Qualis Audio
We're Listening

An Introduction to the Sentinel Surround Sound Audio Monitor

Dr. Richard Cabot, CTO

Welcome, this is a presentation on the Qualis Audio Sentinel, Surround Sound Audio Monitor. This product is designed to monitor surround content for television and film, in production, post production, ingest, transmission and QC. It helps users know what they are producing or transmitting, and insures the delivery of quality audio to the viewer.

Core Issues

- Surround is more complex than stereo
    - More opportunities for error
- Loudness - CALM Act
- Budgets (both $ and time) are shrinking
- Personnel
    - Skilled personnel are very expensive (& rare)
    - People get tired and bored
- Detailed records can be invaluable
    - Keeping records is tedious so it is often skipped
    - When you need them they often aren't there

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One of the core problems in audio today is the shift to surround sound. It is inherently more complex than stereo, both because of the larger channel count and because of the way it is mixed. For example, channel balance problems occur on more dimensions than just left to right, and channel phase problems can manifest themselves on 7 pairwise combinations of channels.

Another crucial issue is loudness.   With recent passage of the CALM Act and similar legislation around the world, content producers and broadcasters are under legal requirements to insure that loudness is maintained within an acceptable range.

This is a world of ever shrinking budgets, both dollars and time. There is less money available and less time to get the job done.

Personnel feel the squeeze and people who are skilled in the subtleties of surround audio are rare and therefore expensive. Additionally, people get tired and bored with repetitive or tedious tasks. When they do, their attention drifts and mistakes get made.

Record keeping is an essential but often neglected aspect of every job. They can often be crucial to document that things were correct should a question arise later or to help track down the problem after the fact if something does go wrong. People dislike keeping records so if you leave it up to individuals to keep records of what they did those records may not be there when you need them.

Product Concept

- Embed audio expertise into algorithms
- Continually monitor surround audio
- Drastically reduce the need to pay attention
- Warn when problems are likely
- Keep detailed records, just in case

This can

- Improve efficiency, productivity and accuracy
- Free personnel for other tasks

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The idea behind the product was to create an electronic listener, to take the expertise of someone skilled in audio, encapsulate it in algorithms and package it in a form that could continuously monitor a surround audio stream. It could warn the user when problems are likely in much the same way that the human listener would. This drastically reduces the need for anyone to pay close attention. When an alarm is received, skilled personnel can look at the problem and decide what needs to be done.

Because the product is a machine it's easy for it to keep detailed records, it will always keep detailed records. You don't need to worry that it will get tired or bored and not bother. The Sentinel measures and logs continuously. The logs may be reviewed at any time or may be automatically merged with as-run information from an automation system to produce reports giving loudness and other audio parameters for each and every show and commercial.

All of this can be a huge assist for personnel, improving their efficiency, productivity, accuracy, reducing their workload and reducing costs across the enterprise.

The Sentinel performs a wide variety of monitoring functions. Principal among these are loudness and true-peak level measurements in full compliance with all ITU, EBU and ATSC standards.

It can measure downmix compatibility. It's unique in that regard, in that it can make numeric assessments of downmix compatibility. You don't have to depend on human beings to interpret dancing figures on a screen to gauge compatibility. When we say compatibility we mean how the surround program will sound if you listen to it in stereo or mono. It may sound great in surround but if you aren't listening to it in stereo and mono you can miss problems that make it sound very different in these formats. These can be interchannel phasing issues that make portions of the program unintelligible or correlated content in multiple channels that result in serious loudness variations.

The Sentinel can perform a basic assessment of intelligibility, letting you know if the dialog will or won't be clearly audible above the other content in the program. This is often critical in live sports production but can be important with other types of program material as well.

The Sentinel finds problems on individual channels such as dead channels, clipping, over-level conditions, hum, etcetera.

There is an extensive metadata monitoring capability which can find problems with inconsistencies across channels or discrepancies between the metadata and the actual channel content.

Sentinel Hardware

- DSP and web server in 1U rack package
- Front panel provides basic control
  - LCD, buttons and knob set network parameters
  - Local display of alarms
- Primary interaction through network connection
  - Real time displays via standard web browser
 - Alarms via email, SNMP or contact closure

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The hardware looks like this. It is a one unit high rack box containing a DSP and a web server. The DSP makes audio measurements and the web server serves those up via a network connection. The front panel includes a basic display, buttons and a knob which are used to set up network parameters and display alarm information locally.

