Technical Article

IZT Test and Measurement Solutions

Virtual Field Tests Using the IZT RecPlay System

- RF recording and replay
- Automotive receiver testing
- Powerful signal analysis

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The ability to record RF signals during test drives and to reproduce them in the laboratory can significantly reduce time-to-market and cost when developing radio receivers. The IZT Record and Replay system (IZT RecPlay) is widely used in the car industry and enables manufacturers to test and to verify their implementations in a very reliable and reproducible way. Applications include in-car entertainment systems with analog and digital broadcasting such as DAB, but also GNSS used for navigation and its relation to traffic information received from broadcast signals.

INTRODUCTION

Field tests are essential when developing radio receivers for DAB or other broadcast standards. Especially, the automotive industry, including suppliers and the car manufacturers perform test drives to cover real-life reception conditions for in-vehicle testing. For example, WorldDAB has published test route recommendations for Norway, Germany and Switzerland so that manufacturers can test their products in comparison to the expected behavior[1]. Typical DAB functionality to be covered during these test drives include Service Following scenarios, Announcement Signaling and all on-air content as well as signaling. Furthermore, all kinds of difficult reception conditions can be monitored and recorded such as Single Frequency Network (SFN) reception, multi-path reception in general and interferences.

While further test routes might be added to the WorldDAB recommendations, manufacturers and their suppliers have defined own routes to verify their receiver implementations. However, variations will occur in the structure of the DAB ensembles as well as reception conditions vary depending on many factors.

IZT's RecPlay system enables the developers to perform virtual field tests, for example to build a data base of RF recordings and to reproduce field conditions in the laboratory. At the one side this ensures reproducible testing conditions. At the other side, development time and costs can significantly be optimized as the number of actually required test drives is reduced.

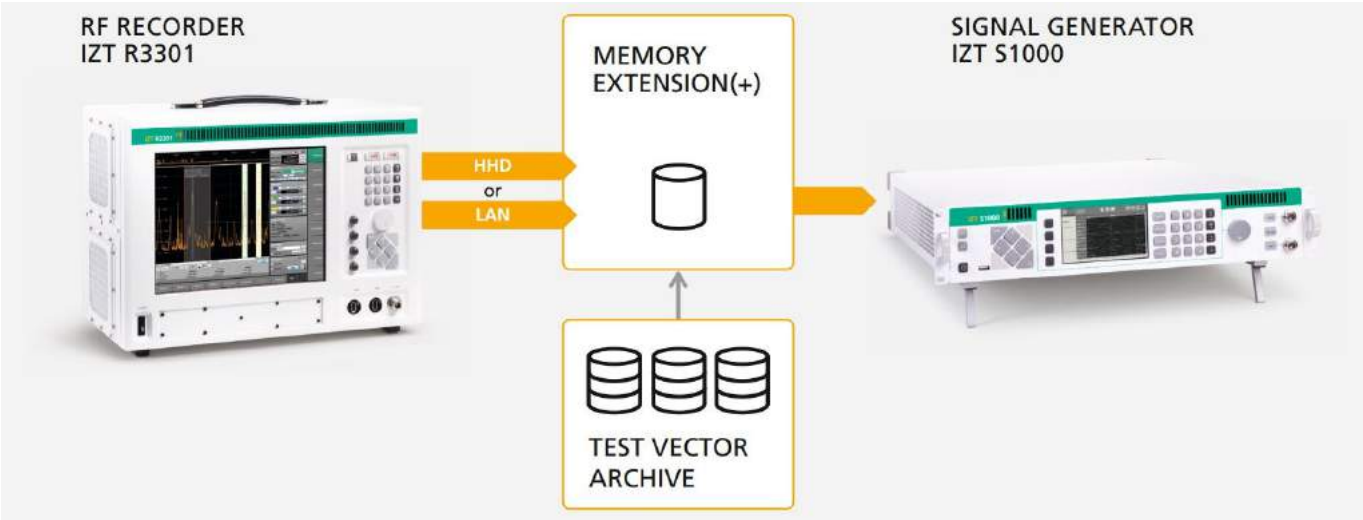

FIGURE 1: ONE-CHANNEL RECORD AND REPLAY SETUP

[1] https://www.worlddab.org/automotive/dab-plus-test-routes

RECORDING AND REPLAY SETUPS

The IZT RecPlay System consists of three components: a recording system, a server with software for offline editing and a signal source to replay the signals. The three components can be chosen depending on customer needs. Possible criteria are:

- Required bandwidth
- Environment at operation site
- Type of application (dynamic or static)
- Which further processing of the collected data is required

To fulfill all requirements, users can select from different RF receiver models, servers and RF signal generators. The R3000 Receiver Family provides various models for each application up to 25 MHz real-time bandwidth and a frequency range from 9 kHz to 3 GHz (6 GHz and 18 GHz options available). All devices out of the IZT R3000 Receiver Family are equipped with matured RF technology. The various models perfectly fit to different use cases due to their rack based, mobile or rugged design.

The IZT R3301 RF Recorder is a complete mobile solution for receiving and recording scenarios with excellent signal quality. The recorder covers the frequency range from 9 kHz to 3 GHz (6 GHz and 18 GHz options available) with a real-time bandwidth selectable up to 25 MHz.

FIGURE 2: PORTABLE MONITORING RECEIVER AND RECORDER IZT R3301 INCLUDING UNINTERRUPTIBLE POWER SUPPLY, BUILT-IN SENSOR CONTROLLER AND SWAPPABLE RAID SYSTEM

Alternatively, small size mobile and rugged single-channel RF recording systems are available. They can be provided by combining IZT R3410 or IZT R3411 Receivers with an external lightweight sensor controller and IZT Signal Suite recorder applications. Mobile sensor controllers based on notebooks are provided in different ready-to-use configurations.

FIGURE 3: COMPACT RECORDING SETUP CONSISTING OF A MOBILE AND RUGGED IZT R3410 AND NOTEBOOK AS A LIGHTWEIGHT SENSOR CONTROLLER

Additional RF recorder platforms are available to fit a variety of customer requirements. The IZT R4000/IZT R4010 features excellent RF performance together with a large real-time bandwidth of 120 MHz. In order to reduce the massive amount of data being collected, it features the unique capability to dynamically extract parts of the full instantaneous bandwidth and record and post process them separately.

FIGURE 4: IZT R4010 RF RECEIVER WITH 120 MHZ BANDWIDTH AND SELECTIVE PROCESSING

The IZT S1000/IZT S1010 Signal Generator is used as replay generator and covers the frequency range from 9 kHz to 3 GHz on two independent RF outputs with a bandwidth of 120 MHz. It allows combining different recorded and calculated scenarios inside this bandwidth.

DIVERSITY AND MULTI-BAND SETUPS

The system is ideal for handling phase-coherent and frame-synchronous recordings with multiple antennas at the same center frequency, for example for validation of diversity radio tuners.

