IEC 62516-3

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Terrestrial digital multimedia broadcasting (T-DMB) receivers – Part 3: Common API

Récepteurs pour diffusion multimédia numérique terrestre (T-DMB) – Partie 3: API commune

IEC 62516-3:2013

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Terrestrial digital multimedia broadcasting (T-DMB) receivers – Part 3: Common API

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The text of this standard is based on the following documents:

CDV	Report on voting
100/2020/CDV	100/2110/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62516 series, published under the general title *Terrestrial digital multimedia broadcasting (T-DMB) receivers*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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TERRESTRIAL DIGITAL MULTIMEDIA BROADCASTING (T-DMB) RECEIVERS –

Part 3: Common API

1 Scope

This part of IEC 62516 describes the T-DMB common application program interface (API). It provides a software platform that, when combined with the T-DMB O/S, forms a universal interface for application programs. This interface allows application programs to be written in such a way that they run on any T-DMB receiver unit, as described in IEC 62516-1:2009 and IEC 62516-2:2011 regardless of its manufacturer.

This part of IEC 62516 also defines a software environment that allows multiple application programs to be interoperable on a single receiver unit by sharing the fixed resources of the receiver, and it provides a set of interfaces that the T-DMB middleware and the ASIC specific software use.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62516-1:2009, *Terrestrial digital multimedia broadcasting (T-DMB) receivers – Part 1: Basic requirements*

IEC 62516-2:2011, *Terrestrial digital multimedia broadcasting (T-DMB) receivers – Part 2: Interactive data services using BIFS*

ETSI EN 300 401 v1.3.3, *Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers*

3 Abbreviations

ADC	Analog to Digital Converter
API	Application Programming Interface
ASIC	Application Specific Integrated Circuit
FIC	Fast Information Channel
HAL	Hardware Abstraction Layer
ISR	Interrupt Service Routine
MAC	Media Access Control
PAD	Program Associated Data
RF	Radio Frequency
R-S	Reed Solomon
SDIO	Secure Digital Input/Output
SI	Service Identifier
T-DMB	Terrestrial-Digital Multimedia Broadcasting

O/S Operating System

4 T-DMB common API overview

4.1 T-DMB receiver overview

A T-DMB receiver provides the device functionality specified in the T-DMB receivers (see IEC 62516-1:2009 and IEC 62516-2:2011). Figure 1 shows the block diagram of a typical T-DMB receiver. For the T-DMB receiver depicted in Figure 1, only those blocks that conform to the scope of this standard are shown.

Figure 1 also shows the T-DMB common API with respect to the T-DMB receiver block diagram.

