SES
Platform Services

Media Platform Solutions | AS-20001

Multiscreen

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SES Platform Services GmbH

Beta Straße 1-10

D-85774 Unterföhring

Germany

SES
Platform Services

TABLE OF CONTENT

1 INTRODUCTION

1.1 PURPOSE OF DOCUMENT

This document introduces the concepts and architecture of the Multiscreen product of SES Platform Services (SPS). It also specifies requirements for reference devices.

1.2 DOCUMENT HISTORY

Version	Date	Author	Changes
0.53	2015-08-23	Harald Molina-Tillmann	Working draft

1.3 REFERENCES

1.3.1 SPS DOCUMENTS

[1] SPS; "AS-5101: HD+ Platform: Basic HDTV STB Requirements”; v1.9
[2] SPS; "AS-20101: Power states of Multiscreen-Servers"
[3] SPS; "AS-20501: Novaspread-S"
[4] SPS; "AS-20502: Novaspread-S: Reference manual"
[5] SPS; "AS-20503: Novaspread-S: OS interface"
[6] SPS; "AS-20511: Novaspread-C"
[7] SPS; "AS-20512: Novaspread-C: Reference manual"
[8] SPS; "AS-20513: Player for Novaspread-C"
[9] SPS; "AS-20513: Player for Novaspread-C: Reference manual "
[10] SPS; "AS-30102: FREETVA-RC Profile"; v1.0

1.3.2 SES DOCUMENTS

[11] SES; "SAT>IP Protocol Specification"; v1.2.2
[12] SES; "SAT>IP Operator Extensions"

1.3.3 IETF DOCUMENTS

[13] RFC 3550; "RTP: A Transport Protocol for Real-Time Applications"
[14] RFC 2326; "Real Time Streaming Protocol (RTSP)"
[15] RFC 5246; "The Transport Layer Security (TLS) Protocol"; v1.2
[16] RFC 2616; "Hypertext Transfer Protocol – HTTP"; v1.1

1.3.4 ITU DOCUMENTS

[17] H.262; "Information technology – Generic coding of moving pictures and associated audio information: Video"
[18] H.264; "Advanced video coding for generic audio-visual services"
[19] H.265; "High efficiency video coding"

1.3.5 OTHER DOCUMENTS

[20] Free TV Alliance; "Remote Control Specification"; v1.0 [WR2]
[21] UPnP; "Device Architecture"; v1.1
[22] ETSI; TS 102 366; "Digital Audio Compression (AC-3, Enhanced AC-3) Standard"
[23] ISO/IEC; 11172-3; "Information Technology - Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s - Part 3: Audio”

1.4 TERMINOLOGY

1.4.1 ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
ANSI	American National Standards Institute
A/V	Audio/Video
CA	Conditional Access
CAK	Conditional Access Kernel
CAS	Conditional Access System
CASS	Conditional Access Sub-system
CICAM	Common Interface Conditional Access Module
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DRM	Digital Rights Management
DVB	Digital Video Broadcasting
ECM	Entitlement Control Message
EIT	Event Information Table
EMM	Entitlement Management Message
EPG	Electronic Program Guide
FREETVA-RC	Free TV Alliance – Remote Control
FTA	Free To Air
GSM	Groupe Spécial Mobile
HBBTV	Hybrid Broadcast Broadband TV
HDMI	High Definition Multimedia Interface
HDTV	High Definition Television
HLS	HTTP Live Streaming
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IDTV	Integrated Digital Television
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IF	Intermediate Frequency
IP	Internet Protocol

IPC	Inter Process Communication
IRD	Integrated Receiver Decoder
ITU	International Telecommunication Union
LAN	Local Area Network
LED	Light Emitting Diode
LNB	Low Noise Block
MPEG	Moving Picture Experts Group
OS	Operating System
OSAL	Operating System Abstraction Layer
PCR	Program Clock Reference
PID	Packet Identifier
PIP	Picture In Picture
PMT	Program Map Table
PVR	Personal Video Recorder
QPSK	Quadrature Phase-Shift Keying
RCU	Remote Control Unit
RF	Radio Frequency
RMB	Reference Multiscreen-Box
RMS	Reference Multiscreen-Server
RTP	Real-time Transport Protocol
RTSP	Real-Time Streaming Protocol
SDTV	Standard Definition Television
SPS	SES Platform Services
TV	Television
UDP	User Datagram Protocol
USB	Universal Serial Bus
WLAN	Wireless Local Area Network
WOL	Wake On Lan

1.4.2 GLOSSARY

1.4.2.1 Technical components

Expression	Meaning
Backend	Aggregation of all components that provide Internet services used for Multiscreen (including e.g. license server, subscriber manager, device manager, EPG data manager)
CASS	Component of Multiscreen-Servers used for decryption of broadcasted content
DRM-C	Client component of a Multiscreen DRM system used by Multiscreen-Apps
DRM-S	Server component of a Multiscreen DRM system integrated in Multiscreen-Servers
Multiscreen	The set of features and technology as defined by SPS in this document
Multiscreen-App	Downloadable iOS/Android application that implements client functionality of Multiscreen
Multiscreen-Box	Stationary device that includes a framework for Multiscreen-Apps
Multiscreen-Client	Combination of a Multiscreen-App and a Multiscreen-Box or third-party mobile device
Multiscreen-Server	Central device in the home network that distributes streams to connected devices
Novaspread	Software package for central Multiscreen functionality provided by SPS
Novaspread-C	Client component of Novaspread to be used by Multiscreen-Apps
Novaspread-S	Server component of Novaspread to be integrated in Multiscreen-Servers
Player	Software component of the Multiscreen-App used to display streamed content

1.4.2.2 Involved parties

Party	Main products and services	Colour
App-Developer	Multiscreen-App (both frontend and backend)	
DRM-Provider	DRM system (including DRM-S, DRM-C, DRM backend system, CAS)	
Manufacturer	Multiscreen-Server, Multiscreen-Box	
Operator	Backend system design (including content, subscriber, home domains)	
SPS	Frontend system design, Novaspread	

Note 1: The used notations do not imply any requirements for the setup of projects and contracts.

2 SCOPE

2.1 CONTEXT

Broadcasted premium content is usually protected by a conditional access system (CAS). If such content is distributed in the home network, the receiving device must include a hardware decryption module such as a CICAM or an embedded CASS with smartcard reader.

SPS Multiscreen provides secure streaming of premium content to devices without hardware decryption module. This includes simple IP set-top boxes and mobile devices of third parties.

