System Test Document
of
NSC Open Source Project

Digital Audio Broadcasting Receiver

NSC 93-2218-E-027-033

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Section 1. 測試目的與接受準則 (Objectives and Acceptance Criteria)

1.1 系統範圍 (System Scope)

『DAB Receiver』(以下簡稱本系統)的功用在於將 DAB 檔案轉換成 PCM 檔案和 PAD 檔案。本系統一共分為二個部份，分別為 ADS(子系統一)、XPAD(子系統二)。

■ ADS 是將 DAB 檔案解碼成 PCM 檔案；
 ■ XPAD 負責將 DAB 檔案解碼成 PAD 檔案。

本系統著重於解碼的運算速度以及數值運算正確性。

1.2 測試目的 (Purpose of this Document)

本測試文件主要針對本系統進行測試，以便達到以下的目的：

(1) 定義執行方案以便為達成系統的『初步測試』(Beta Testing)與『驗收測試』(User Acceptance Testing)目標作預先的準備。

(2) 與相關的負責單位進行溝通，以便決定系統的測試策略(Testing Strategies)。

(3) 定義可進行驗收的項目(deliverables)與相關的責任區分(responsible)。

(4) 與相關的負責單位進行溝通，以便決定相依性與可能風險(Dependencies and Risks)。

1.3 測試接受準則 (Test Acceptance Criteria)

本測試計劃需要滿足下面的測試接受準則：

(1) 測試程序需要依照本測試計劃所訂定的程序進行，所有測試結果需要能符合預期測試結果方能接受。

(2) 以測試案例為單位，當測試未通過時，需要進行該單元的測試，其接受的準則如第一項中所規定的相同。

(3) 測試時，第一階段將使用 ISO 之測試位元流(test bitstream)，檢驗撰寫完畢之 MPEG-1/2 Layer II 之解碼程式是否完全正確。然後第二階段再使用數位廣播之測試位元流(test bitstream)，做最後之功能確認。

(4) 驗證我們程式所解出來的音訊檔是否達到 12 bit 之精確度。
Section 2. 測試成員及工作指派 (Personnel and Responsibility)

2.1 測試時程 (Testing schedule)

- Iterations
  - Iteration 1 (2005/08/05 ~ 2005/08/10)
  - Iteration 2 (2005/09/01 ~ 2005/09/15)
- Important Dates
  - Test Document Review (2005/09/20)
  - Product Delivery (2005/09/30)

2.2 測試成員及工作指派 (Personnel and Responsibility)

<table>
<thead>
<tr>
<th>縮寫</th>
<th>姓名</th>
<th>縮寫</th>
<th>姓名</th>
</tr>
</thead>
<tbody>
<tr>
<td>YSC</td>
<td>尤信程</td>
<td>CF</td>
<td>顏嘉甫</td>
</tr>
<tr>
<td>HC</td>
<td>張志宇</td>
<td>RZ</td>
<td>李卓瀚</td>
</tr>
</tbody>
</table>

Table 1 Personnel, Responsibility and work days.

<table>
<thead>
<tr>
<th>Test Scope</th>
<th>Test Activities</th>
<th>Personnel</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAB receiver</td>
<td>Integration Plan &amp; Procedure</td>
<td>RZ, CF, HC</td>
<td>5 days</td>
</tr>
<tr>
<td></td>
<td>Perform Integration</td>
<td>RZ, CF, HC</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>Integration Report</td>
<td>RZ, CF, HC</td>
<td>2 days</td>
</tr>
<tr>
<td>ADS</td>
<td>Test Plan &amp; Procedure</td>
<td>RZ, CF</td>
<td>4 days</td>
</tr>
<tr>
<td></td>
<td>Perform Test</td>
<td>RZ, CF</td>
<td>8 days</td>
</tr>
<tr>
<td></td>
<td>Test Report</td>
<td>RZ, CF</td>
<td>2 days</td>
</tr>
<tr>
<td>XPAD</td>
<td>Test Plan &amp; Procedure</td>
<td>HC</td>
<td>3 days</td>
</tr>
<tr>
<td></td>
<td>Perform Test</td>
<td>HC</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Test Report</td>
<td>HC</td>
<td>2 days</td>
</tr>
</tbody>
</table>
Section 3. 测试环境 (Testing Environment)