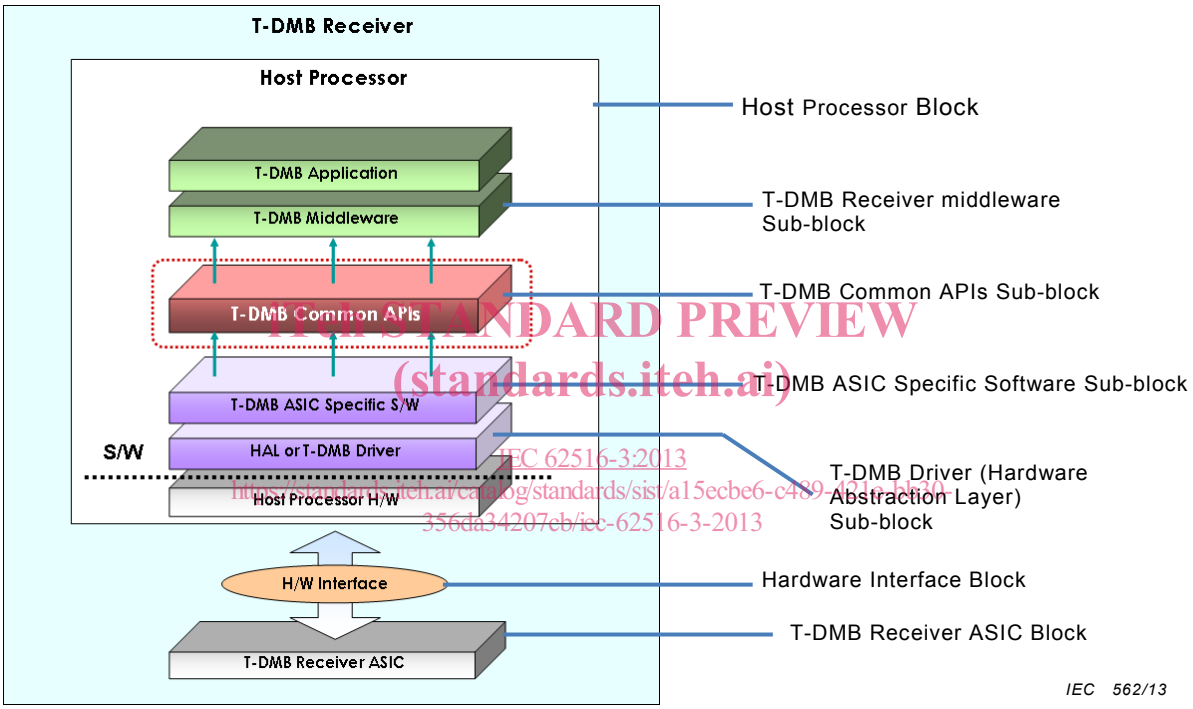


Figure 1 – Block diagram of a typical T-DMB receiver

4.2 T-DMB receiver ASIC block

The T-DMB receiver ASIC block represents the semiconductor hardware that provides the functionality of demodulating a T-DMB signal and retrieving data carried by the T-DMB physical layer. This block provides functionality like RF front-end, ADC, timing and frequency estimation, channel estimation, viterbi decoding, etc. In short this block provides the complete physical layer implementation of ETSI EN 300 401 v1.3.3. Depending upon the implementation, this block can also provide outer decoding functionality (e.g. R-S decoding and/or convolutional de-interleaving).

4.3 Host processor block

4.3.1 General

The host processor block represents the T-DMB functionality provided by the host processor in a T-DMB based device. In other words, this represents the host processor hardware and the software implementation residing in the host processor. The host processor block retrieves and processes the T-DMB information obtained from the T-DMB receiver ASIC block. The T-DMB information retrieved consists of multiplex configuration information received on fast

information channel (FIC), content received on the main service channel. This block communicates with the T-DMB receiver ASIC block to retrieve the information received from the T-DMB signal. The host processor block consists of the following functional sub-blocks.

4.3.2 T-DMB driver (hardware abstraction layer) sub-block

The T-DMB Driver or hardware abstraction layer (HAL) Block represents the driver level software in the main processor that directly interfaces with the T-DMB receiver ASIC block. The T-DMB driver sub-block provides controller functions (e.g. turning on or turning off the T-DMB receiver ASIC block) and data exchange functions (e.g. retrieving the data from the T-DMB receiver ASIC block or conveying the characteristics of a sub-channel to be received) for a given T-DMB receiver ASIC hardware. The T-DMB Driver software is specific to the type of hardware interface mechanism that exists between the Host Processor Block and the T-DMB Receiver ASIC block.

For example, the T-DMB driver software will be different depending upon whether the hardware interface between the main processor and the T-DMB receiver ASIC block is interrupt driven, implemented with memory mapped address/registers or packet based transaction interface like SDIO. Some examples of tasks performed by T-DMB driver sub-block are:

- hardware interactions such as initialization, sleep or wakeup triggers;
- data exchange with hardware such as emptying hardware buffers into main memory or providing ISR implementation.

The T-DMB driver software functions are tightly coupled with the T-DMB receiver ASIC hardware and are considered time sensitive in nature. Therefore the T-DMB driver software is typically given a higher priority with respect to other sub-blocks shown. For example, the T-DMB driver performs the tasks of retrieving the data received by the T-DMB receiver ASIC block or instructing the T-DMB receiver ASIC block to tune to a frequency as requested by the application layer.

4.3.3 T-DMB ASIC specific software sub-block

T-DMB ASIC specific software sub-block provides the MAC layer functionality not covered by the T-DMB driver sub-block. Depending upon the division of MAC layer functionality across different sub-blocks, it may provide complete or partial MAC layer functionality. At the least, the T-DMB ASIC specific software sub-block is expected to provide high level MAC layer functionality that is not practical to be delegated to T-DMB driver sub-block. It interfaces with the T-DMB receiver middleware sub-block using the T-DMB common APIs.

