework for interworking enabled mode for IPTV terminal device to support multi-device service. The overall architecture is referenced from [H.720].

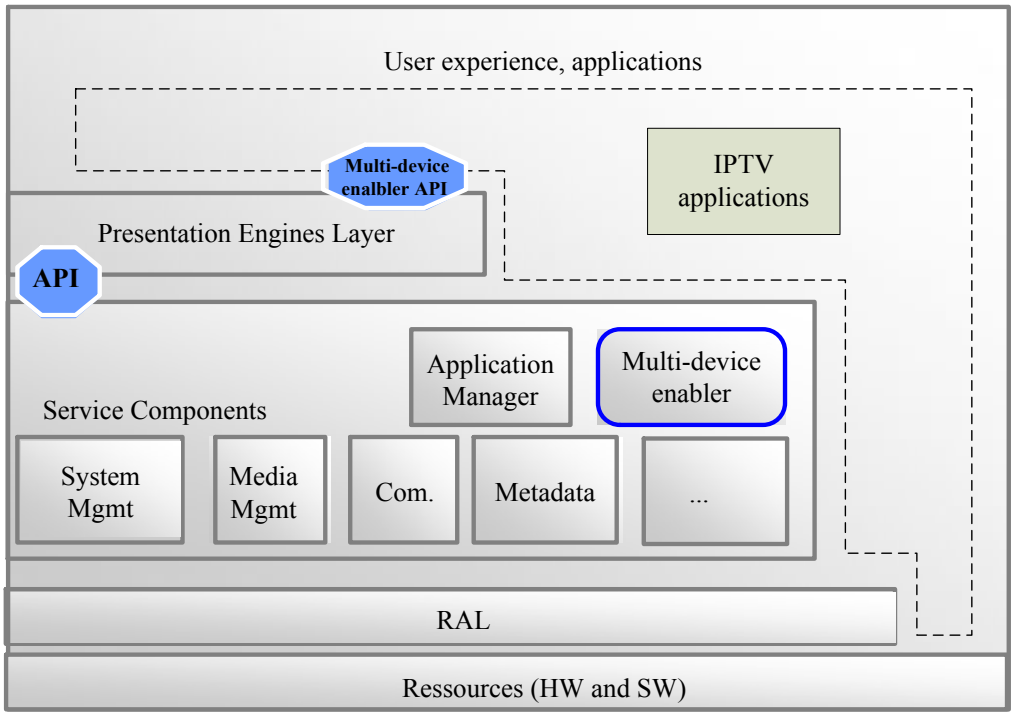

Figure 7: Application framework to support multi-device service

[Editor Notes:] This figure will be further harmonized with TDES.3by complete the service components in service logic adapted layer to support Multi-device applications.[May, 2012, Geneva]

The overall application framework shows that the interworking enabled mode for multiple terminal devices are not required to change the current software architecture defined by ITU-T's Recommendations. So it is recommended to enable multi-device features by providing multi-device applications.

Multi-device application is a kind of interworking enabled application which could add multi-device service feature into IPTV service. The software architecture is recommended to support to installed, uninstall, update and run multi-device applications in IPTV terminal devices. The multi-device application may have fully or restrict access to other layers in this software architecture. The service components in service logic adaptation could be used and enriched by application services in order to simplify the development of service components and applications.

Multi-device application could be composed of one or more features. It will provide IPTV service with the following features:

– UI for Multiple device and content discovery
– IPTV Service or content sharing
– Remote control, including UI.
– Message interchange (pull or push)
– Synchronization control

Multi-device enabler is the function which provides capabilities for device interworking. The minimum function component is recommended to include (not exhaustively):

– Functional roles: It defines which the device module is, such as media server, media player/ media rendering media controller. Each module provides different actions. For example, in DLNA, the device may be categorized as Digital Media Server (DMS), DMP, DMR or DMC. DMS provides media server functions and DMC provides control functions.