2.2 SCOPE AND CUSTOMISATION

SPS Multiscreen defines the following in particular:

- Technical components of server devices required for Multiscreen
- Software libraries for server middleware and client applications
- Network protocols
- Security

Manufacturers of Multiscreen server devices are free to add other features e.g.:

- PVR
- Middleware for interactive applications
- Gaming platforms
- Enhanced I/O methods

The following is not defined in detail and can be fully customized by an Operator:

- User-interface on client devices
- Additional features on client devices
- Business model
- Subscriber management
- Device registration

2.3 CONTENT

The focus of SPS Multiscreen is protected HDTV content. However, SPS Multiscreen applies also to unprotected content (FTA) as well as to SDTV and Radio services.

2.4 USAGE SCENARIOS

SPS Multiscreen addresses two basic scenarios. In the first scenario the user is successively watching premium content in different rooms and on different devices in the home network. A typical case is a single household with the user having only one subscription or license. In the second scenario several users want to have access to different content in parallel on different devices in the home network. A typical case is a family household.

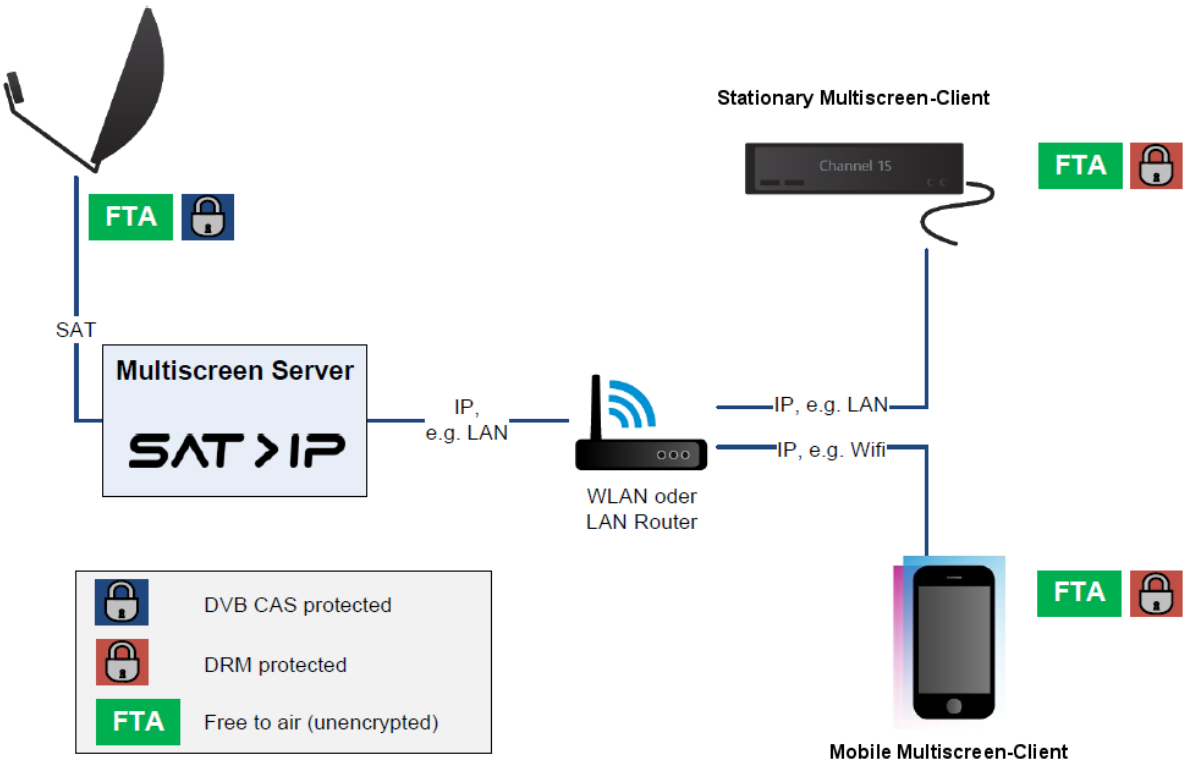
2.5 USE CASES

SPS Multiscreen serves the following use cases in particular:

- Watch content on a mobile device in rooms without stationary device
- Watch content on a mobile device while watching different content on a stationary device in parallel
- Watch content on big screens in rooms without satellite connection
- Watch different content on big screens in different rooms while having only one subscription or license