4.3.4 T-DMB common APIs sub-block

The T-DMB common APIs sub-block defines the interfaces that allow the T-DMB ASIC specific software sub-block to communicate with the T-DMB receiver middleware. Any T-DMB receiver middleware that adheres to the interfaces defined by the T-DMB common APIs will work with any T-DMB ASIC specific software sub-block that adheres to these interfaces as well. More details on this interface are provided in the rest of this standard.

4.3.5 T-DMB receiver middleware sub-block

The T-DMB receiver middleware sub-block communicates with the T-DMB ASIC specific software sub-block using the T-DMB common APIs. The T-DMB receiver middleware implements the control and stream layer and provides the interface with application layer protocols. It triggers the T-DMB ASIC specific software to receive the specified contents as requested by the application layer. It acts on the notifications or content provided by the T-DMB ASIC specific software. It delivers any content received from the T-DMB ASIC specific software to the application layer protocols.

4.4 Hardware interface block

The hardware interface block represents the hardware interface mechanism that exists between the host processor block and the T-DMB receiver ASIC block. This interface provides the communication and data exchange functionality. The T-DMB driver sub-block uses this block to exchange commands and data with the T-DMB receiver ASIC block. The hardware interface block can be any desired interface, such as proprietary bus interface or a standard based interface (e.g. SDIO).

5 API description

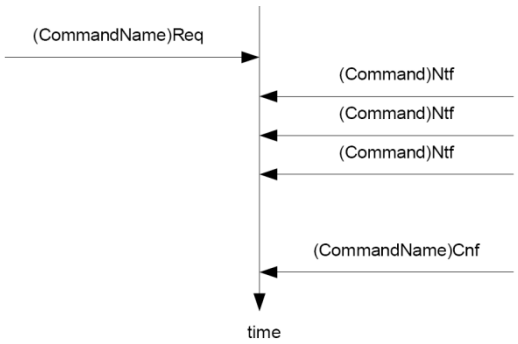
5.1 T-DMB common APIs

This clause provides a detailed description of each T-DMB common API. The API function prototype details are provided along with defined types needed by the T-DMB common APIs.

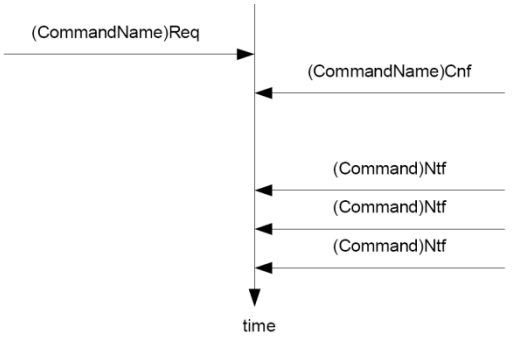
Commands are executed by sending requests, confirmations and notifications. Figure 2 shows three different command patterns. These are used in the T-DMB common APIs.

If commands are interleaved which means two commands running at the same time, an arbitrary sequence of message types is possible.

a) Req - Cnf Command Pattern



b) Req - Ntf - Cnf Command Pattern



c) Req - Cnf - Ntf Command Pattern

IEC 563/13

Figure 2 – Three different command patterns

5.2 Command types

5.2.1 General

The commands supported by the T-DMB common APIs can be categorized as follows.

- API-inquiry functions:
  - GetAPIVersion: Returns the API version.
  - Get T-DMBCapability: Returns API's T-DMB receiver capabilities and properties.
- Selecting an ensemble:
  - Tune: Tunes directly to a specified frequency.
  - Search: Searches for an ensemble.
- Accessing service directory:
  - SelectSI: Subscribes to service directory information.
  - GetEnsembleInfo: Gets information about a specified ensemble.
  - GetServiceInfo: Gets information about a specified service.
  - GetComponentInfo: Gets information about a specified component.
- Monitoring reception conditions:
  - SelectReceptionInfo: Subscribes to reception condition information.
- Selecting services:
  - SelectComponent: Starts or stops a service. In case of an audio/video service decoding of audio/video samples is started automatically. In case of a data service, the service can be accessed with the SelectObject command.
  - SelectApplication: Launches a T-DMB application.
  - SelectComponentStream: Gets access to the packet stream of the component.
- Selecting objects:
  - SelectObject: Requests data objects for delivery with or without automatic updating.
- Scanning for T-DMB services:
  - Scan: Scans a specified frequency range for T-DMB ensembles and updates the service directory.
- Miscellaneous:
  - OperationControl: accesses and modifies parameters of the receiver.
  - GetLocationInfo: retrieves location information from the receiver.