The following table should a profile for ITU-T IPTV terminal device roles in interworking model:

	Functional roles			
Device model	**Media server**	**Media Player**	**Media Renderer**	**Media controller**
H.721	Optional	Recommend	Optional	Optional
H.722	Recommend	Recommend	Recommend	Recommend
H.IPTV-TDES.4	Optional	Recommend	Optional	Recommend

[Editor Notes:] There are some API issues should be address here for further understand by Multi-device application developers. [May 2012, Geneva]

TBD

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8 Functional components of IPTV full-fledged terminal device

The functional components in this clause are major referenced from H.720, H.721, H.722, and H.IPTV-TDES.4. The basic functional components architecture supports implementation of various IPTV services, see Figure 8. By considering supporting interworking enabled mode, those functional components may provide interworking capabilities to support multi-device services, which may be considered as a kind of additional IPTV service.

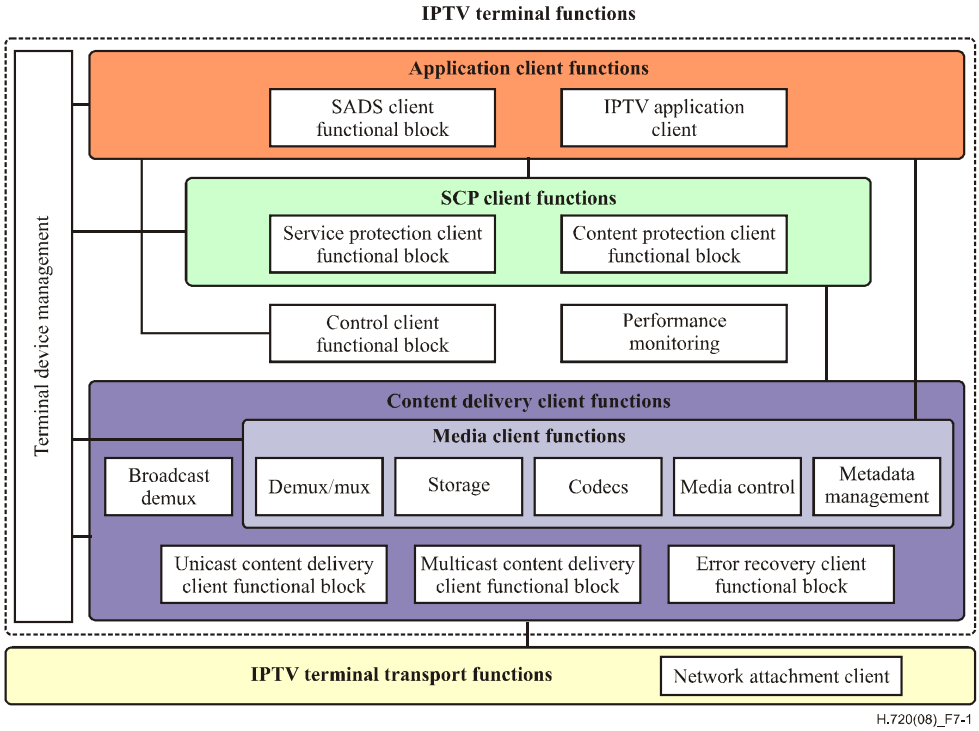

Figure 8: IPTV terminal functions [ITU-T H.720]

The brief explanation for each functional component should compliant with the explanation in H.720, H.722 and H.IPTV-TDES.4. The following explanation specifically addresses each functional component to support interworking enabled mode:

– **IPTV Terminal Transport Functions**
These functions are responsible for handling IP-based connection between 2 or more IPTV terminal devices, besides fixed network and mobile IPTV network. Network attachment clients provide connectivity to other terminal device, fixed/wireless networks such as WiFi and IEEE802.3. It also supports NON-IP based connection such as Bluetooth and Infrared, but still transmits IP packet over those connection.

– **Content Delivery Client Functions**
These functions receive and control the delivery of the content from the content delivery and storage functions. For interworking enabled mode, those functions also provided to received and control the delivery of content from other terminal device which is performance the role as media server.