3.1 操作环境 (Operational Environment)

本系统所需的硬体为 IBM 相容的个人电脑，作业系统需求为 MS-DOS 或 MS-Windows。测试的内容在确认每个 Frame 皆为正确解码，且不需要特殊的环境设定。

- 在 ADS 方面，对每个副程式做测试前，必须先准备好输入资料（使用 ISO 之 test bitstream），以确认 ADS 是否正确执行。
- 在 XPAD 方面，用已知输出结果的 test bitstream 做为输入，再对 XPAD 的输出做比对，确认 XPAD 是否已正确执行。

3.2 硬体需求 (Hardware Specification and Configuration)

<table>
<thead>
<tr>
<th>項次</th>
<th>名稱</th>
<th>數量</th>
<th>規格</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IBM compatible PC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Speaker</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

3.3 軟體需求 (Software Specification and Configuration)

<table>
<thead>
<tr>
<th>項次</th>
<th>名稱</th>
<th>規格</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>軟體 (acquired)</td>
<td>作業系統 Microsoft Windows Microsoft Visual C++ 6.0 With Debug Tools (Debug IDE)</td>
</tr>
<tr>
<td>2</td>
<td>軟體 (acquired)</td>
<td>作業系統 Microsoft Windows Eclipse C/C++ Development Tools 3.0.0 (Debug IDE)</td>
</tr>
</tbody>
</table>

3.4 测试资料来源 (Test Data Sources)

- 以 Subsystem 中的子区块为测试的单位，而输入来源须符合标准 DAB 音讯档格式。

3.5 测试工具与设备 (Tools and Equipments)

本测试计划的执行采用 CPP Unit 是於 Windows 相容性作业系统下，采用 Component 的 Function Structure 作测试的单位：

(1) CPP Unit
(2) Visual C++ IDE
(3) Eclipse C/C++ Development Tools
Section 4. 测试案例 (Test Cases)

4.1 ADS Subsystem Test Cases

4.1.1 Objective and Acceptance
- 确认在 ADS 中的各个子区块皆正常且能正确工作。

4.1.2 Test Software and Hardware
- Test program

4.1.3 T1 Test Cases

<table>
<thead>
<tr>
<th>ADS validation (T1-002)</th>
<th>Decoding of bit allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets</td>
<td>Severity</td>
</tr>
<tr>
<td>ADS</td>
<td>Critical</td>
</tr>
</tbody>
</table>

- Test Instructions
  - **Step 1**: 讀取 DAB test bitstream
  - **Step 2**: 執行 Layer2_decode (可不執行 Layer2_reQuantize 之後之程式)
  - **Step 3**: 查看 bit allocation 的資訊與正確 bit allocation 比较是否相同

<table>
<thead>
<tr>
<th>ADS validation (T1-002)</th>
<th>Decoding of scale-factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets</td>
<td>Severity</td>
</tr>
<tr>
<td>ADS</td>
<td>Critical</td>
</tr>
</tbody>
</table>

- Test Instructions
  - **Step 1**: 讀取 DAB test bitstream
  - **Step 2**: 執行 Layer2_decode (可不執行 Layer2_reQuantize 之後之程式)
  - **Step 3**: 查看 scale-factors 的資訊與正確 scale-factors 比较是否相同
### ADS validation (T1-003)

<table>
<thead>
<tr>
<th>Targets</th>
<th>Severity</th>
<th>Reference</th>
<th>Expected Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS</td>
<td>Critical</td>
<td>Layer2.c</td>
<td>計算 scale-factors CRC，將其與正確之 scale-factors CRC 比較是否相同</td>
</tr>
</tbody>
</table>