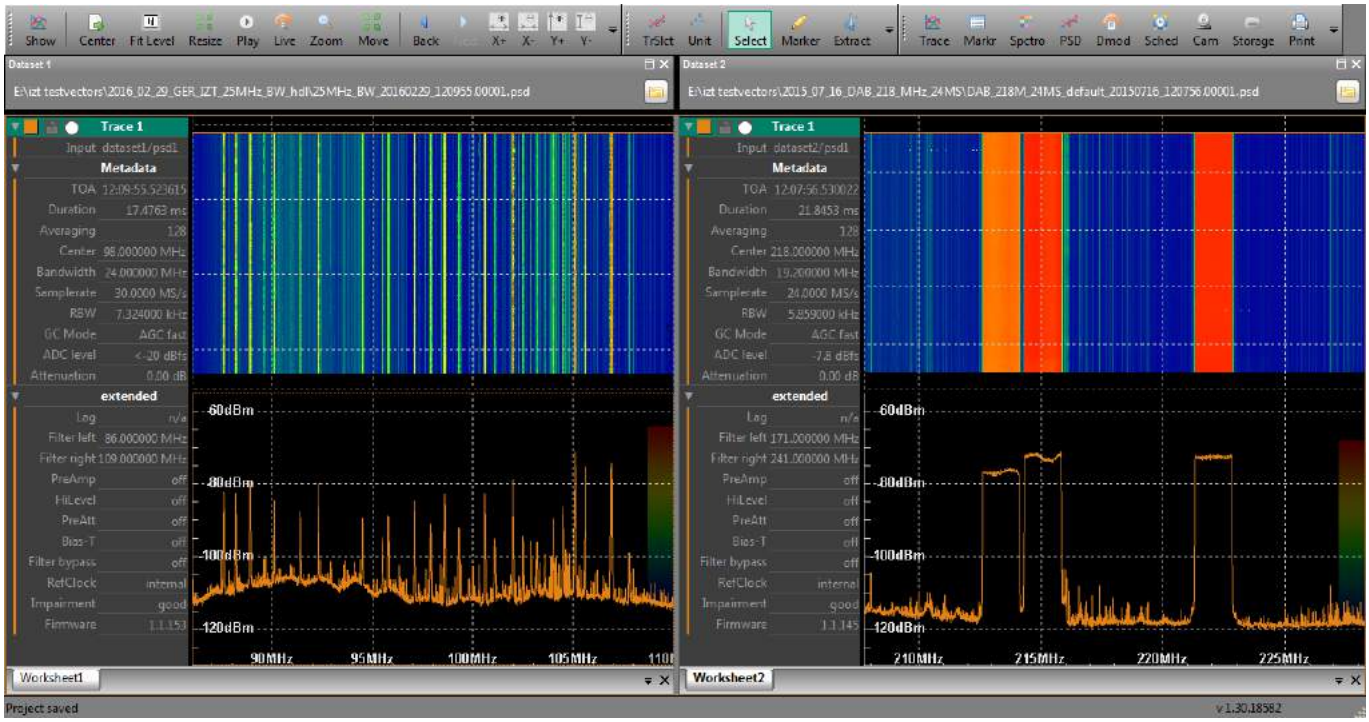

FIGURE 5: SYNCHRONOUS DAB-FM SCENARIO

IZT RecPlay can handle frame-synchronous recording with multiple antenna channels at different center frequencies. For example, DAB and FM can synchronously be recorded and replayed even though they use different frequency bands. This enables testing seamless DAB to FM linking. The setup can also record DAB and GNSS signals at the same time. This challenging use case requires a very high accuracy in signal and data processing of the record and replay system.

SIGNAL PROCESSING AND ANALYSIS

The IZT RecPlay system is complemented by the IZT Signal Suite, a powerful data processing and visualization application that allows reviewing and editing recorded RF signals offline.

The main features are:

- Signal extraction of individual signals
- Fast interactive display of spectrum and spectrogram
- Metadata display, such as receiver settings and location information
- Markers in spectrum and spectrogram, for example reference, delta, TOA
- Processing of diversity and multi-channel recordings

Plug-in interfaces enable various additional functionalities in combination with the Data Processor application. This includes I/Q data import/export, DAB and FM demodulation and map visualization of embedded NMEA data.