– **Media Client Functions**
These functions are responsible for content processing functionalities such as storage, metadata processing, and decoding of audio/video contents. In case that a terminal device acts as a media server, these functions should provide media transcoding capabilities.

– **SCP Client Functions**
These functions are responsible for service and content protection aspects of IPTV terminal device.

– **Application Client Functions**
These functions are responsible for the basic functions, management functions, and service supporting functions. Multi-device service is mostly acted as a kind of service supporting functions. It could be an IPTV client function or independent application but need to be coordinated with IPTV client functions and SDAS function to present multi-device service features, such as pushing a VoD streaming to other terminal devices.

– **Control Client Functional Block**
The control client functional block allows the terminal device to initiate service requests to the IPTV service control functional block, in order to prepare for the connection to the content delivery functions. In addition, in interworking mode, this functional block may allow to initiate service request from other IPTV terminal devices.

– **Terminal Device Management Function**
This functional entity provides configuration management and remote management of IPTV Terminal Device.

– **Performance Monitoring**
This function is responsible for monitoring of performance aspects of IPTV Terminal Device.

[Editor Notes:] The context in this section may need to be updated while H.722 or TDES.4 is developed. (May, 2012, Geneva)

TBD

9 Middleware

TBD

10 Interface

10.1 Physical interfaces

Figure 9 illustrates the physical interfaces that support interworking among multiple IPTV terminal devices.