5.2.2 Get receiver capability

Figure 3 shows the get receiver capability. The T-DMB common APIs asks the T-DMB receiver for its capabilities.

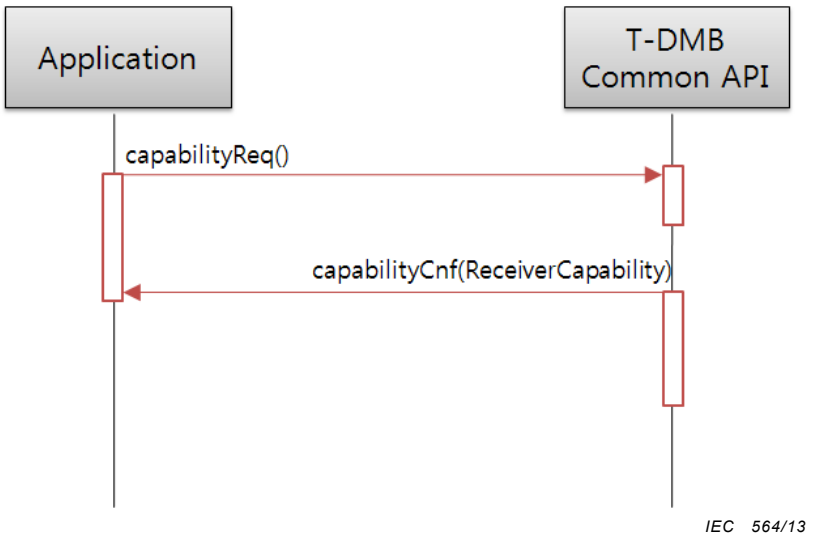


Figure 3 – Get receiver capability

void capabilityReq ()

The T-DMB Common APIs asks the T-DMB receiver for its capabilities.

Parameters

None

void capabilityCnf(ReceiverCapability)

T-DMB receiver provides its capabilities to the API.

5.2.3 Tuning

Figure 4 shows the tuning. The T-DMB receiver is tuned by calling tuneReq. The receiver tunes to the requested frequency and responds afterwards with tuneCnf confirmation. The confirmation contains information about the reception quality.

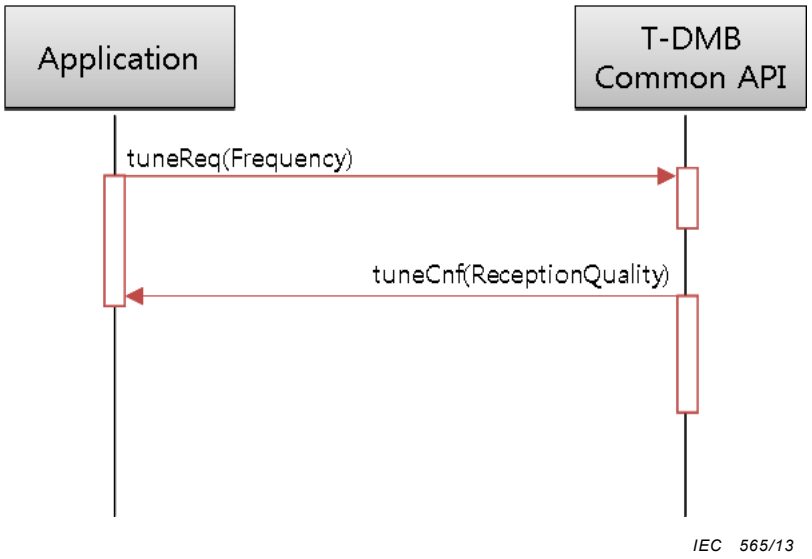


Figure 4 – Tuning

void tuneReq(int tuneFrequency,int transmissionMode)

The tuneReq request initiates the Tune command. The Tune command sets directly a specified T-DMB frequency. A T-DMB receiver shall be tuned to a T-DMB frequency and synchronized in order to get access to T-DMB services. A tuned T-DMB receiver tries automatically to synchronize on a T-DMB ensemble. The Tune command is used to select a

specified T-DMB frequency. Depending on the specification for the transmissionMode it is tested if a T-DMB ensemble can be detected. If the connected T-DMB receiver supports automatic detection the default setting for transmissionMode can be used. Otherwise it has to be specified which transmission modes should be tested. The result of the command is delivered by the tuneCnf confirmation. All currently existing selections of audio and data services or selections of data objects are automatically stopped before tuning is performed by the T-DMB receiver.