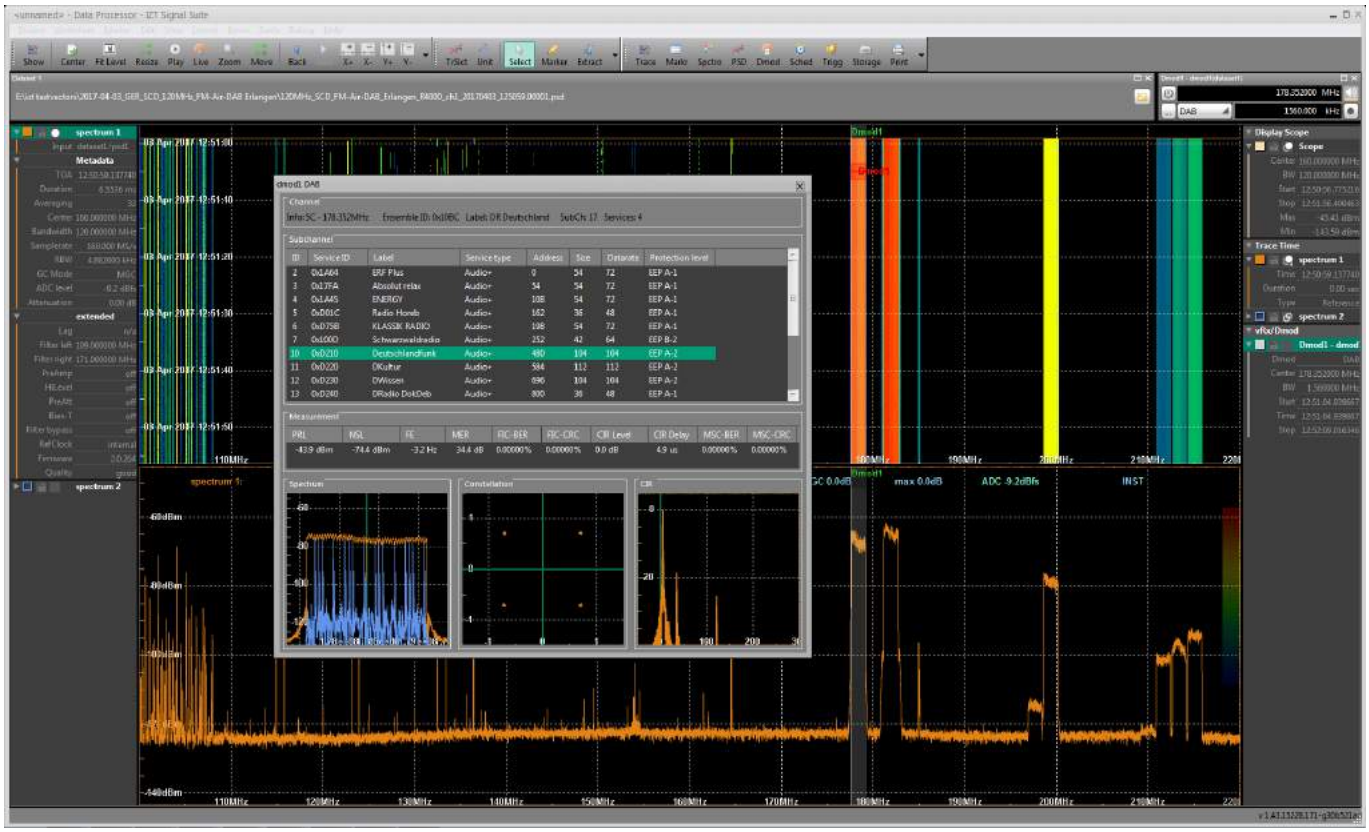

FIGURE 6: DAB SIGNAL DEMODULATION PERFORMED ON A 120 MHZ WIDEBAND RECORDING

The IZT Viewer application enables the user to view and demodulate recordings or signals which have been extracted before.

CONCLUSION

Field tests are essential when developing radio receivers for DAB or other broadcast standards. Especially, the automotive industry, including suppliers and the car manufacturers perform test drives to cover real-life reception conditions for in-vehicle testing. IZT provides recorder and replay platforms in combination with related software solutions. IZT's RecPlay system enables the developers to perform virtual field tests, for example to build a data base of RF recordings and to reproduce field conditions in the laboratory. In consequence, time-to-market and cost can be significantly reduced when developing radio receivers.

FIGURE 7: RECORDER SETUP WITH IZT R3301 AND IZT R3410

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About IZT The Innovationszentrum fuer Telekommunikationstechnik GmbH IZT specializes in the most advanced digital signal processing and field programmable gate array (FPGA) designs in combination with high frequency and microwave technology.

The product portfolio includes equipment for signal generation, receivers for signal monitoring and recording, transmitters for digital broadcast, digital radio systems, and channel simulators. IZT offers powerful platforms and customized solutions for high signal bandwidth and real-time signal processing applications. The product and project business is managed from the principal office located in Erlangen/Germany. IZT distributes its products worldwide together with its international strategic partners. The IZT quality management system is ISO 9001:2015 certified.

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