The primary interaction is through the network connection. It allows real time displays of measured data via any standard web browser. It also allows setting of measurement modes, limit values, alarms, reporting methods, etcetera. The alarms may be returned via email, SNMP traps or conventional contact closures.

Log data is accessed over the network and can be stored on any network attached computer or server. This log data can be used to automatically generate reports using the Qualis Audio Visilog report generation software.

External Connections

SENTINEL System Connections
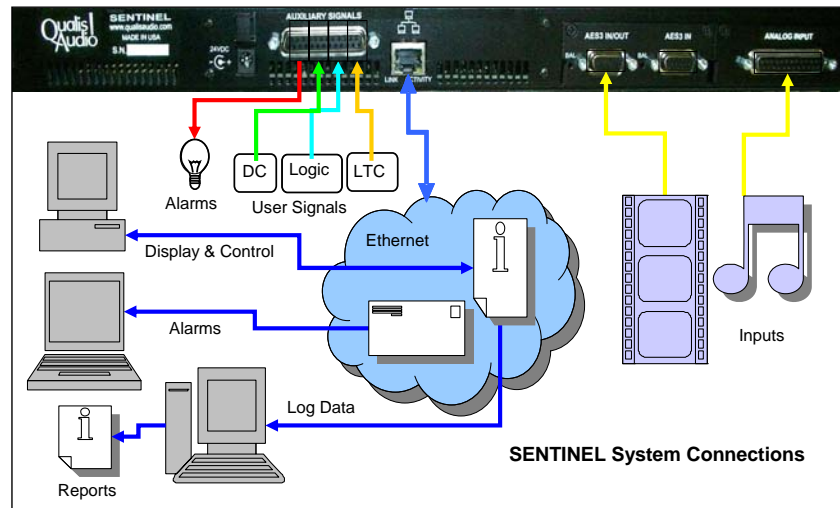
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This is what the rear of the Sentinel looks like, the external connections to it. On the right are the inputs. Your choice of SDI, HD-SDI, AES or analog signals may be applied. The HD-SDI version de-embeds up to 16 audio channels.

The Sentinel connects to your network infrastructure through a standard Ethernet connection. The display of measurements and the control of settings is done through that port using a standard browser. The alarms are also delivered through that port via email or SNMP traps.

The Auxiliary Signals connector accepts timecode, logic signals and DC voltages for monitoring. It is also contains contact closure outputs for conventional alarm reporting.

Applications

- In production:
  - Reduces load on mix engineer
  - Improves consistency
- On transmission:
  - Unattended monitoring, frees personnel
  - Catches problems quickly
- At ingest:
  - Objective and consistent checks of submissions
  - Allows lower skilled operators

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The Sentinel can be used in a wide variety of applications.

In production it can be used to reduce the load on a mix engineer because it's constantly measuring and warns when things go outside the predetermined allowable range. The engineer can focus on the action or on directions from the producer and not have to worry about subtleties in the audio. When problems do occur he is warned and can then look closer at the audio and adjust his mix technique appropriately. It will also inherently improve mix consistency since the same criteria are applied to each session and standards won't shift.

Live Mix Application

Here's an example of a live mix application where the Sentinel is being used to on Sunday morning football. The mix engineer has the display mounted on a stand just above the console bridge. In this application the surround balance display is in the upper left corner, the dialog balance display is in the middle, the loudness meter is on the right and the downmix compatibility display is in the lower left.

Applications

- In production:
  - Reduces load on mix engineer
  - Improves consistency
- On transmission:
  - Unattended monitoring, frees personnel
  - Catches problems quickly
  - Logs all measurements
- At ingest:
  - Objective and consistent checks of submissions
  - Report results back to submitter
  - Allows lower skilled operators

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The Sentinel can be used for transmission, allowing unattended monitoring and freeing personnel to perform other functions in the plant. Problems are reported immediately, much faster than the time it takes for a viewer to notice, find the station phone number and reach someone who can address the issue. Alarms can be reported via contact closures, email notification or SNMP traps. All error reporting and alarm generation includes numerous safeguards to eliminate redundant error reports and drastically reduce false alarms.