Parameters

- tuneFrequency – This parameter specifies the frequency the T-DMB receiver will be tuned to in hertz.
- transmissionModes –
  This parameter specifies the transmission modes a T-DMB receiver tests for T-DMB ensembles. The default value is T-DMBConstants.transmissionModeAutomatic which means that the receiver is automatically detecting the transmission mode. The parameter is a flag field supporting the following flags which can be specified together:
  - T-DMBConstants.transmissionModeAutomatic: The transmission mode is automatically detected. All other flags are ignored in this case.
  - T-DMBConstants.transmissionMode1: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 1.
  - T-DMBConstants.transmissionMode2: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 2.
  - T-DMBConstants.transmissionMode3: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 3.
  - T-DMBConstants.transmissionMode4: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 4.

void tuneCnf(TuneCnfEvent e)

The TuneCnf method finalizes a Tune command and is sent as a response to a TuneReq message. It provides information about the currently selected T-DMBfrequency and reception conditions. The Tune command is used to select a specified T-DMBfrequency. The tuneReq request initiates the Tune command. The tuneCnf finalizes the Tune command and provides information about the reception state. This includes the selected frequency, the detected transmission mode and the synchronization state of the receiver.

5.2.4 Searching

Figure 5 shows the searching. To search for some ensemble, the application calls searchReq. The T-DMB common APIs respond with a notification that the search has started. Other notifications are sent in between depending on the search method (e.g., a 16 kHz step was made). The transaction ends with a searchCnf confirmation containing the resulting state of the search process.

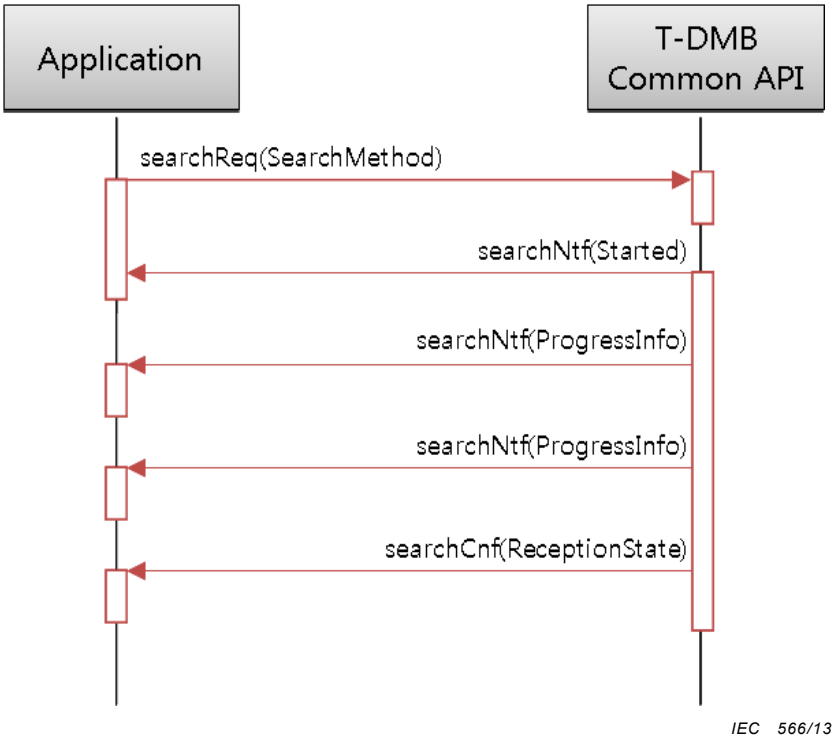


Figure 5 – Searching

void searchReq(
int searchMode,
int tables,
int startFrequency,
int stopFrequency,
int transmissionModes,
int notifications)

