Bluetooth® Audio Expert System

Key Features and Benefits

- **Total Audio and Protocol Event Correlation**
  Correlates audio, codec, and *Bluetooth* protocol events to a single timeline

- **Real-Time Analysis**
  Displays audio, codec and *Bluetooth* protocol events synched to audio waveforms *as they happen*

- **Superior Root Cause Analysis**
  Pinpoints audio problems related to *Bluetooth* protocol issues

- **Powerful Protocol Analysis**
  Comes fully integrated with Frontline software, providing seamless drill-down to the protocol packet level

- **Visualization of Audio Problems**
  Provides real-time visualization of audio issues time-aligned with *Bluetooth* protocol events

- **Bit Rate Variance Analysis**
  Bit rate graphs highlight *Bluetooth* transport and bandwidth issues that impact audio quality

- **Referenced Mode Analysis**
  Significantly enhances the detail and depth of audio analysis by comparing results with known baseline information

- **Easy to Use**
  Simplifies troubleshooting *Bluetooth*-related audio issues for both experienced and new *Bluetooth* developers

- **Solve Problems Faster**
  Minimizes test cycles and time-consuming guesswork for protocol-related audio issues

TELEDYNE LECROY
Everywhere**you**look™

The Complete Bluetooth® Audio Picture

Until now, the industry-best analysis tools have let you examine the pieces of the *Bluetooth* audio puzzle without ever showing you the complete picture. Frontline's *Bluetooth* Audio Expert System completes that picture by clearly depicting, in one intuitive tool, when and how *Bluetooth* protocol and audio work- and sometimes *don't* work- together.

Your Audio Issues Might Be Related to Your *Bluetooth* Implementation

Does your *Bluetooth*-enabled audio device suffer from poor audio quality when streaming A2DP, poor voice quality in telephone calls when using *Bluetooth* hands-free or a headset, audio disconnects, delays, stutter, or intermittent anomalous noises?

Many audio quality issues are directly related to *Bluetooth* protocol implementation and interoperability. Because these protocol-related conflicts and issues are manifested as audio problems, debugging has typically meant hours of often fruitless guesswork and repeated test cycles.

Call In the Audio Expert

Frontline's *Bluetooth* Audio Expert System is the first and only analysis tool on the market to combine audio analysis with *Bluetooth* protocol analysis, allowing developers to quickly pinpoint the root cause of a wide array of *Bluetooth* protocol-related audio problems.
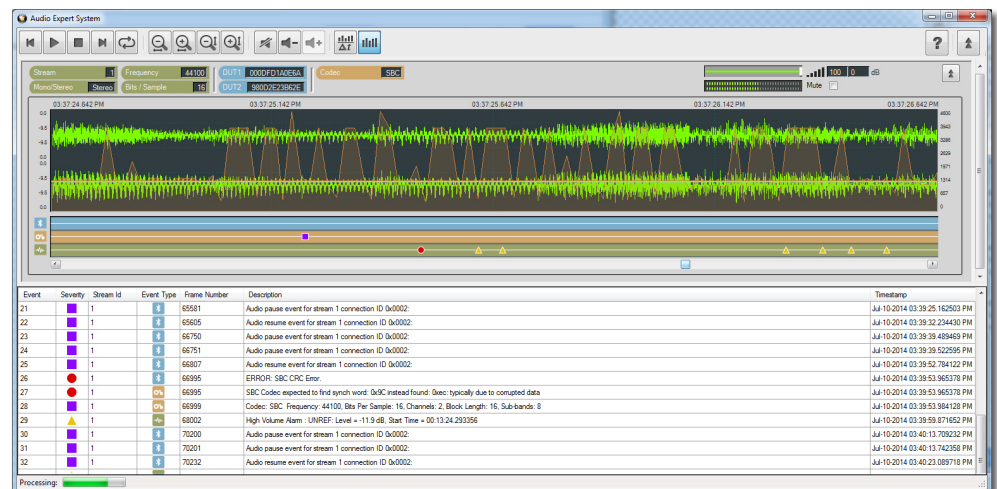
The *Bluetooth* Audio Expert System provides a real-time visualization of audio impairment events that are time correlated with *Bluetooth* protocol and transport events, enabling the user to clearly see and thoroughly understand what's happening at the precise moment audio problems occur. No more guesswork- the *Bluetooth* Audio Expert System visually and in real time correlates protocol, codec and audio events to the moment of the audio error, making root cause diagnoses faster and easier than ever.

How Does it Solve Audio Problems?

Bluetooth frames containing encoded audio data are captured by the Frontline BPA® 600 Dual Mode *Bluetooth* Protocol Analyzer and are passed to the *Bluetooth* Audio Expert System, which displays the audio live in the waveform viewer pane of the Audio Expert System.

Simultaneously, *Bluetooth*, codec and audio events and errors are indicated on a timeline which aligns with the displayed waveform. The *Bluetooth* Audio Expert System time aligns *Bluetooth* audio and the *Bluetooth* protocol traces, identifying three specific event types within the trace: *Bluetooth*, codec and audio events.

An integrated event detail table links back to the Frontline's powerful Frontline software, allowing users to quickly drill down to a specific packet or packet range of interest.