3 SYSTEM ARCHITECTURE

3.1 OVERVIEW

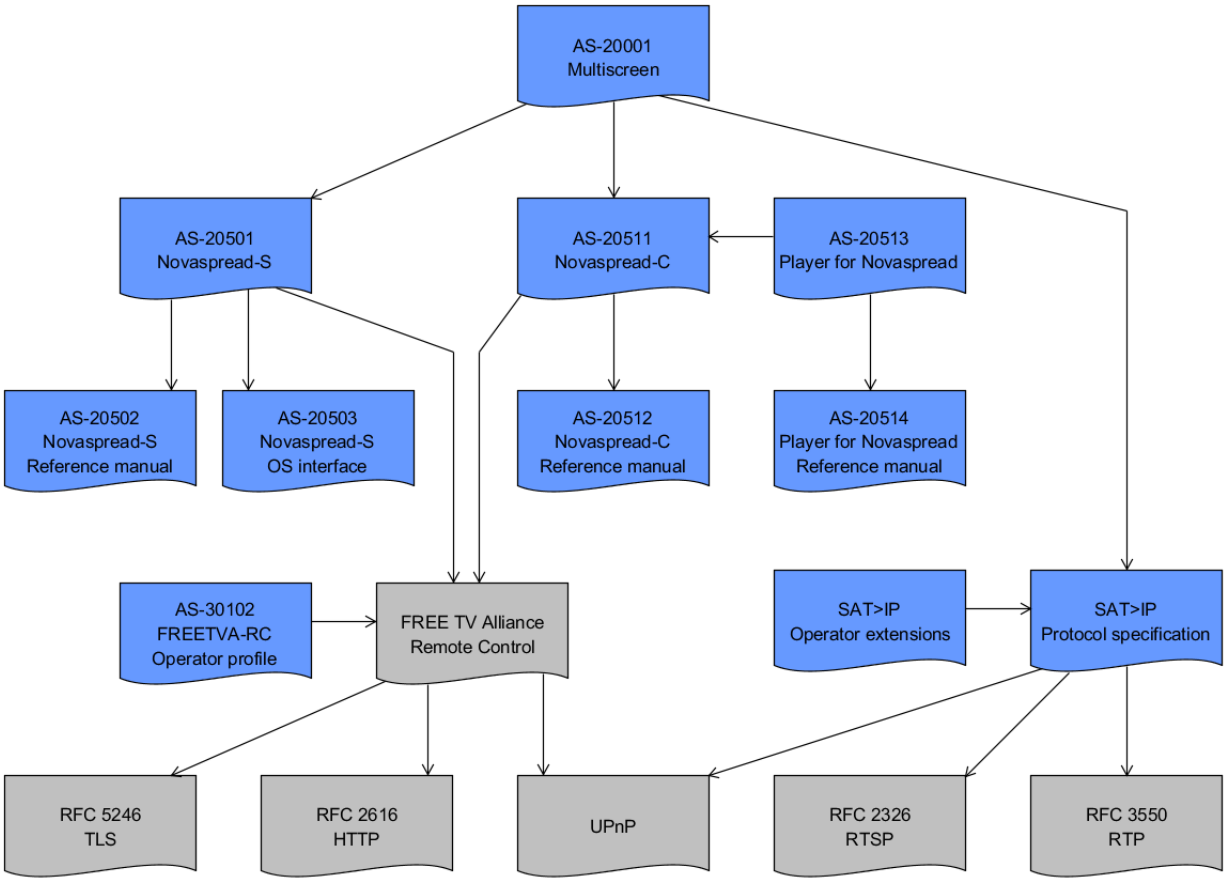


The diagram above illustrates the basic architecture of Multiscreen.

- Unencrypted content (FTA) and encrypted content (CAS-protected) is broadcasted over the satellite network (DVB-S/S2).
- A central device in the home network (referred to as "Multiscreen-Server") receives and decodes the DVB TV and Radio services.
- The Multiscreen-Server decrypts CAS-protected services using an embedded CASS, and re-encrypts them using an embedded DRM system.
- The content together with a corresponding hardware license is streamed to stationary and mobile clients (referred to as "Multiscreen-Clients") over the home network.
- The Multiscreen-Clients convert the received hardware license to a software license, which they request from the Backend of the Operator.
- The Multiscreen-Clients decrypt and display the content.

3.2 REFERENCED DOCUMENTS AND TECHNOLOGIES

The major part of Multiscreen is specified through references to other documents and technologies as shown in the following diagram and table.



Technology	Version	Reference	Functions
UPnP	1.1	[21]	IP addressing for devices in the home network Advertising and discovery of Multiscreen-Servers in the home network
HTTP	1.1	[16]	Communication between Multiscreen-Client and Multiscreen-Server
TLS	1.2	[15]	Authentication of Multiscreen-Server and Multiscreen-Client
RTSP		[14]	Media control
RTP		[13]	Media transport
SAT>IP [1]	1.2.2	[11]	Profile of UPnP Profile of RTSP and RTP

FREETVA-RC [2]	1.0	[WR2]	[20]	Profile of UPnP Profile of TLS authentication API provided for Multiscreen-Clients

1: Extended by document [12]

2: Profiled in document [10]

3.3 SOFTWARE PACKAGES

3.3.1 NOVASPREAD

The core functionality required for Multiscreen is implemented in a software package that is provided by SPS. This software package is called "Novaspread". It includes both a server component (Novaspread-S) and a client component (Novaspread-C), which are further described in document [3] and [6], respectively.

Novaspread-S

This module includes:

- UPnP service advertisement
- HTTP 1.1 server
- TLS 1.2 server
- SAT>IP server
- SAT>IP client
- FREETVA-RC (see documents [20] and [10])
- Communication with resource manager for tuners and transcoders
- Communication with server component of DRM system (DRM-S)
- Management of broadcasted usage rules

Multiscreen-Servers must integrate Novapread-S and provide the required interface defined in documents [3] and [4] and [5].

Novaspread-C

This module includes:

- UPnP service discovery
- Client certificate
- Integrated client component of DRM system (DRM-C)
- SAT>IP client
- API for all functions of Multiscreen
- Java bridge for Android based devices

Multiscreen-Apps must integrate Novaspread-C and access it via the interface defined in document [6].

3.3.2 PLAYERS

Players are software modules which are integrated in Novaspread-C. They manage incoming RTP streams and display the content.

There are two types of Players:

- » Player as part of DRM-C (see next section)
- » Stand-alone Player used for FTA content

Note 2: The selection of Players is defined by the Operator.

The integration of Players in a Multiscreen-App is defined in document [8].

3.3.3 DRM SYSTEM

Content protection is realised using a third-party DRM system. It includes a server component (referred to as "DRM-S") and a client component (referred to as "DRM-C").

DRM-S

This module provides:

- » Re-encryption
- » Generation of hardware licenses
- » Provision of broadcasted usage rules

It is integrated in Multiscreen-Servers.

DRM-C

This module provides:

- » Decryption
- » Player functionality

It is used by Novaspread-C.

3.4 COMPONENTS

3.4.1 SATELLITE RECEIVING INSTALLATION

SPS Multiscreen supports two types of satellite receiving installations:

- » Standard installations (e.g. Single/Dual-LNB, Multiswitch installation, Single cable installation)
- » SAT>IP LNB installation

The combination of both types is supported, too.

3.4.2 MULTISCREEN-SERVER

The Multiscreen-Server is an enhanced DVB-S receiver which is used as the central device in the home network. It streams content to connected Multiscreen-Clients.

A typical Multiscreen-Server includes the following:

- » RF interfaces
- » DVB-S/S2 tuners
- » Transcoder
- » IP connection

- » Smartcard reader
- » CASS
- » DRM-S
- » Novaspread-S
- » HDMI output
- » Navigator application
- » Setup application

The Multiscreen-Server might include other components such as HbbTV or integrated mass storage.

In regards to Multiscreen the Multiscreen-Server particularly provides the following services:

- » DVB reception
- » Service advertising
- » Transcryption
- » Transcoding
- » Hardware resource conflict management
- » Streaming
- » Provision of device data and smartcard data

Note 3: Devices of other types might also be Multiscreen-Servers. This includes IDTVs, home network devices (e.g. Router), or satellite equipment (e.g. Multiswitch). However, this is not covered by this version of this document.

Note 4: Requirements on a reference Multiscreen-Server are defined in Annex A.

3.4.3 MULTISCREEN-CLIENT

3.4.3.1 Introduction

Multiscreen-Clients are components that can display streams which they receive from a Multiscreen-Server. They are connected to the Internet and communicate with the Backend of the Operator.