The searchReq request initiates a Search command. The Search command searches for a T-DMB ensemble according to a specified search mode. After a successful execution of the Search command a T-DMB ensemble has been found, the state Tuned is entered and the T-DMB receiver tries to synchronize automatically to the found T-DMB ensemble. The Search command is used to search for a T-DMB ensemble. The searchReq request initiates the search and specifies the frequencies and transmission modes to test. Additionally, the notifications that the T-DMB client gets can be specified while the command is executed. Searching for an ensemble may require a substantial amount of time from only a second up to several minutes. This depends also on the search mode specified. If the reception conditions are bad it is possible that no T-DMB ensemble at all is detected. In order to stop searching for a T-DMB ensemble the Tune command can be used which tunes the T-DMB receiver to a certain frequency independent from the reception conditions. The start of searching is indicated by a SearchNtf event with a status code 'Started'. In this case the state machine of the Tune state enters the searching state (see Figure 5). If the previous state has been tuned all currently existing selections of services or objects are stopped automatically. While searching is performed, several notifications delivering information about the current status are sent to the client. The command ends with a SearchCnf event.

Parameters

- **searchMode** – This parameter specifies the way the T-DMB receiver is searching for a T-DMB ensemble. The default value is SearchModeAutomatic which means it is searching according to a default method. The parameter is a flag field supporting the following flags which can be specified together
  - T-DMBConstants.SearchModeAutomatic: default method

  - T-DMBConstants.SearchMode16kHzSteps: The frequency range is searched in 16 kHz steps. This is a very intensive search which means that command execution can take a large amount of time.
  - T-DMBConstants.SearchModeUp: The search direction is from low to high frequencies.
  - T-DMBConstants.SearchModeDown: The search direction is from high to low frequencies.
  - T-DMBConstants.SearchModeUseTables: The search is based on the specified frequency tables.
  - T-DMBConstants.SearchModeUseFrequencyRange: The search is based on the specified frequency range.
  - T-DMBConstants.SearchModeContinuous: The search is looping over the specified frequency range until a T-DMB ensemble has been found. The default is to stop after the specified frequency range has been checked once.
- **tables** – This parameter specifies frequency tables the receiver uses in order to search for T-DMB ensembles. The parameter is a flag field supporting the following flags which can be specified together:
  - T-DMBConstants.searchCEPTFrequencyTableBandIII: The frequencies according to the CEPT frequency table for Band III are tested for T-DMB Ensembles.
  - T-DMBConstants.SearchCEPTFrequencyTableLBand: The frequencies according to the CEPT L-Band table are tested for T-DMB ensembles.
  - T-DMBConstants.SearchCanadaFrequencyTableLBand: The frequencies according to the Canadian L-Band table are tested for T-DMB ensembles.
- **transmissionModes** – This parameter specifies the transmission modes a T-DMB receiver tests for T-DMB ensembles. The default value is T-DMBConstants.transmissionModeAutomatic which means that the receiver is automatically detecting the transmission mode. The parameter is a flag field supporting the following flags which can be specified together:
  - transmissionModeAutomatic: The transmission mode is automatically detected. All other flags are ignored.
  - transmissionMode1: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 1.
  - transmissionMode2: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 2.
  - transmissionMode3: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 3.
  - transmissionMode4: At the specified frequency it is tested if a T-DMB ensemble is sent in transmission mode 4.
- **notifications** – This parameter specifies the type of notifications the client wants to get while the Seek command is performed. The parameter is a flag field supporting the following flags which can be specified together:
  - notificationsOff: No intermediate notifications are sent. Only a SearchNtf notification which informs about the start of searching is sent.
  - notifications16kHzSteps: With each 16 kHz step a notification is sent. This is used only if 16 kHz step searching is specified as search mode.
  - notificationsTableEntry: With each table entry frequency a notification is sent. This is the default value.

void searchCnf(SearchCnfEvent e)

The searchCnf method finalizes a Search command and provides information about the command status, currently selected T-DMB frequency and current reception conditions. The Search command is used in order to search for a T-DMB ensemble according to a specified search mode. Searching for a T-DMB ensemble can take a large amount of time. The start of searching is indicated by a 'Started' searchNtf message. Other searchNtf messages inform a