When used for ingest applications the Sentinel will perform objective and consistent checks of all audio content. This reduces operator errors. It also provides a documented trail of all material and its conformance. If content fails, this data can be forwarded to the content creator, giving precise information about what needs to be fixed.

Ingest Application

Here's an ingest application where the Sentinel is used exactly as we just described. The operator is free to focus on issues such as profanity and correspondence between the audio and video content (such as having a moving sound follow the same direction as a moving image).
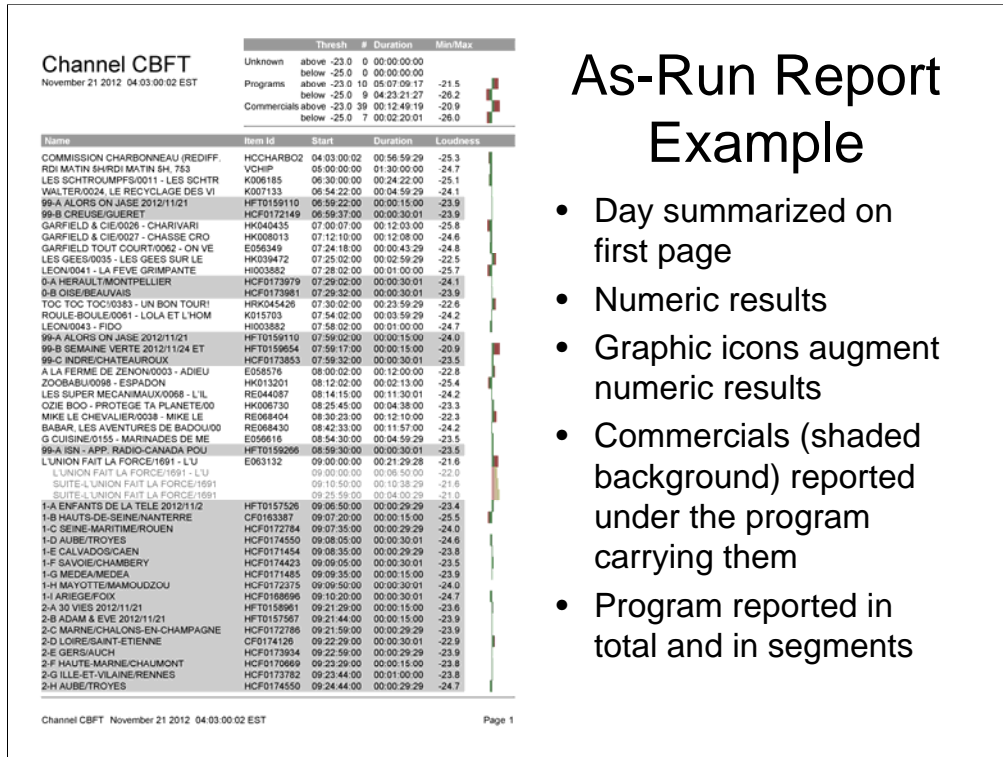
Applications

- Forensics:
  - Extensive analysis ability simplifies troubleshooting
  - Data export to Excel for customized analysis
- Remote monitoring:
  - Simplifies master control operation
  - Personnel may collaborate on problems, even if separated by large distances
- Process control and improvement:
  - Automatic report generation provides rapid feedback
  - Objective characterization gives actionable data

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The Sentinel is very effective in forensic applications, those where something has gone wrong and you need to determine the underlying cause. Its extensive data analysis capabilities and rich user interface greatly simplify troubleshooting. Any range of measured data can be exported to Excel for further customized analysis.

The units network interface allows simple and flexible remote monitoring. This greatly simplifies master control operation, allowing local probes at each monitoring point with a central display of status and problems. The ability for multiple simultaneous user access allows local personnel to collaborate with remotely located technical experts.

Another important application is process control and improvement. The Sentinel has extensive automatic report generation capabilities which provide rapid feedback about content in production, ingest or transmission. Its objective assessment allows reliable decision making and corrective action.