Audio Expert System examines captured (by the BPA 600 Dual Mode Bluetooth Protocol Analyzer) Bluetooth frames containing encoded audio data.

The *Bluetooth* Audio Expert System's referenced mode audio testing uses baseline information to significantly improve audio analysis for easier correlation with *Bluetooth* protocol, codec and bit rate variance data.
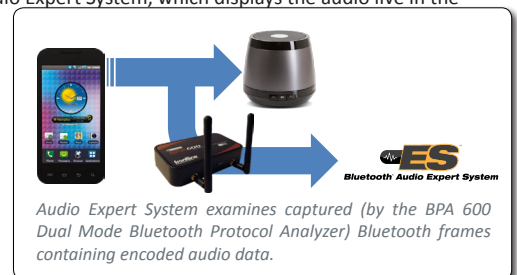
Bit Rate Variance Graphs

When audio data is conveyed over the high-latency *Bluetooth* transport, achieving the correct bit rate becomes difficult and audio quality is impacted. Further affecting latency (which directly affects bit rate) are a wide variety of environmental changes that can impact *Bluetooth*, including:

- Interference (excessive re-transmissions)
- Bandwidth consumption (simultaneous OBEX and audio transfers)
- Changes in Adaptive Frequency Hopping

By overlaying the expected bit rate against the actual audio bit rate and waveform, the *Bluetooth* Audio Expert System can help the developer pinpoint and resolve the actual source of the bit rate problem.

Full Workflow Integration

The Audio Expert System is seamlessly integrated with Frontline's industry-leading Frontline Protocol Analysis System software, allowing for quick and complete *Bluetooth* audio problem-solving:

- Common timestamping of *Bluetooth* protocol data, audio events, audio waveform display, codec events and bit rate variance graphs
- Works with existing Frontline hardware
- *Bluetooth* Audio Expert System data and results are synchronized and coordinated with the existing rich set of Frontline software interfaces for precise and thorough protocol analysis

Files can be exported easily to allow users to conduct tests on encoded raw data using their own codecs, and to further review and analyze .wav files in other audio tools.

Referenced Mode Testing

In a typical unreferenced mode test scenario, audio is captured from a source and is analyzed with no frame of reference. This approach yields information about a limited range of audio characteristics such as clipping, audio drop out, frequency ranges and audio levels.

Audio signal analyzed against no frame of reference results in limited detection of audio issues

The *Bluetooth* Audio Expert System's referenced mode does much more. In referenced mode testing, the user transmits a "known" audio file (a file which has already been analyzed by the *Bluetooth* Audio Expert System for number of key parameters and ranges). The transmitted file is compared against the initial baseline data to provide a far more detailed understanding of how the signal has changed from the sending device under test to the receiving DUT. The identification of variances in audio signal characteristics enables the user to make a truly informed and accurate diagnosis of audio issues that can more readily and rapidly be correlated with *Bluetooth* protocol, codec and bit rate variance data.

Audio signal analyzed against provided reference signal produces faster and more accurate identification of audio issues
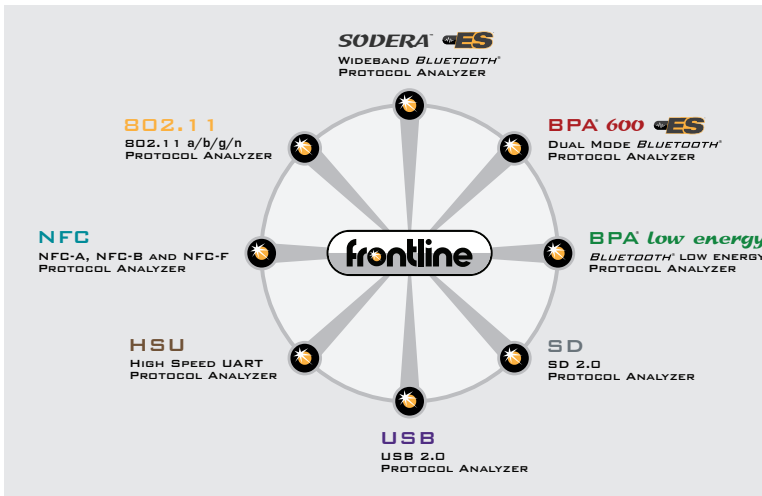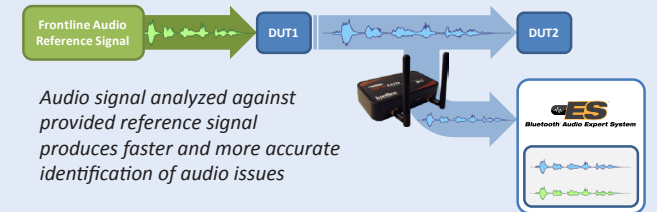
The Frontline Modular Approach

Frontline software is at the core of our protocol analysis products, allowing technology-specific hardware interfaces to work individually or in combination with other hardware interfaces. This modular approach gives the developer or analyst the widest possible range of scenarios for debugging complex communications.

The *Bluetooth* Audio Expert System is a software module of the Frontline Protocol Analysis System software, and analyzes packets captured by the BPA 600 Dual Mode *Bluetooth* Protocol Analyzer. It utilizes OpenSynergy's Blue SDK stack (www.opensynergy.com).

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