Multiscreen-Clients typically provide the following:

- » UPnP service discovery
- » Selection of Multiscreen-Server
- » Channel and stream selection
- » Client certificate
- » License management
- » Receiving and displaying streams
- » Operator specific functions

There are both mobile Multiscreen-Clients and stationary Multiscreen-Clients.

3.4.3.2 Architecture

A Multiscreen-Client comprises two parts:

1. A device including a framework for download and execution of applications
2. A downloadable Multiscreen application running on the device

Device of mobile Multiscreen-Clients

The device of a mobile Multiscreen-Client is typically a third-party tablet or smartphone providing a store for downloadable applications.

Device of stationary Multiscreen-Clients (Multiscreen-Box)

The device of a stationary Multiscreen-Client is typically a simple IP set-top box with an HDMI output interface. However, it could include other components such as a DVB frontend or a web browser.

In this document such a device is referred to as "Multiscreen-Box".

The Multiscreen-Box is approved by the Operator.

Note 5: Requirements on a reference Multiscreen-Box are defined in Annex B.

Application of Multiscreen-Clients (Multiscreen-App)

The actual Multiscreen functionality of a Multiscreen-Client is implemented in form of a downloadable application that runs on a mobile or stationary device as introduced above.

In this document such an application is referred to as "Multiscreen-App".

Multiscreen-Apps use Novaspread-C as introduced in section 3.3.1.

Note 6: Multiscreen-Apps can be provided by the Manufacturer of a Multiscreen-Box or by the Operator.

Note 7: Recommendations for Multiscreen-Apps are provided in document [6].

3.4.3.3 Other Multiscreen-Clients

Note 8: Future versions of this document may cover other types of Multiscreen-Clients e.g.:

- Stationary devices without application framework
- PC applications
- Web applications
- Chromecast
- AppleTV
- Games consoles
- IDTVs

3.4.4 BACKEND

The Backend of the Operator provides license management. Typically, this includes:

- Provision of general DRM data required by Multiscreen-Clients
- Conversion of hardware licenses (as delivered by Multiscreen-Servers) to software licenses (as needed by Multiscreen-Clients)

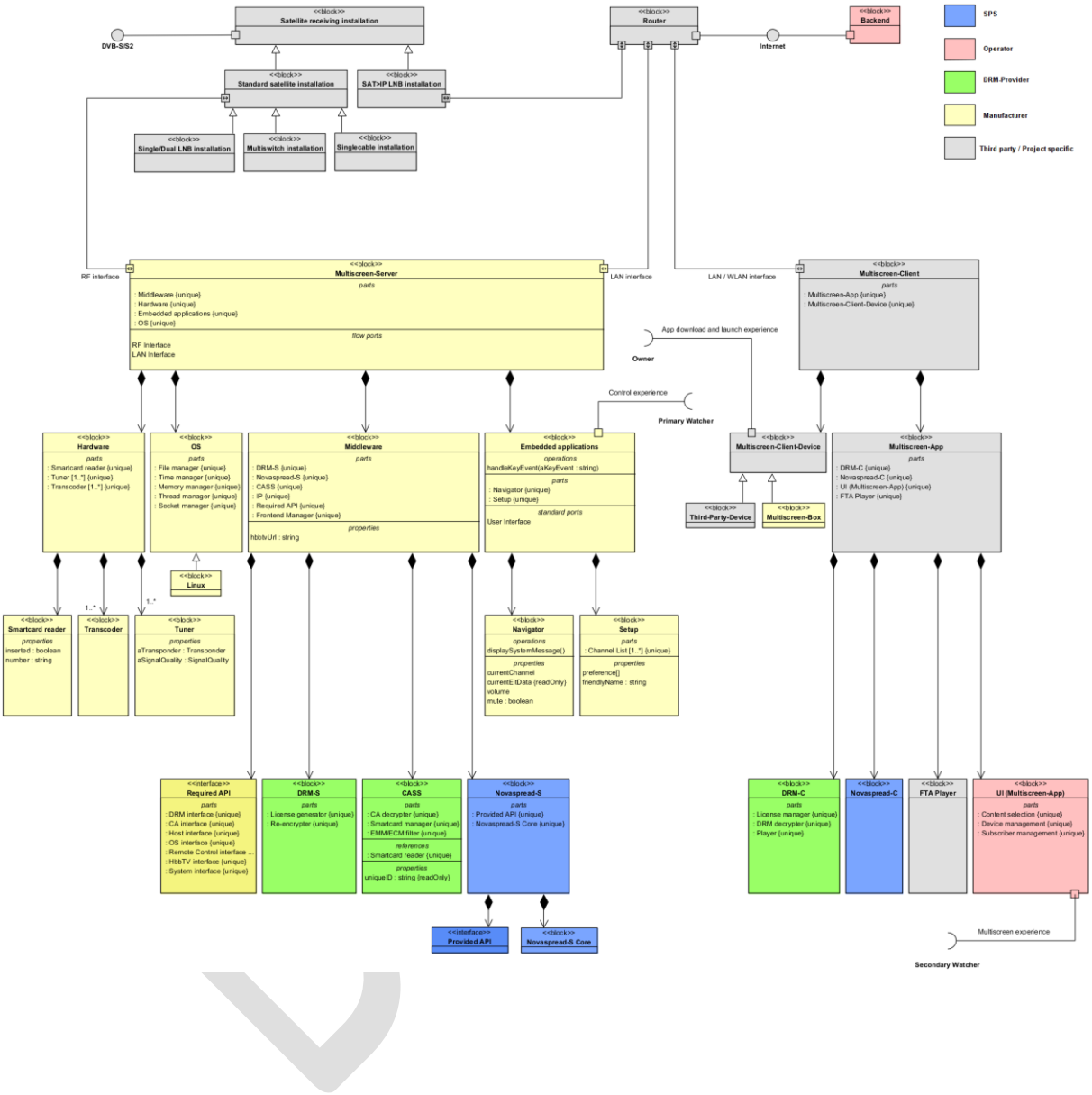
Note 9: Details are defined by the Operator or the DRM-Provider.

Note 10: The Backend of an Operator typically also provides functionality as listed below. This functionality is used by the Multiscreen-App, but it is out of scope of this document.

- Subscriber management
- Device registration
- Log-in
- Provision of channel list
- Text for system messages
- User notifications

3.5 SYSTEM DETAILS

The following block definition diagram provides a more detailed view on the Multiscreen architecture. Further explanation can be found in documents [3] and [6] and [8].