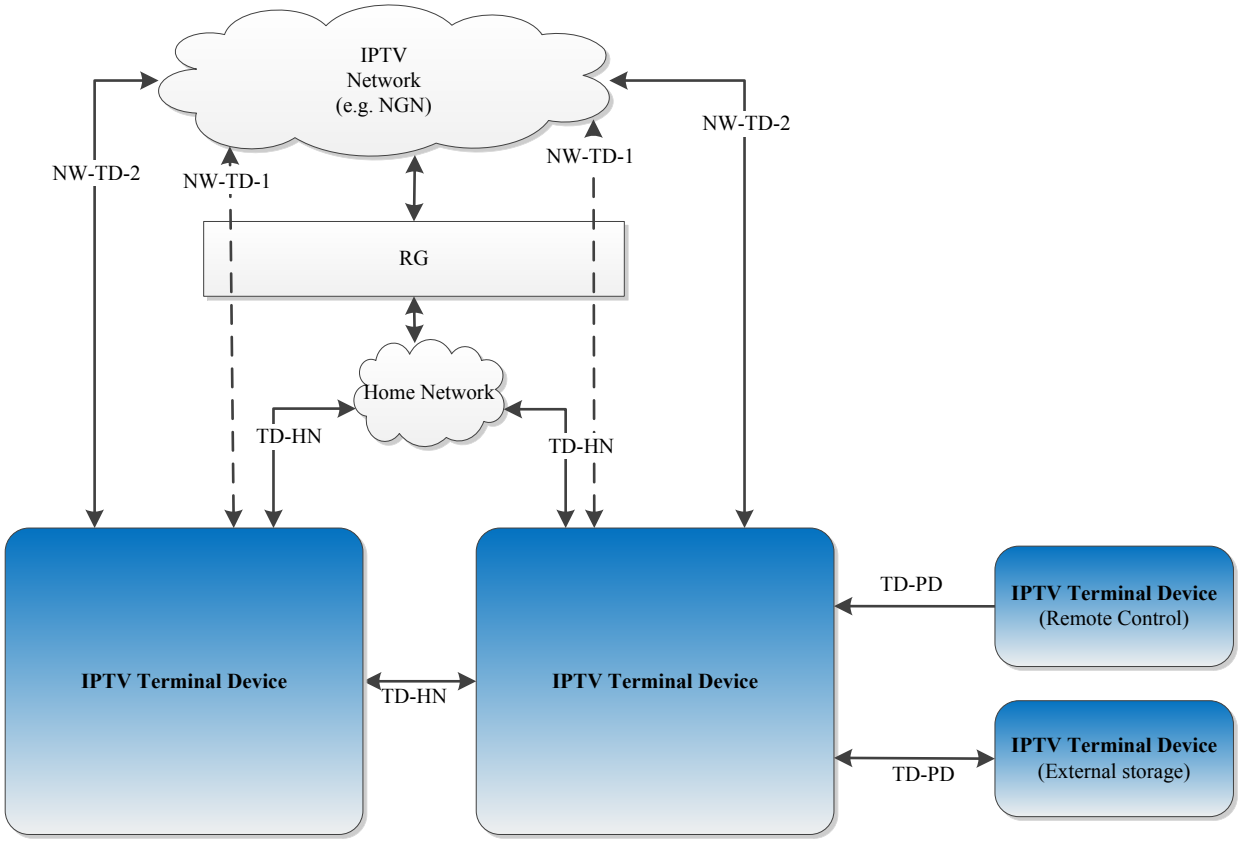

Figure 9: Physical interfaces that support interworking among multiple IPTV terminal devices

This clause mainly describes and specifies the interfaces of support interworking capabilities among the IPTV terminal devices.

The full description of IPTV terminal device interfaces are referred to H.721, as well as full-fledged terminal device and mobile terminal device, which are defined in [ITU-T H.722], [ITU-T H.IPTV-TDES.4].

10.1.1 TD-HN interface

TD-HN is an interface that provides a connection to the home network. TD-HN is used for the connection between the IPTV terminal device and other in-home devices such as an external PVR. In terminal interworking mode, TD-HN is also used for the connection among IPTV terminal device by direct connections.

10.1.2 NW-TD-1 & NW-TD-2 interface

NW-TD-1 & NW-TD-2 interface are interfaces that provides connection to the IPTV network or public network. In terminal interworking mode, NW-TD-1 & NW-TD-2 is also used for the connection among IPTV terminal device by indirect connections.

10.1.3 TD-PD interface

This interface is not only between a peripheral device and the IPTV terminal device but also among the IPTV terminal devices.

It allows transfer of information through non-IP based connection (e.g. blue-tooth and infrared communication) and IP based connection (e.g. UPnP, WiFi).

10.1.4 Input interface

The input interface is responsible for the interaction between user devices and the appropriate applications in the IPTV terminal device. In terminal interworking mode, another IPTV terminal device is able to act as a special user device.

In remote control service, if the IPTV terminal device acts as a device which is controlled by remote controller, the interface requires device to receive control signals.

10.1.5 Output interface

In remote control service, if the IPTV terminal device acts as a remote controller which can control other IPTV terminal device, the interface requires device to send control signals.

10.2 Reference point for Multi-device application

The logical interface between terminal devices in H.IPTV-TDES.5 refers to a pair of logical port for multi-device application to build a virtual communication link to exchange information. For example, H.IPTV-TDES.5 defines the some multi-device functional components as a multi-device enabler and a multi-device application could use those components to implement an actual multi-device action.