- **Test Instructions**
  - **Step 1:** 讀取 DAB test bitstream
  - **Step 2:** 執行 Layer2_decode (可不執行 Layer2_reQuantize 之後之程式)
  - **Step 3:** 查看 scale-factors CRC 的資訊與正確 scale-factors CRC 比較是否相同

### ADS validation (T1-004)

<table>
<thead>
<tr>
<th>Targets</th>
<th>Severity</th>
<th>Reference</th>
<th>Expected Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS</td>
<td>Critical</td>
<td>Layer2.c</td>
<td>輸出處理過後之資料，與正確輸出資料比較正確率</td>
</tr>
</tbody>
</table>

- **Test Instructions**
  - **Step 1:** 讀取 DAB test bitstream
  - **Step 2:** 執行 Layer2_decode (需執行過 Layer2_reQuantize)
  - **Step 3:** 輸出處理過後之資料，與已知的正確輸出比較正確率

### ADS validation (T1-005)

<table>
<thead>
<tr>
<th>Targets</th>
<th>Severity</th>
<th>Reference</th>
<th>Expected Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS</td>
<td>Critical</td>
<td>Layer2.c</td>
<td>輸出處理過後之資料 (PCM)，與已知的正確輸出比較正確率</td>
</tr>
</tbody>
</table>

- **Test Instructions**
  - **Step 1:** 讀取 DAB test bitstream
  - **Step 2:** 執行 Layer2_decode (完整執行)
  - **Step 3:** 輸出處理過後之資料 (PCM)，與已知的正確輸出比較正確率

### 4.2 XPAD Subsystem Test Cases

#### 4.2.1 Objective and Acceptance

- 能正確的分解出 XPAD 記載的資料

#### 4.2.2 Test Software and Hardware

- Test program
4.2.3 T2 Test Cases

<table>
<thead>
<tr>
<th>ADS validation (T2-001)</th>
<th>Decoding of F-PAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets</td>
<td>Severity</td>
</tr>
<tr>
<td>XPAD</td>
<td>Critical</td>
</tr>
</tbody>
</table>

■ Test Instructions
  ■ Step 1: 讀取 DAB test bitstream
  ■ Step 2: 取得 PAD 所在位置
  ■ Step 3: 執行 fpad_decode
  ■ Step 4: 查看輸出處理過後之資料，將其與正確之 F-PAD 比較是否相同

<table>
<thead>
<tr>
<th>ADS validation (T2-002)</th>
<th>Decoding of X-PAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets</td>
<td>Severity</td>
</tr>
<tr>
<td>XPAD</td>
<td>Critical</td>
</tr>
</tbody>
</table>

■ Test Instructions
  ■ Step 1: 讀取 DAB test bitstream
  ■ Step 2: 取得 PAD 所在位置
  ■ Step 3: 執行 xpad_decode
  ■ Step 4: 將相同 group 的資料放在同一個輸出檔

<table>
<thead>
<tr>
<th>ADS validation (T2-003)</th>
<th>Decoding of Dynamic Label Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets</td>
<td>Severity</td>
</tr>
<tr>
<td>XPAD</td>
<td>Critical</td>
</tr>
</tbody>
</table>

■ Test Instructions
  ■ Step 1: 讀取 DAB test bitstream
  ■ Step 2: 取得 PAD 所在位置
  ■ Step 3: 執行 xpad_decode
  ■ Step 4: 查看 X-PAD 之 CRC check 是否相同
  ■ Step 5: 若 CRC check 無誤，將 data 輸出
Section 5. Test Procedure and Schedule

5.1 Test Sequence

- Analysis of DAB system dependency, Test Case and subsystems, and design the following test process:

**Step 1:** Test ADS subsystem and Test Case

**Step 2:** Test XPAD subsystem and Test Case

### Diagram:

**Step 1: Test ADS subsystem**

```
ADS ----> T1
```

**Step 2: Test XPAD subsystem**

```
XPAD ----> T2
```

5.2 Digital Audio Broadcasting Receiver System

5.2.1 Initialization Condition

- All subsystems function normally

5.2.2 Test Cases Sequences

<table>
<thead>
<tr>
<th>Test Cases Sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-001</td>
</tr>
<tr>
<td>T1-002</td>
</tr>
<tr>
<td>T1-003</td>
</tr>
<tr>
<td>T1-004</td>
</tr>
<tr>
<td>T1-005</td>
</tr>
<tr>
<td>T2-001</td>
</tr>
<tr>
<td>T2-002</td>
</tr>
<tr>
<td>T2-003</td>
</tr>
</tbody>
</table>
5.2.3 Termination Condition
- 沒有遇到 defects 或 defects 已被修正的情況下能正常結束程式

5.2.4 Related Schedule
- Please refer section 2.1, 2.2

5.3 ADS Subsystem
5.3.1 Initialization Condition
- 輸入檔案須符合格式

5.3.2 Test Cases Sequences

<table>
<thead>
<tr>
<th>Test Cases Sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-001</td>
</tr>
<tr>
<td>T1-002</td>
</tr>
<tr>
<td>T1-003</td>
</tr>
<tr>
<td>T1-004</td>
</tr>
<tr>
<td>T1-005</td>
</tr>
</tbody>
</table>

5.3.3 Termination Condition
- 沒有遇到 defects 或 defects 已被修正的情況下能正常結束程式

5.3.4 Related Schedule
- Please refer section 2.1, 2.2

5.4 XPAD Subsystem
5.4.1 Initialization Condition
- 輸入檔案須符合格式
5.4.2 Test Cases Sequences

<table>
<thead>
<tr>
<th>Test Cases Sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2-001</td>
</tr>
<tr>
<td>T2-002</td>
</tr>
<tr>
<td>T2-003</td>
</tr>
</tbody>
</table>

5.4.3 Termination Condition

- 沒有遇到 defects 或 defects 已被修正的情況下能正常結束程式

5.4.4 Related Schedule

- Please refer section 2.1, 2.2
Section 6. 测试结果与分析（Test Results and Analysis）

6.1 ADS Subsystem

6.1.1 Test Case Pass Rate

<table>
<thead>
<tr>
<th>Test Case #</th>
<th>Results (PASS/FAIL)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-001</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T1-002</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T1-003</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T1-004</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T1-005</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T1-006</td>
<td>PASS</td>
<td></td>
</tr>
</tbody>
</table>

RATe 100%

6.1.2 效能评估

音讯解碼系統的精確度測量方法是使用 ISO 的 test bitstream。在標準 ISO 的聲音解碼測試檔案中，每一個取樣點都經過標準化(Normalized)過，其值介於 -1.0 ~ +1.0 之間，其檔案格式精確度可到 24Bit，請參考下列方式換算為浮點數：

- MSB $0.5^0 = -1$
- MSB-1 $0.5^1 = 1/2$
- MSB-2 $0.5^2 = 1/4$

...  

- MSB-23 $0.5^{23} = 1/8388608$.  

系統解碼出来的結果必須也符合標準 PCM 的檔案格式。本 DAB 系統解碼出的 PCM 檔案格式為 16Bits，請依下列方式換算為浮點數：

- MSB $0.5^0 = -1$
- MSB-1 $0.5^1 = 1/2$
- MSB-2 $0.5^2 = 1/4$

...  

- MSB-15 $0.5^{15} = 1/32768$
將 ISO 標準 PCM 檔案換算成浮點數的結果 X[i] 及 DAB 系統解碼的標準 PCM 檔案 Y[i]，經由 ISO/IEC 11172-4 Annex A 的方法計算其 RMS 供比對，其方法如下：

\[
RMS = \sqrt{\frac{1}{N} \sum_{i=1}^{N} [\text{norm}(X[i]) - \text{norm}(Y[i])]^2}
\]

X[i] 與 Y[i] 分別表示兩個序列的第 i 個取樣點的值。

Audio Test Accuracy Table:

<table>
<thead>
<tr>
<th>檔名</th>
<th>平均</th>
<th>精確位數</th>
<th>最差的點</th>
<th>誤差</th>
<th>精確位數</th>
</tr>
</thead>
<tbody>
<tr>
<td>fl10</td>
<td>0.000129</td>
<td>12</td>
<td>0.000865</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl11</td>
<td>0.000129</td>
<td>12</td>
<td>0.000857</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl12</td>
<td>0.000129</td>
<td>12</td>
<td>0.000794</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl13</td>
<td>0.000131</td>
<td>12</td>
<td>0.000831</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl14</td>
<td><strong>0.000157</strong></td>
<td>11</td>
<td>0.000883</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl15</td>
<td><strong>0.000173</strong></td>
<td>11</td>
<td>0.000998</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>fl16</td>
<td>0.000119</td>
<td>12</td>
<td>0.000919</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Test02</td>
<td>0.000121</td>
<td>12</td>
<td>0.001059</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Test03</td>
<td>0.000121</td>
<td>12</td>
<td>0.001059</td>
<td>9</td>
<td></td>
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<tr>
<td>Test04</td>
<td>0.000079</td>
<td>12</td>
<td>0.001291</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Test08</td>
<td>0.000121</td>
<td>12</td>
<td>0.001037</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Test09</td>
<td>0.000112</td>
<td>12</td>
<td>0.001256</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

分析：

\[
1/(2^{11} \times 12^{0.5}) = 0.00014095465
\]

除了 fl14 與 fl15 的誤差較大之外，其餘的 RMS 都小於 0.00014095465，精確度接近 limited accuracy ISO/IEC 11172-3 audio decoder。

6.2 XPAD Subsystem

6.2.1 Test Case Pass Rate

<table>
<thead>
<tr>
<th>Test Case #</th>
<th>Results (PASS/FAIL)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2-001</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T2-002</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>T2-003</td>
<td>PASS</td>
<td>DAB 檔案具有 Dynamic Label Segment</td>
</tr>
<tr>
<td>RATE</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
6.2.2 測試資料

■ 用於測試之 DAB 檔案格式如下

<table>
<thead>
<tr>
<th>檔名</th>
<th>Frame 數</th>
<th>XPAD 型態</th>
<th>是否具有 Dynamic Label Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test02.mpg</td>
<td>175</td>
<td>2、3</td>
<td>✓</td>
</tr>
<tr>
<td>Test03.mpg</td>
<td>175</td>
<td>2、3</td>
<td>✓</td>
</tr>
<tr>
<td>Test04.mpg</td>
<td>63</td>
<td>NO XPAD</td>
<td></td>
</tr>
<tr>
<td>Test08.mpg</td>
<td>103</td>
<td>2、14、21、23、28</td>
<td>✓</td>
</tr>
<tr>
<td>Test09.mpg</td>
<td>63</td>
<td>NO XPAD</td>
<td></td>
</tr>
</tbody>
</table>

■ 若 DAB 檔案中具有 Dynamic Label Segment 這種型態，需測試 T2-003 是否正常。
■ 在 Dynamic Label Segment 型態中，可以透過本身的 CRC check 來確認其之正確性。
■ 若 DAB 檔案中存在非 Dynamic Label Segment 型態時，需將該種型態的 XPAD 做完整收集的工作，以便未來能直接拿來做解碼的工作。

6.2.3 測試結果

■ 解碼後可得具有 Dynamic Label Segment 的檔案，經過 CRC check 確認後所解出來的資料皆有“Conformance Testing for DAB Audio”的字串或部分字串。
■ 非 Dynamic Label Segment 型態皆有做相對應的收集
Appendix A Glossary

