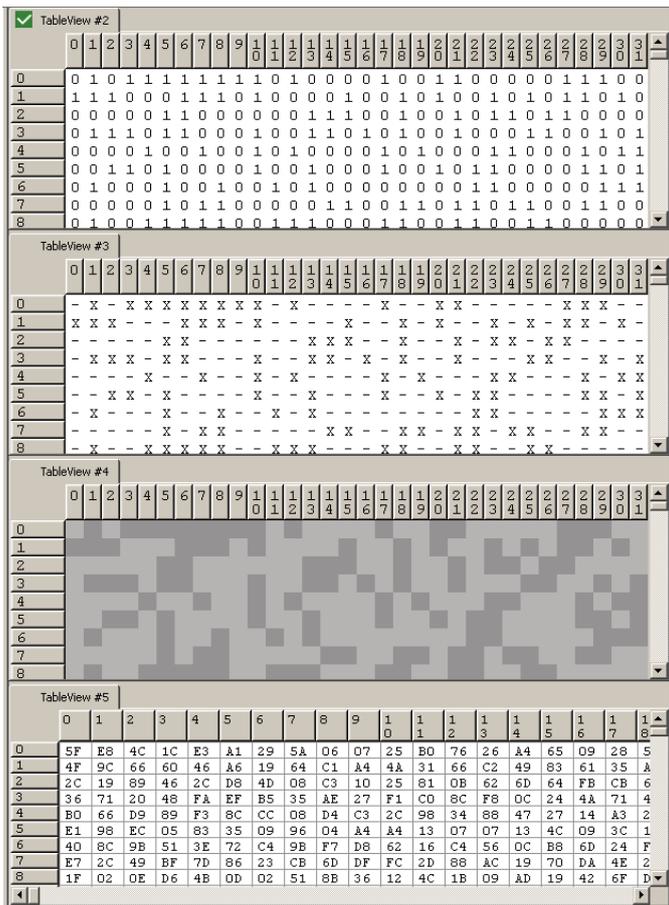


FIG 3 These two displays represent the same bit stream. However, after special processing by the R&S®CA250 bit stream analysis software, the frame structure is easily visible in the right half.

FIG 4 Different display modes simplify the detection of structural features.



Sophisticated: handling frame structures

Overall, several display modes are available to allow improved recognition of structural features (FIG 4). For each of the display modes, grid lines and row or column labels can be enabled optionally.

This initial view is obviously no substitute for in-depth technical analysis, but it does provide a rough idea of the structure and complexity of the data stream.

For comprehensive analysis of frame structures, the following algorithms are available:

- Autocorrelation and cross-correlation
- Tsallis entropy analysis
- Maurer test
- Chi-square analysis
- Configurable pattern search (with analysis of the periodicities of patterns that are detected)

Based on the insights gained by analyzing the structure, the frame content can be extracted. Here too, R&S®CA250 has all of the required tools such as demultiplexers and multiplexers as well as intuitive functions for deleting sections that do not represent any data content.

Challenge: analysis of channel codings

Another major challenge in bit stream analysis involves detecting and processing channel codings. Many of these techniques such as convolution and block codes often occur in the form of non-systematic codings. Unlike systematic channel codings in which user data is clearly delimited from the checksum, no such relationship exists with non-systematic codings since the user data is computed with the checksums.

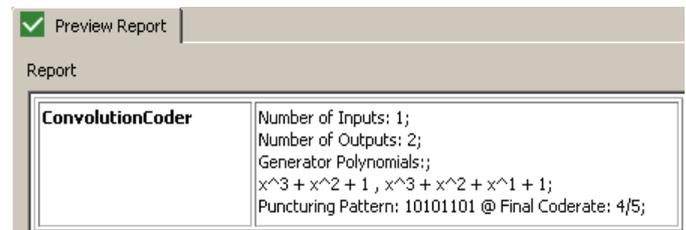
In the case of systematic codes, user data can be recognized even without decoding through simple removal of the checksum; however, decoding is always required with non-systematic codes. This makes algorithms for automatic detection of the channel coding crucial when it comes to selecting the proper decoder. The R&S®CA250 bit stream analysis software automatically detects convolution, Reed-Solomon, BCH, Hamming, and CRC codes.

In addition to the type of channel coding, the automatic algorithm also provides (in the case of convolutional code analysis, for example) the code rate, the generator polynomials, and any relevant puncturing patterns (FIG 5). Of course, R&S®CA250 has a suitable decoder for each analysis algorithm. It also covers the interleavers commonly used in conjunction by offering channel codings by offering a wide spectrum of different types.

A further mechanism that is frequently used in data transmission is scrambling, which involves overlaying a pseudo-random sequence on top of a data sequence. Such pseudo-random sequences are mostly generated using linear feedback shift registers. They simplify clock recovery and help ensure a more uniform spectrum. At first glance, such bit streams appear to be random sequences. However, due to its efficient algorithms, the R&S®CA250 bit stream analysis software can automatically detect the scrambler polynomials that are used. Following successful identification of the scrambler in use, suitable descramblers allow continuation of the analysis process.

Comprehensive: tools for source decoding

The range of applications for the R&S®CA250 bit stream analysis software includes channel decoding as well as the analysis of source codings. A wide range of tools is available to help present the original message in text or audio form. Text data can be decoded using ASCII, ITA alphabet code, Huffmann alphabet code, and many other techniques.



Report	
ConvolutionCoder	Number of Inputs: 1; Number of Outputs: 2; Generator Polynomials;; $x^3 + x^2 + 1$, $x^3 + x^2 + x + 1$; Puncturing Pattern: 10101101 @ Final Coderate: 4/5;

FIG 5 In the case of convolutional codes, for example, the automatic algorithm also provides the code rate, the generator polynomials, and any relevant puncturing patterns.

The following codecs are available for recovering voice signals transmitted in digital format:

- A-law / μ -law (in accordance with ITU G.711)
- ADPCM (in accordance with ITU G.726)
- LD-CELP (in accordance with ITU G.728)
- CVSD (in accordance with STANAG 4209)
- LPC-10 (in accordance with STANAG 4198)
- MELP (in accordance with MIL-STD-3005)

Expandable: script and programming interfaces

Since advanced transmission techniques typically interleave multiple channel coding mechanisms within one another, many analysis and decoding steps can be required to achieve success. However, the user does not have to pay attention to each of these steps since the R&S®CA250 bit stream analysis software fully logs all of the operations with the relevant parameters to allow full concentration on analysis of the respective channel coding layer.

For use in automatic processing of repetitive analysis routines, R&S®CA250 provides a script interface based on the Python script language. This allows the user to quickly and easily enter sequences of analysis tasks, particularly if they are iterative. The clearly structured C++ programming interface allows the user to integrate independently developed algorithms and decoders into the R&S®CA250 bit stream analysis software in an uncomplicated manner.

Summary

By providing a unique range of analysis capabilities combined with a number of decoders and an intuitive user interface, the R&S®CA250 bit stream analysis software is an indispensable tool in radiomonitoring since it helps the user to keep an overview even in heavily occupied frequency bands.

Jörg Biedermann