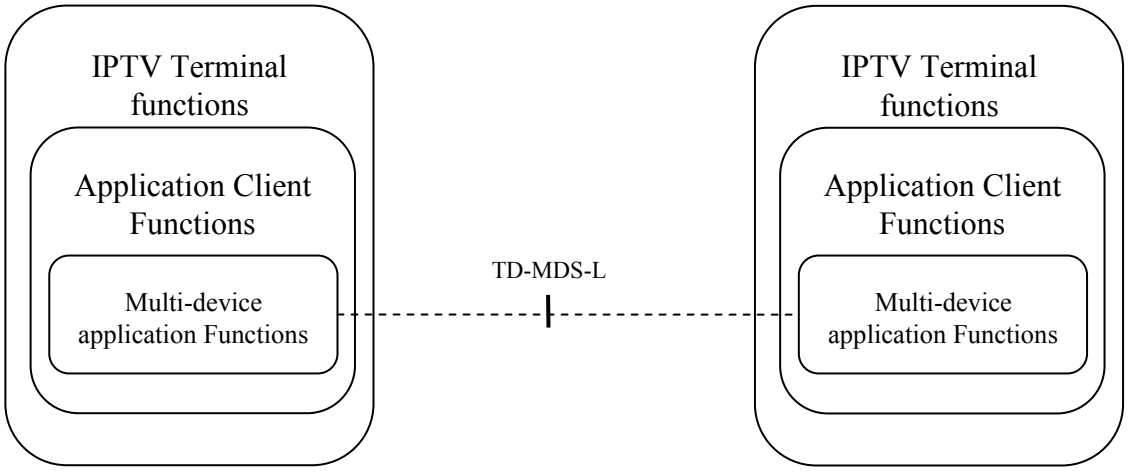

Figure 10: Reference point between Multi-device application Functions

TD-MDS-L

The Reference point TD-MDS-L stands for Terminal Device-Multi Device Service-Logical interface. This Reference point is between Multi-device application Functions which are located in the different IPTV Terminal Functions. [NOTE: Need to add what TD-MDS-L means]

This Reference point is used by IPTV Terminal Functions to send/receive messages which are required to initiate a multi-device application. Those multi-device application related messages may include:

– Messages for terminal discovery

– Messages for controlling media session, e.g. to build a communication channel, to control media play, remote control to another terminal device, etc.

– Messages for reporting terminal device status, e.g. to keep device online presence, to keep multiple device to be synchronized.

[NOTE: Need a better explanation here or a reference to the MDS clause that describe this case. Check Y.1910 for the correct terminology for "sub reference point"]

11 Security module

This clause mainly describes and specifies the security requirement to support interworking capabilities among IPTV terminal devices.

The full description of IPTV terminal device security module is found in [ITU-T H.721], as well as full-fledged terminal device and mobile terminal device, which are defined in [ITU-T H.722] and [ITU-T H.IPTV-TDES.4].

Security requirement can be referred to [Y.1901], Section 6.3 *Security aspects including service and content protection*, and [X.1191].

11.1 Home network security

In a home network, some type of firewall product is recommended to be used, such as a network appliance or a personal firewall software package to prevent intruders from scanning and attacking.

In a wireless network, especially, security guarantee provisioning is recommended to be established, for example, by setting user account and password with encryption for each terminal device which are allowed access.

11.2 System security

System is recommended to authenticate each terminal device with user account and password when they login into the service.

System is recommended to have anti-theft security capability to prevent unauthorized terminal devices from entering the page by using the URL of the authorized terminal devices.

11.3 Authentication

TBD

Appendix I:

Scenario and user case for interactive model

This appendix describes the user case for interactivity among terminal devices.

I.1 Sharing/interactive EPG over multiple terminal devices (collaborative EPG)

A user wants to browse some new content released from Internet video website. By active the "multi-screen EPG" service, he can use his Pad device and STB to access the same EPG page, while his Pad and STB could be connected together by his home network. (The layout of EPG page

may different according to the display capability of PAD or STB.). Furthermore, if he found his target content on his Pad EPG, he could chose to play it from his TV screen (STB).

In the other application, a user could recommend media content to his friend or make a bookmark. Then his friend could receive his recommendation or browser his bookmark from other terminal devices.

The diagram in Figure I.1 gives an example of sharing EPG in different terminal devices.