alias component: mirrored signal component resulting from sub-Nyquist sampling
announcement cluster: group of services which share the same announcement interruption privileges
audio bit stream: sequence of consecutive audio frames
audio frame: frame of a duration of 24 ms (at 48 kHz sampling frequency) or of 48 ms (at 24 kHz sampling frequency)
audio mode: the audio coding system provides single channel, dual channel, stereo and joint stereo audio modes. In each mode, the complete audio signal is encoded as one audio bit stream
bark: see "Critical band"
bark: the psychoacoustic measure in the frequency domain which corresponds to the frequency selectivity of the human ear. The unit of this psychoacoustic measure is called Bark. The Bark scale is a non-linear mapping of the frequency scale over the entire audio frequency range
bit allocation: time-varying assignment of bits to samples in different sub-bands according to a psychoacoustic model
blackout state: the denial of access to a service because it is restricted for some reason (for example, targeted only to a particular geographical region)
bound: the lowest sub-band in which Intensity stereo coding is used, in the case of Joint stereo mode
Capacity Unit (CU): the smallest addressable unit (64 bits) of the Common Interleaved Frame (CIF)
Common Interleaved Frame (CIF): the serial digital output from the main service multiplexer which is contained in the Main Service Channel part of the transmission frame. It is common to all transmission modes and contains 55 296 bits (i.e. 864 CUs)
convolutional coding: the coding procedure which generates redundancy in the transmitted data stream in order to provide ruggedness against transmission distortions
critical band: psychoacoustic measure in the frequency domain which corresponds to the frequency selectivity of the human ear. The unit of this psychoacoustic measure is called Bark. The Bark scale is a non-linear mapping of the frequency scale over the entire audio frequency range
DAB audio frame: same as audio frame, but includes all specific DAB audio-related information
DAB transmission signal: the transmitted radio frequency signal
database key: set of FIG fields that sub-divide a database for certain service information features
data service: service which comprises a non-audio primary service component and optionally additional secondary service components
dual channel mode: the audio mode, in which two audio channels with independent programme contents (e.g. bilingual) are encoded within one audio bit stream. The coding process is the same as for the Stereo mode
energy dispersal: operation involving deterministic selective complementing of bits in the logical frame, intended to reduce the possibility that systematic patterns result in unwanted regularity in the transmitted signal
ensemble: the transmitted signal, comprising a set of regularly and closely-spaced orthogonal carriers. The ensemble is the entity which is received and processed. In general, it contains programme and data services

Extended Programme Associated Data (X-PAD):
the extended part of the PAD carried towards the end of the DAB audio frame, immediately before the Scale Factor Cyclic Redundancy Check (CRC).

Fast Information Block (FIB):
data burst of 256 bits. The sequence of FIBs is carried by the Fast Information Channel. The structure of the FIB is common to all transmission modes

Fast Information Channel (FIC):
part of the transmission frame, comprising the Fast Information Blocks, which contains the multiplex configuration information together with optional service Information and data service components

Fast Information Data Channel (FIDC):
the dedicated part of the Fast Information Channel which is available for non-audio related data services, such as paging

Fast Information Group (FIG):
package of data used for one application in the Fast Information Channel. Eight different types are available to provide a classification of the applications

Fixed Programme Associated Data (F-PAD):
the fixed part of the PAD contained in the last two bytes of the DAB audio frame

intensity stereo coding:
method of exploiting stereo irrelevance or redundancy in stereophonic audio programmes. It is based on retaining only the energy envelope of the right and left channels at high frequencies. At low frequencies, the fine structure of the left and right channel of a stereophonic signal is retained

joint stereo mode:
the audio mode in which two channels forming a stereo pair (left and right) are encoded within one bit stream and for which stereophonic irrelevance or redundancy is exploited for further bit reduction. The method used in the DAB system is Intensity stereo coding

logical frame:
data burst, contributing to the contents of a sub-channel, during a time interval of 24 ms.

logical frame count:
the value of the CIF counter corresponding to the first CIF which carries data from the logical frame

Main Service Channel (MSC):
channel which occupies the major part of the transmission frame and which carries all the digital audio service components, together with possible supporting and additional data service components

masking:
property of the human auditory system by which an audio signal cannot be perceived in the presence of another audio signal
masking threshold: function of frequency and time, specifying the sound pressure level below which an audio signal cannot be perceived by the human auditory system