4 ADDITIONAL CONCEPTS

4.1 POWER STATES OF MULTISCREEN-SERVER

Document [2] defines the concept for the power states of the Multiscreen-Server. This concept allows for starting a Multiscreen session from a Multiscreen-Client even if the Multiscreen-Server has been put to stand-by. The concept recommends the Wake-on-LAN (WOL) technology to minimize energy consumption in stand-by mode.

4.2 HARDWARE RESCOURCE CONFLICT MANAGEMENT

4.2.1 INTRODUCTION

Several hardware resources are requested both by Multiscreen-Clients and by the Multiscreen-Server itself in a competitive way:

- RF interface
- Tuner
- Demodulator
- Descrambler
- Transcoder
- General processing power

These resources are e.g. requested for:

- Recordings
- Primary HDMI output on Multiscreen-Server
- Secondary HDMI output on Multiscreen-Server (Picture-in-picture)
- Streaming to Multiscreen-Clients
- Other streaming services
- Downloads

This may result in conflicts e.g.:

- A programmed recording is going to start but all tuners are already in use.
- A Multiscreen-Client requests a transcoded stream but all transcoders are already in use.
- The user selects a new service for the primary HDMI output on a different satellite IF level but the maximum of concurrent satellite IF levels (e.g.2) are used for other services.

To solve such conflicts the system assigns a priority value to each service that uses limited hardware resources. In case of a conflict services with low priority loose their hardware resources and are terminated.

4.2.2 TUNERS IN NOVASPREAD-S

Novaspread-S does not directly access hardware components. Instead, communication between Novaspread-S and the middleware uses a data structure for virtual tuners (see document [3]). The assignment of actual hardware components to virtual tuners is managed by the middleware. Novaspread-S simply allocates and releases tuners without knowing about the underlying architecture. This allows for porting Novaspread-S to a wide range of platforms.

Hardware components can be shared between several virtual tuners. In a Multiscreen-Server with two RF interfaces and four DVB frontends at least the RF interfaces must be shared (see section 4.2.7). It is also possible to share one DVB frontend with two or more virtual tuners. So a tuner in the scope of Novaspread-S shall not be confused with the actual hardware tuner of the DVB frontend. Instead, one virtual tuner is used for one Multiscreen streaming service. Internally it is associated with several references to used hardware components such as an RF interface and a DVB frontend and a transcoder.

4.2.3 PRIORITIES

4.2.3.1 Introduction

All services that require limited hardware resources get a priority value. Priorities for Multiscreen streaming services are managed by Novaspread-S. Priorities for all other services are managed by the middleware. In case of a hardware resource conflict, the middleware compares the priority values of the involved services to determine which service (or which services) will loose its hardware resources and will be terminated.

Lower values represent lower priorities. Higher values represent higher priorities.

4.2.3.2 Ranges

The following ranges of priorities are defined:

Range	Priorities	Usage	Examples
0	0000 - 0999	*reserved for future use*	
1	1000 - 1999	Low priority services of Multiscreen-Server	PiP Download
2	2000 - 2999	Standard Multiscreen streaming services	
3	3000 - 3999	High priority services	Primary HDMI output (priority = 3500) Recording High priority Multiscreen services
4	4000 - 65535	*reserved for future use*	

4.2.3.3 Priorities for services of the Multiscreen-Server

The classification of services of the Multiscreen-Server to either range "1" or "3" is defined by the Manufacturer and the Operator in mutual agreement. The exact values are defined by the Manufacturer according to the features and the conflict management algorithm of the Multiscreen-Server.

As an exception, the priority for outputting content via the primary HDMI interface of the Multiscreen-Server is fixed at 3500.

4.2.3.4 Priorities for Multiscreen streaming services

Priorities for Multiscreen streaming services are set by Novaspread-S when allocating a virtual tuner (see section 4.2.2). Novaspread-S may change the priority of an allocated virtual tuner at run time.

Novaspread-S selects the proper priority based on the following:

- The general algorithm as set up by the Multiscreen-App (see section 4.2.4)
- The request mode as requested by the Multiscreen-App (see section 4.2.4)
- Privileges of certain Multiscreen-Clients (e.g. for a paired Multiscreen-Client or through provision of a correct PIN code)
- The time of allocation

Multiscreen streaming services usually have a priority in range "2", but they are not restricted to that. E.g. a privileged Multiscreen-Client may get a priority of 3501.In that case, HDMI output may have to be stopped as a result of the streaming request if there are not any other alternatives.

4.2.4 INTERFACE FOR MULTISCREEN-APPS

Multiscreen-Apps cannot directly set a priority value for their streaming requests. This is managed by Novaspread-S. Instead, Multiscreen-Apps have two possibilities to influence the priorities of Multiscreen streaming services.

General algorithm

A Multiscreen-App can choose between three general algorithms to influence the management of priorities:

LIFO:	Services which have started more recently get lower priority.
FIFO:	Services which have started more recently get higher priority.
RANDOM:	The time when the service has started does not influence the priority.

Request mode

For each stream request the Multiscreen-App can choose between two request modes:

BEG:	The stream request is only accepted if there is not any hardware resource conflict.
FORCE:	The stream request is accepted even if other Multiscreen streaming services have to be terminated to fulfil the request.

Guidelines for App-Developers are provided in document [6].

4.2.5 PROCESSING STREAM REQUESTS

Stream requests are processed as follows:

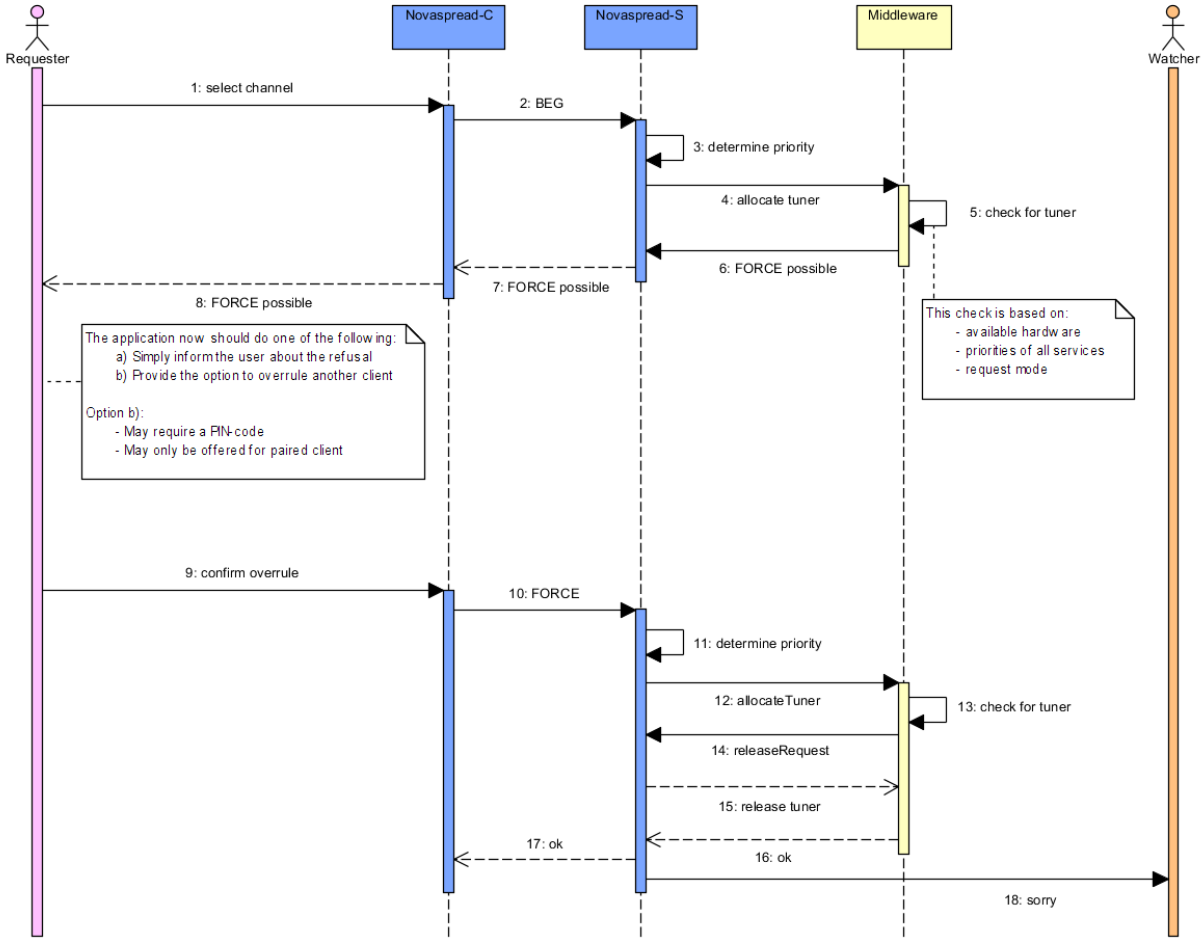
- The Multiscreen-App requests a stream providing physical tuning data and the request mode ("BEG" or "FORCE").
- Novaspread-C sends the request to the Multiscreen-Server.
- Novaspread-S determines the priority value for the request.
- Novaspread-S tries to allocate a virtual tuner from the middleware.
- Depending on available resources, the priority values of all involved services, and the allocation request mode the middleware does one of the following:
  - Provide the requested tuner
  - Terminate services of lower priority and provide the requested tuner [1]
  - Refuse a request of mode "BEG" but inform Novaspread-S that an allocation in mode "FORCE" would be successful [2]
  - Refuse request
- Depending on the result Novaspread-S starts streaming using the provided tuner or it informs the Multiscreen-Client about the refusal.

1: The proper selection of services with low priority is explained in section 4.2.7.

2: In this case the Multiscreen-App could ask the user if it was acceptable if other Multiscreen-Clients lost their streams. If the user confirms, the Multiscreen-App resends the request but this time in mode "FORCE".

The implementation of hardware resource conflict management at the Multiscreen-Server is further described in document [3].

The following sequence diagram illustrates a typical example of conflict management after a stream request:



4.2.6 PROCESSING SERVER REQUESTS

The middleware can request Novaspread-S to release virtual tuners of lower priority if this is required for high priority services of the Multiscreen-Server. Novaspread-S cannot refuse such release requests.

The proper selection of services with low priority is explained in section 4.2.7.

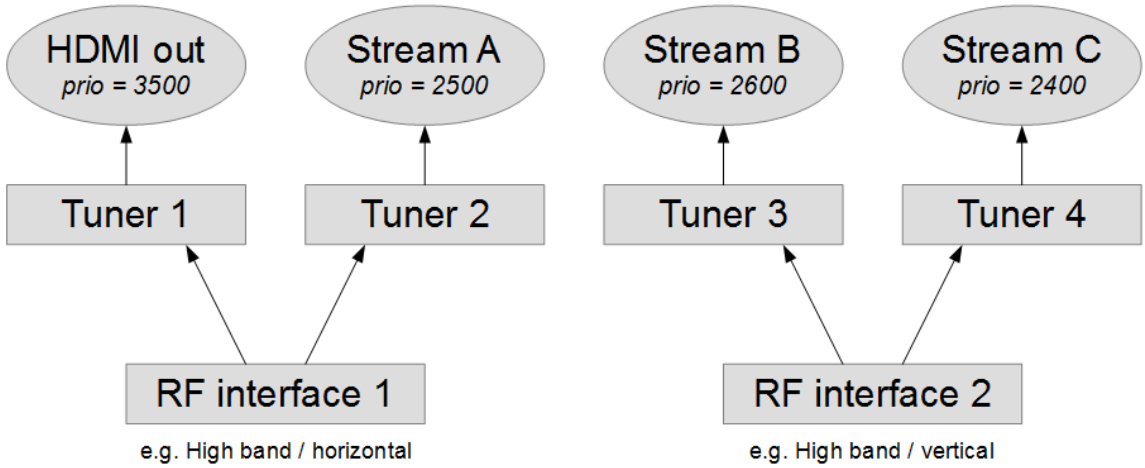
4.2.7 SELECTION OF LOW PRIORITY SERVICES

If a hardware resource conflict shows up due to a new service request, the middleware must decide which of the active services will be terminated. In standard cases it is sufficient to terminate the service with the lowest priority and use the released resources for the new service. If all active services have higher priority than the new service, the request is refused. However, in special cases this method may not be successful and the unnecessary termination of the service with lowest priority should be avoided. The most common examples for such cases result from sharing satellite IF levels due to a limited number of RF interfaces.

Typical Multiscreen-Servers include four DVB frontends but only two RF interfaces. That means only two satellite intermediate frequency (IF) levels (i.e. combinations of frequency range and polarization) can be received in parallel. Consequences are:

» The RF interfaces must be shared between several virtual tuners.
» Requesting a Multiscreen stream or another service on a third IF level leads to a hardware conflict.