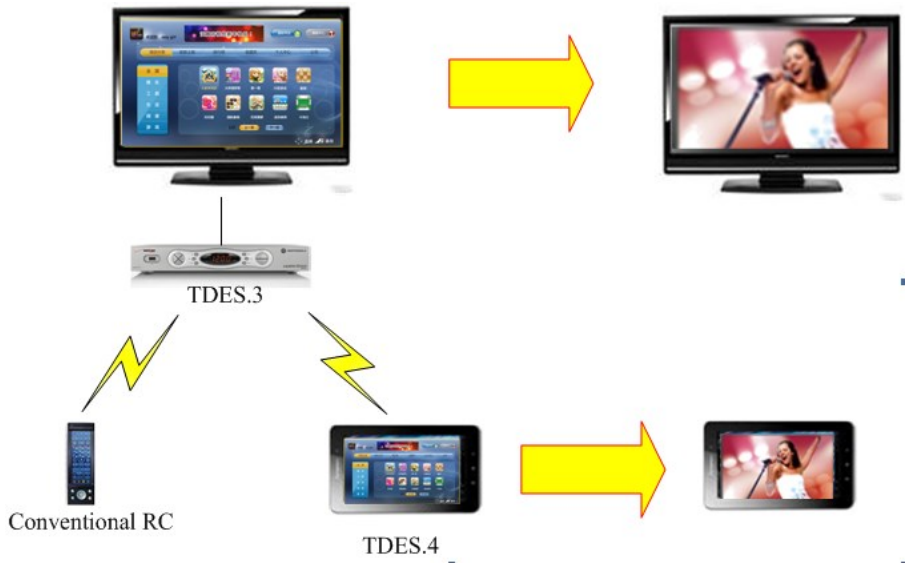

Figure I.1: EPG and media content sharing over multiple TDs

I.2 Remote control over multiple terminal devices (multi-screen controller)

Using Pad or other touch-screen enabled device may provide more convenient Remote Controller graphic UI then conventional Remote Controller. While a user is watching program on his TV screen, his could use his Pad or Smart phone Remote Controller GUI to control media play instead of conventional Remote Controller such as fast forward, stop and record. See Figure I.2

Similar to the above case, any two terminal device should be connected together first and they could directly or indirectly communicate to each other (depending on the way they are connected).

Figure I.2: Remote Controller over multiple TDs

I.3 Sharing media file/stream over multiple terminal devices (multi-screen sharing)

A user has his friend visited his home. His friend wanted to share some pictures or short movie with him, which stored in his mobile phone or Pad. His friend could choose to connect the phone or Pad into a home network. Then use can choose to use TV set to display those media content list and choose one of his TV to play those picture or videos. That is actually the DLNA scenarios. See Figure I.3-1.

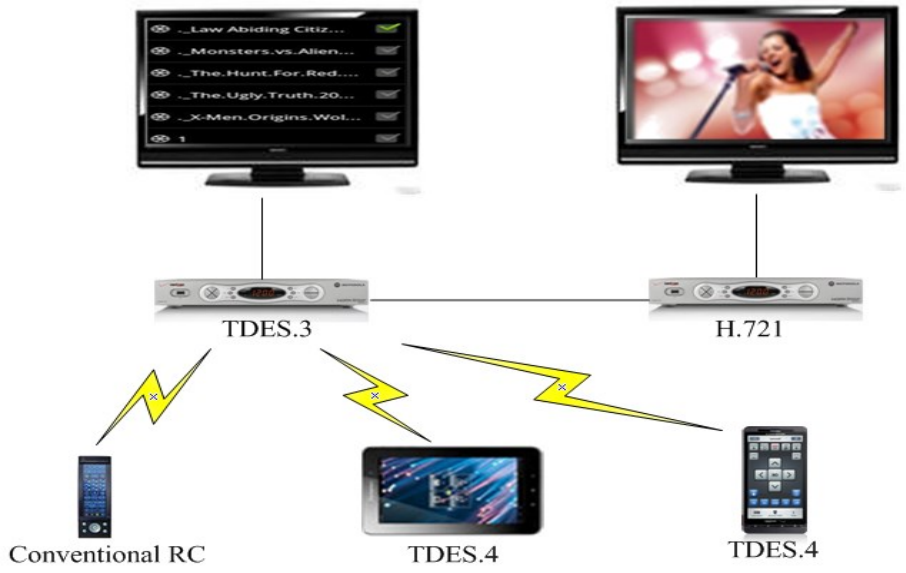

Figure I.3-1: media sharing over multiple TDs (DLNA scenarios)

Another media sharing case is to stop media play from one terminal device and resume the media from other terminal device, as illustrated in Figure I.3-2. This is called multi-room DVR in USA.

Figure I.3-2: Stop and resume media play from different TDs

I.4 Title TBD

Small DS terminal in a coffee shop reacts to a client in front when he walks in and controls the big screen behind the counter.