As-Run Report Example

- Day summarized on first page
- Numeric results
- Graphic icons augment numeric results
- Commercials (shaded background) reported under the program carrying them
- Program reported in total and in segments

Here's an example report of loudness tied to a networks as-run logs created by the Visilog report generation software. The example shown here includes a daily summary at the top, followed by numeric and graphical displays for each piece of content. Programs are shown against a white background and commercials are shown against a gray background. The specifics are extensively customizable. The items displayed may include all content or just that which falls outside specified limits. Graphs of loudness throughout the day may be included as can other measurements such as true peak levels or downmix compatibility.

These reports are generated automatically every day with no human intervention. They may be automatically emailed to a distribution list, keeping both management and technical personnel informed and greatly simplifying the implementation of a process improvement system.

Broadcast Plant Architecture
(Sentinel application areas in green)
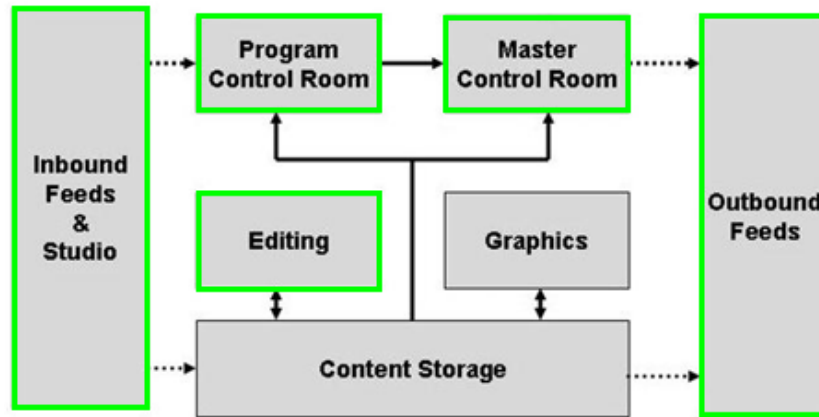
This shows application locations for the Sentinel in a typical broadcast plant. It can be used to monitor inbound feeds, material going through the program control or master control rooms and the resulting outbound feeds. It can also be used by editing personnel at any point where content is altered.

About Qualis Audio

- Founded by Dr. Richard Cabot, DSP and audio measurement expert, co-founder and CTO of Audio Precision, Fellow and former president of the Audio Engineering Society

Key personnel include

- VP of Software David Kellerman, network and UI expert from Northlake Software
- VP of Hardware Steve Tuttle, hardware and firmware expert previously with Tektronix and Quality Checked Software Inc.
- Director of Sales and Marketing Doug Ordon, formerly with Pinnacle and AMS Neve

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Qualis Audio is focused on surround audio measurement and monitoring for the television and film industries.

It was founded by Dr. Richard Cabot whose expertise is digital signal processing for audio measurement. Formerly co-founder and CTO of Audio Precision, he is a Fellow of the Audio Engineering Society and served it in numerous positions, including as president. He holds numerous patents in audio measurement technology, including several on the technology in Qualis Audio products.

Key personnel include:

David Kellerman who develops the networking and user interface software. David was the founder of Northlake Software.

Serving as VP of Hardware is Steve Tuttle who previously developed hardware and firmware at Tektronix and served as an expert on software testing with Quality Checked Software Inc.

Materials at www.qualisaudio.com

- Sentinel Data Sheet and User Manual
- Visilog Reporting Software brochure
- Tech notes on loudness measurement, downmix compatibility, automated QC, etc.
- Information about the Sentinel and its capabilities
- The CALM Act, the FCC NPRM, the comments filed by Qualis Audio and a copy of the FCC Rules and Order
- A loudness meter test suite in file form

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You will find much more information on the Qualis Audio web site at www.qualisaudio.com

There is a data sheet and users manual for the Sentinel.

There is a brochure on the Visilog report generation software.

There are several tech notes on loudness measurement, downmix compatibility, automated audio QC, etc.

There are presentations on detailed aspects of the Sentinel and its capabilities.

Copies of the CALM Act, the FCC notice of proposed rule making, the comments filed by Qualis Audio and a copy of the FCC Rules and Order

Also available on the site is a loudness meter test suite in file form which can be used to verify conformance of any manufacturers meter with the international loudness measurement standards.