As an example the following use case may be given:



If the user now selects a new service for the HDMI output but this service is broadcasted on the low band, a hardware conflict arises in regards to the RF interfaces even though "Tuner 1" stays available for the HDMI output. Even though "Stream C" has lowest priority, the middleware does NOT terminate that service since the required RF interface would still not become available for the new service. Instead, "Stream A" is terminated because it has the next lowest priority and its termination releases an RF interface.

If in the same example "Stream B" had a priority of 2450, the middleware would request the release of both "Stream B" and "Stream C". "Stream A", which would have higher priority, would continue to run.

4.3 TRANSCODING

There may be three reasons for transcoding the original DVB service before it is streamed to a Multiscreen-Client:

1. The home network does not provide sufficient bandwidth.
2. The Player does not support the original codec.
3. The Player cannot process the stream fast enough.

In these cases the Multiscreen-App can request transcoding to a different video format or reducing the bandwidth. For this the Multiscreen-App may provide a user interface to enhance or reduce the streaming quality. The transcoding request is signalled as defined in document [12].

4.4 IDENTIFICATION OF SERVER DEVICES

Multiscreen-Servers are advertised in the home network according to UPnP:

- The Device type is `urn:ses-com:device:SatIPServer:1` as defined in document [11].
- The device description includes the additional tag for transcryption `<satip:X_SATIPCPT>` as defined in document [12].
- The device description includes a service with a type compliant to the format `urn:{operator}:service:freetvarc-service:{version}` as defined in document [20].

This allows for the discovery of three different types of servers:

- Full-fledged Multiscreen-Server (including both a SAT>IP server and a FreeTV RC server)
- Stand-alone SAT>IP server (without Multiscreen)
- Stand-alone FreeTV RC server (without Multiscreen)

The Multiscreen-App could support any of these servers depending on the business model of the Operator.

4.5 CHANNEL MANAGEMENT AND CHANNEL SELECTION

The client interface to request a channel requires the following:

- Physical tuning parameters
- DVB triplet (i.e. Original Network ID, Transport Stream ID and Service ID)
- Information whether the service is an HD service
- Information whether the service is encrypted

The Multiscreen-App should get these parameters from the Backend. Alternatively, the Multiscreen-App could use the Novaspread interface to read the DVB triplets from the Multiscreen-Server while using tuning parameters that are coded in the Multiscreen-App.

It is also possible to synchronize the channel lists in the Multiscreen-Client and the Multiscreen-Server using Novaspread (see document [6]).

In any case Novaspread implements detection of the IDs of the elementary streams (PIDs) which are required for SAT>IP (see document [11]).

4.6 ADDITIONAL SECURITY CONCEPTS

4.6.1 RESTRICTION OF PARALLEL STREAMS

The Operator can restrict the following:

- Overall number of parallel streams
- Number of concurrent streams that are carrying the same content but are sent to different Multiscreen-Clients

The latter can be signalled either for the whole platform or independently for each DVB service.

Evaluation and execution of these rules is implemented by Novaspread-S.

4.6.2 CLIENT AUTHENTICATION

Novaspread-S prevents unauthorized access to the Multiscreen features. This is implemented using TLS client authentication.

Details are defined in documents [20] and [10].

4.6.3 PAIRING

Novaspread supports Pairing of a Multiscreen-Server and a Multiscreen-Client. The basic concept is defined in document [20]. Pairing can be used for the following:

1. To prevent non-paired Multiscreen-Clients to control the Multiscreen-Server
2. To give the paired Multiscreen-Client a higher priority compared to non-paired Multiscreen-Clients if both request resources

ANNEX A REFERENCE MULTISCREEN-SERVER

This annex defines requirements on a reference Multiscreen-Server (RMS).

A.1 BASIC REQUIREMENTS

The RMS **shall** be a DVB-S/S2 compliant HDTV receiver based on document [1].

A.2 ARCHITECTURE

A.2.1 HARDWARE

A.2.1.1 DVB frontends

The RMS **shall** include two RF interfaces.

At least the following satellite receiving installations **shall** be supported:

- Connection to Single LNB with one cable
- Connection to Dual LNB with two cables
- Connection to Multiswitch with one cable
- Connection to Multiswitch with two cables
- Single Cable distribution for single-dwelling installations (see section 5.4.2 of document [1])

The RMS **shall** include four DVB-S/S2 frontends each of them including a tuner and a demodulator.

The requirements in section 8.2.2 of document [1] **shall** be met for each of the frontends.

The frontends **shall** provide the necessary resources to meet the requirements on DVB middleware as defined in section A.2.2.2.

A.2.1.2 Decoder

The RMS **shall** support the following video coding schemes:

- MPEG-2, MP@ML (see document [17])
- H.264/AVC, MP@L3 (see document [18])
- H.264/AVC, HP@L4 (see document [18])

The RMS *may* also support video coding schemes according to H.265/HEVC (see document [19]).

The RMS **shall** support the following audio coding schemes:

- MPEG-1, Layer II (see document [23])
- Dolby Digital (AC-3/DD) (see document [22])
- Dolby Digital Plus (E-AC-3/DD+) (see document [22])

A.2.1.3 Transcoder

The RMS **shall** include two A/V transcoders.

The transcoders **shall** at least support the following for H.264 video content as defined above:

Input format	Output format
1080i	1080i (with reduced bit rate)
1080i	720P
720P	720P (with reduced bit rate)

Unauthorized access to content during the transcoding process **shall** be prevented.

A.2.1.4 Home network interface

The RMS **shall** include at least one Ethernet interface supporting a data rate of at least 100 Mbit/s (also known as “Fast Ethernet”) with an RJ-45 connector as physical network connection (100BASE-T).

The RMS *should* provide a WLAN interface (embedded or via USB stick) based on the IEEE 802.11n standard.

Note 11: The home network interface is used by both the SAT>IP client (to receive streams from a SAT>IP LNB) and the SAT>IP server (to distribute streams to Multiscreen-Clients).

A.2.1.5 Front panel

On the front panel the Multiscreen-Server **shall** visually indicate if it is currently streaming. This indication *may* be realized e.g. using a front display or LEDs.

If there is only one bicolour LED, it **shall** be implemented as follows:

- Whenever the Multiscreen-Server is streaming, colour 1 (e.g. white or blue) is turned on.
- If the Multiscreen-Server is not streaming but recording, colour 2 (e.g. red) is turned on. The same colour can be turned on if the Multiscreen-Server is in deep stand-by mode.
- If the Multiscreen-Server is active (i.e. HDMI output is activated) but neither streaming nor recording is running, the LED is turned off.