TBD

I.5 Consuming extra content on multiple terminal devices

For multi-device services, content/service provider may attach an extra content or application to the main content, for example, attach a trailer to a movie, or attach an advertisement to a football match etc. The extra content is valid only when the user selects its main program.

When the user browses the EPG or selects a program on TV, he can see that a car racing program may have an extra electronic game of racing that is attached to this program. When the user confirms to watch the racing program from TV, he can just ignore the extra game, or he can push the game to another terminal device such as tablet PC and play the game on it. The expiry time depends on the content or service provider. It should be noted that to support DLNA functions, H.622.1 can be referenced.

Figure 1: Consuming coupled content on multiple terminal devices

[Editor Notes:] A requirements mapping to scenarios is needed. IP-connection (e.g. Wifi) or Non-IP connection (e.g. Bluetooth). DLNA and H.622.1 can be referenced. (May, 2012, Geneva)

I.6 Requirements Mapping on Scenarios

General requirements:

1) All terminal devices are recommended to be connected together via IP or non-IP network.

2) The IPTV architecture multi-device interworking is recommended to be able to discover terminal devices within the network.

3) The system is recommended to authorize the login request from multi-device by using legitimate user account

4) The system is recommended to identify user accounts from multi-devices are in the same home network and can interact each other.

Specific requirements:

1.1 Sharing/interactive EPG over multiple terminal devices (collaborative EPG)

The system should provide basic video and audio adaptation capability according to the display of PAD (wireless device) and STB.

1.2 Remote control over multiple terminal devices (multi-screen controller)

The system should provide the related remote controller GUI to the display capability of PAD (or smart phone).

1.3 Sharing media file/stream over multiple terminal devices (multi-screen media/file sharing)

1) The PAD(wireless device or mobile phone)should provide file-based download function in offline media sharing mode.

2) The PAD(wireless device or mobile phone)should provide streaming service function in online media sharing mode.

1.5 Consuming extra content on multiple terminal devices for multi-device services (multi-screen content sharing)

The system should provide the extra content related to the main program.

[Editor Notes:]The above requirements are intended to be mapped with the scenarios in Appendix I. (Sep, 2012, USA)

Appendix II

Multi-device synchronization schema

This appendix describes the several synchronization schemas that could be used for establishing a group of synchronised devices composed of synchronization servers and clients. For different situations, ITF could be a synchronization server OR client, even the combination of server and client.

II.1 Master-Slave control

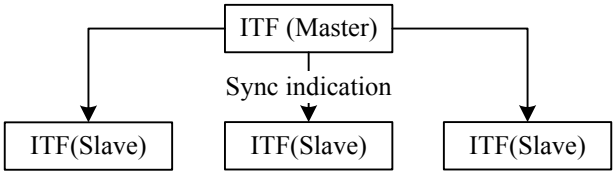

Figure II.1 – Master-slave Synchronization Schema

This schema is consisted of one ITF as a synchronization Master device and a number of Slave devices. All Slaves receives the synchronization indications from Master and does not need to send back its status report. This schema is used to large number of Slave devices which is not appropriate to send reports. And therefore, this schema is appropriate to be used in broadcast session. The Master device here might not be a ITF but a IPTV media server.

II.2 Maestro-based control

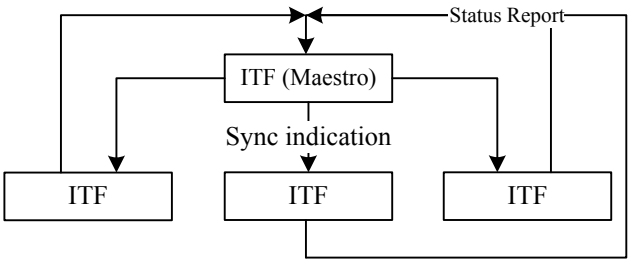

Figure II.2 – Maestro Synchronization schema

This schema is consisted of number of ITFs. Usually it is used to have one device to control other synchronized devices. Normally, at first, each ITF sends its status report to Maestro device individually by unicast. After that, Maestro summaries those reports and generate the synchronization indication then multicast it to all ITFs.