MSC data group: package of data used for one application in the Main Service Channel. MSC data groups are transported in a series of one or more packets

N: transform length of Fast Fourier Transform (FFT)

null symbol: the first Orthogonal Frequency Division Multiplex symbol of the transmission frame

OFDM symbol: the transmitted signal for that portion of time when the modulating phase state is held constant on each of the equi-spaced, equal amplitude carriers in the ensemble. Each carrier is four-phase differentially modulated from one symbol to another, giving a gross bit rate of two bits per carrier per symbol

packet mode: the mode of data transmission in which data are carried in addressable blocks called packets. Packets are used to convey MSC data groups within a sub-channel

polyphase filter bank: set of equal-bandwidth filters with special phase relationship, allowing for efficient implementation of a filter bank

programme: time-slice of a programme service, corresponding to an entry in a programme schedule

Programme Associated Data (PAD): information which is related to the audio data in terms of contents and synchronization. The PAD field is located at the end of the DAB audio frame

programme item: time-slice of a programme, for example, a piece of music or a news report

programme service: service which comprises an audio Primary service component and optionally additional Secondary service components

protection level: level specifying the degree of protection, provided by the convolutional coding, against transmission errors

protection profile: defines the scheme of convolutional coding applied

psychoacoustic model: mathematical model of the masking behaviour of the human auditory system

replacement: the presentation of another service to a customer for whom a "blackout state" applies

Scale Factor (ScF): factor by which a set of values is scaled before quantization. The numerical code for the Scale Factor is called the Scale Factor Index

Scale Factor Select Information (ScFSI): 2-bit code which indicates for each sub-band how many Scale Factors are coded within the audio frame

service: the user-selectable output which can be either a programme service or a data service

service component: part of a service which carries either audio (including PAD) or data. The service components of a given service are linked together by the Multiplex Configuration Information. Each service component is carried either in a sub-channel or in the Fast Information Data Channel

Service Information (SI): auxiliary information about services, such as service labels and programme type codes
single channel mode: the audio mode, a monophonic audio programme is encoded within one bit stream

stereo mode: the audio mode, in which two channels forming a stereo pair (left and right) are encoded within one bit stream and for which the coding process is the same as for the Dual channel mode

stream mode: the mode of data transmission within the Main Service Channel in which data are carried transparently from source to destination. Data are carried in logical frames

stuffing: one or more bits which may be inserted into the audio bit stream. Stuffing bits are ignored by the audio decoding process.

sub-band: subdivision of the audio frequency range. In the audio coding system, 32 sub-bands of equal bandwidth are used

sub-band samples: the sub-band filter bank in the audio encoder creates a filtered and sub-sampled representation of the input audio signal. The filtered samples are called sub-band samples. From 384 consecutive input audio samples, 12 consecutive sub-band samples are generated for each of the 32 sub-bands

sub-channel: part of the Main Service Channel which is individually convolutionally encoded and comprises an integral number of Capacity Units per Common Interleaved Frame

transmission frame: the actual transmitted frame, specific to the four transmission modes, conveying the Synchronization channel, the Fast Information Channel and the Main Service Channel

transmission mode: specific set of transmission parameters (e.g. number of carriers, OFDM symbol duration). Four transmission modes (i.e. I, II, III and IV) are defined to allow the system to be used for different network configurations and a range of operating frequencies

X-PAD data group: package of data used for one application in the Extended Programme Associated Data
Appendix B References


[2] ETSI TS 101 756, Digital Audio Broadcasting (DAB); Registered Tables, V1.1.1, 2000


[7] MPG123 can be obtained at http://www.mpg123.de/
C.1 Traceability between Test Cases

<table>
<thead>
<tr>
<th>Test Case NO.</th>
<th>1.1.0 ADS</th>
<th>1.2.0 XPAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-001</td>
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<td></td>
</tr>
<tr>
<td>T1-002</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>T1-003</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>T1-004</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>T1-005</td>
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<tr>
<td>T2-001</td>
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<tr>
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