A.2.2 MIDDLEWARE

A.2.2.1 Power states

The RMS *should* implement the power state concept as defined in document [2]. That concept *should* be realised using the Wake-on-LAN stand-by mode.

A.2.2.2 DVB

The DVB middleware **shall** support all satellite installations as listed in section A.2.1.1.

The DVB middleware **shall** be able to dynamically configure the connections between the two RF interfaces and the four tuners in all possible combinations.

It **shall** be possible to process transport streams coming from the DVB frontends and transport streams coming from a SAT>IP LNB in parallel.

The DVB middleware **shall** be able to process at least four independent DVB services in parallel. This **shall** include:

- Tuning
- Demodulation
- Demultiplexing
- Descrambling

The DVB middleware **shall** support processing the four DVB services independent of them being either encrypted or unencrypted.

Services of the RMS **shall** have the following priorities (see section 4.2.3):

Recordings:	3501 - 3999
HDMI:	3500
Other:	1000 - 1999

In regard to transcoders Multiscreen-Clients **shall** have highest priority.

The DVB middleware **shall** regularly filter all currently processed DVB services for their ECMs and EMMs in parallel.

Note 12: The filtered ECMs and EMMs are interpreted by Novaspread-S.

The DVB middleware **shall** update the PMT as part of a transcoding process (see document [12]).

A.2.2.3 CASS

The RMS **shall** integrate the Nagravision Conditional Access Kernel (CAK) version 7.7.

A.2.2.4 DRM

The RMS **shall** integrate the server component of the DRM system of Nagravision (DVL) version 3.1.0.

A.2.2.5 Novaspread

The RMS **shall** integrate Novaspread-S as defined in document [3].

A.2.3 EMBEDDED APPLICATIONS

A.2.3.1 Setup

Satellite receiving installation

The RMS **shall** provide a menu to configure all satellite receiving installations as listed in section A.2.1.1.

Home network

The RMS **shall** provide a comfortable and easy way to connect it to the home network.

At least the following two mechanisms to set up the network parameters (IP address, DNS server etc.) of the RMS **shall** be provided:

1. An automatic mechanism based on the Dynamic Host Configuration Protocol (DHCP)
2. A method to set the parameters manually

The default mechanism **shall** be the automatic one (1).

Identification

The RMS **shall** provide a menu to display and change a friendly name identifying the device in the home network. This menu **shall** display a corresponding icon, too.

Note 13: The friendly name and the icon are also used by Novaspread-S for UPnP service advertisement.

A.2.3.2 Navigator

The RMS *should* provide means to synchronize its channel lists and EPG data with those used by Multiscreen-Apps.

ANNEX B REFERENCE MULTISCREEN-BOX

This annex defines requirements on a reference Multiscreen-Box (RMB).

B.1 FEATURES

The RMB **shall** be able to request, receive, and present streams that are delivered by Multiscreen-Servers and stand-alone SAT>IP servers.

The RMB **shall** support both TV and Radio streams.

The RMB *should* support Teletext, Subtitles, Hard of Hearing, and Radiotext as defined in document [1].

The RMB *should* provide displaying information about the present and following event as signalled in the EIT.

The RMB **shall not** forward any content received from a Multiscreen-Server to any other device.

The RMB *may* provide other features as long as these features do not contradict the concepts and requirements of this document.

B.2 ARCHITECTURE

B.2.1 HARDWARE

B.2.1.1 A/V output

The RMB **shall** include an HDMI connector of version 1.3 or later.

There **shall not** be any other interface to output A/V content.

B.2.1.2 Home network interface

The RMB **shall** include a network interface to connect it to the local home network. This interface *may* be Ethernet or WLAN. Apart from that all requirements of section A.2.1.4 **shall** apply.

B.2.2 MEDIA PLAYER

B.2.2.1 HD formats

The RMB **shall** be able to display the following HD formats:

» 720p50
» 1080i50

B.2.2.2 Codecs

The RMB **shall** be able to handle the video coding schemes as specified in section 5.1.1 of document [1].

The RMB **shall** be able to handle the audio coding schemes and downmixes as specified in sections 5.2.1 and 5.2.2 of document [1].

B.2.3 MANAGEMENT OF THE MULTISCREEN-APP

B.2.3.1 Application framework

The RMB **shall** include an application framework for downloading and executing a dedicated Multiscreen-App.

The application framework **shall** be based on one of the following operating systems:

- iOS (version 8 or later)
- Android

The application framework *may* be used for download and execution of other applications, too.

B.2.3.2 Installation

The Multiscreen-App *may* be installed during production.

In the following cases the RMB *should* check for the newest version of the Multiscreen-App:

- As part of the first installation
- As part of the boot process
- Regularly in operational mode

If a new version is available, this version *should* be automatically downloaded and installed. This *should not* interfere with the currently running version.

A downloaded Multiscreen-App *should* be stored persistently.

A new version of the Multiscreen-App *should* become active as part of the next boot process.

B.2.3.3 Runtime

The Multiscreen-App *should* always run as long as the RMB is in operational mode. I.e. if the user has not requested the Multiscreen-App or has exited it, the Multiscreen-App *should* continue to run in the background.

Note 14: This allows for ongoing UPnP discovery and ongoing Backend processes required by the Operator.

B.2.3.4 Launching

The RMB *should* provide a direct interaction element to launch the Multiscreen-App. This *may* be a dedicated button on the remote control unit (RCU) and/or a short-cut button in the main menu.

The RMB *should not* provide an alternative downloadable or embedded application to request streams from Multiscreen-Servers or stand-alone SAT>IP servers.

B.2.4 INTERNET CONNECTION

B.2.4.1 Setup

The RMB **shall** provide a comfortable and easy way to connect it to the Internet.

At least the following two mechanisms to set up the network parameters (IP address, DNS server etc.) **shall** be provided:

1. An automatic mechanism based on the Dynamic Host Configuration Protocol (DHCP)
2. A method to set the parameters manually

The default mechanism **shall** be the automatic one (1).

B.2.4.2 Operation

The RMB **shall** regularly check if it is connected to the Internet.

If the connection is lost, a proper message **shall** be displayed. The message *should* stay on screen until the connection is re-established or the user opens the setup menu. During the time of disconnection the Multiscreen-App **shall** stay deactivated.

B.3 SAFETY REQUIREMENTS

The RMB **shall** comply with the safety requirements as defined in section 8.2.14 of document [1].

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85774 Unterföhring

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For more information about SES, visit

www.ses-ps.com or email **info@ses-ps.com**