[Editor Note: it would be good to have explanations of different scenarios, e.g., "Figure I.3-2: Stop and resume media play from different TDs," in Appendix I, using different schema, e.g., Maestro Synchronization schema, in Appendix II] (Sep 2012, USA)

II.3 Distributed Control

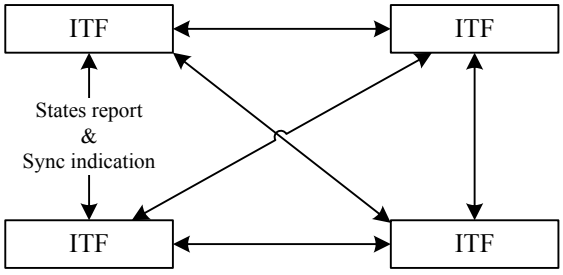

Figure II.3 – Distributed Synchronization Schema

In distribution schema, each ITF exchanges status report by each other. Each of ITF calculates the synchronization indication by compare the report send by itself with other ITF's report and then sends (multicast) indication to other ITFs. This schema is suitable for small group of device for synchronization. The synchronization indication could be adaptively changed according to network load and distribution control schema.

II.4 Hierarchical control

This schema introduces the concept of multiple hierarchically arranged application domains. When Child ITF pairs to Parent ITF, they join an application domain – they become able to be synchronized by the Parent ITF. An application domain has a single Parent ITF, and all Child ITFs receive the synchronization notifications from this single instance, and may or may not send back their status report (it depends of what network protocols are being used, i.e. whether they support unicast or multicast/broadcast connections). A Parent device may distribute part of the orchestration duties to other Child ITF. Child ITF may recursively create application subdomains, and other ITF may join as Childs. An ITF cannot be Child and Parent on a same subdomain [Note: This sentence needs to be modified. It is intended to mean that "no loop is allowed"].

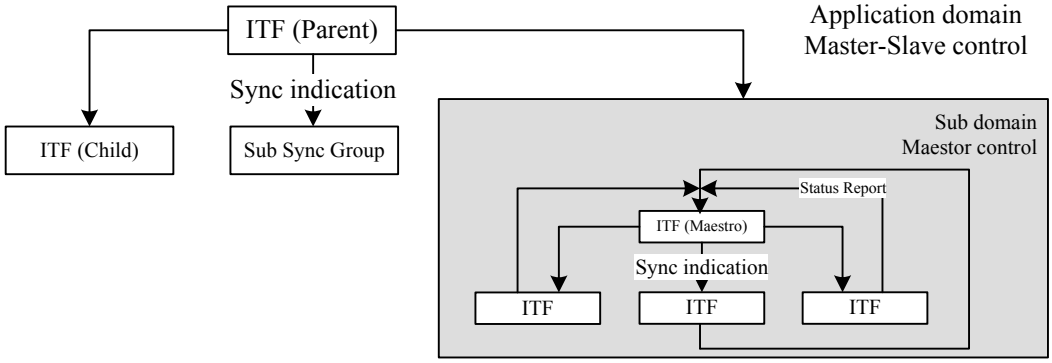

Figure II.4 – An instance of hierarchical distribution synchronization schema

[Editor Notes:] Sub domain in the Figure II.4 has the same meaning as Sub Sync Group. And this is an instance of Hierarchical Distribution mode, where Synchronization Schemas in different domains can be exchanged.

TBD

Bibliography

[ITU-T Y.Sup5] ITU-T Supplement 5 to Y-series Recommendations (2008), *ITU-T Y.1900-series – Supplement on IPTV service use cases*.

[IETF] draft-ietf-avtcore-idms-06: *Inter-destination Media Synchronization using the RTP Control Protocol (RTCP)*.

[UPnP] UPnP Forum, UPnP Device Architecture 1.0 (Document Revision Date 15 October 2008).

[Wifi-P2P] Wi-Fi Alliance Technical Committee P2P Task Group, Wi-Fi Peer-to-Peer (P2P) Technical Specification Version 1.1.

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