The
Broadcasters' Desktop Resource
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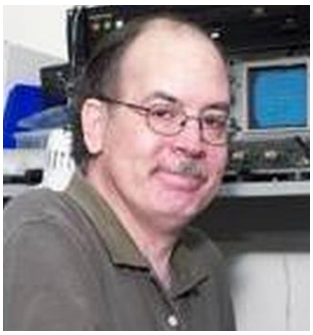
SOUNDING OFF ON AUDIO

Dynamic Range in Radio, Audio & Life



By Bob Burnham

[February 2019] The "sound" of a radio station is a product of many factors, all contributing to what – each Program Director hopes – is a package that attracts listeners. How to get there is the theme of Bob Burnham's thoughts.

At one time – when I was not even yet a teenager – I wondered why songs coming out of a home stereo never sounded quite the same (or as good) as they sounded on the radio.

It would take some years before I would discover what radio stations do to the audio tracks to modify the equalization and then limit the dynamic range of their programming before feeding it into their transmitter. The result is a "signature" sound for the station.

Most of us know the process but the point is that it actually does make the music *seem* to sound better.

Transients that might otherwise cause distortion were squashed, the bass that might otherwise interfere with clarity was controlled, and the characteristics of drum sounds and air talent voices were modified in such a way that made them seem more powerful.

And what was the "secret sauce?" It was audio compression.

IT STARTS WITH GOOD LEVELS

The core of this article is about how accurate transmission of sounds maximizes the effectiveness of the listening experience.

We want our lives to progress in a constant flow with no rough edges, sort of like the waveform of a standard AM broadcast. This is because life itself could probably be described as analog. We are not bits and bytes. We each live in our own little module of existence that constantly changes.

As analog creatures, we create analog sounds, which for various reasons, we deem to be valuable enough to transport, modify, save or distribute.

That could be why we can actually be emotionally affected by the way a radio station sounds. That is if that sound is close to or even resembles what is our idea of great sound. Of course, the content is also part of what causes that reaction as well.

New broadcasters sometimes think we are a little too nit-picky about running good levels in the studio. This discussion will hopefully add some insight and verification that there is actually some wisdom behind our pre-occupation.

A GOOD THING IN BROADCASTING

In terms of sound, dynamic range is the difference between the softest sounds and the loudest sounds.

A limited dynamic range boils down to making the quietest sounds louder – and the loudest sounds quieter. There are various reasons why this is a good thing in certain applications. The listening environment is a factor.

In broadcasting, it is necessary to limit dynamic range so as to make it easier to listen in a typical listening environment, to stay legal, have a presence on the dial, and be competitive. If someone is scanning across the dial and your signal is significantly lower in volume than the competition, you will not be the station where they stop.

In essence, this boils down to audio levels that are consistent.

For example, when driving a car, natural road noise means, when listening, you have, perhaps, a 10 dB range where you would then have to crank up you radio during quiet passages. Fortunately, you may have noticed, you do not have to do so because radio stations limit their dynamic range, at least at most popular music stations (a classical, jazz or public radio station will probably be more conservative with their processing).

However, there can easily be too much of a so-called good thing.

Music can lose its impact when over-processed. Thus, for certain musical applications, limiting dynamic range actually is considered a very bad thing.

PROPER LEVELS

Back in the studio, someone just learning the fundamentals of broadcasting usually is told to make sure levels *never exceed* a certain point on the metering but always average *above* a certain level – and the voice should not blast the metering into the red.

Historically, in the earliest days of broadcasting going back to the 1920s, there actually was an engineer sitting in a radio station's Master Control whose primarily job was to ride gain and ensure the transmitter did not over-modulate.

Using his best guess, his job was to anticipate what was coming next and compensate for any modulation peak that potentially could damage the transmitter, or knock it off the air.

Various devices have been developed over the decades to automatically care for audio peaks, eliminating the job of just riding gain. At minimum, such equipment actually can react much faster than a human – today even having the ability to look-ahead for peaks.

As noted, most of these devices work and sound much better if they are fed what is known as a good level.

Digital processing can be more for-giving (as long as one does not get to close to their absolute peak), but the garbage-in garbage-out maxim is still correct: if it sounds bad going in, it will sound equally bad going out.

HOW THE DYNAMIC RANGE AFFECTS STATION COVERAGE

The general public is not tolerant of a noisy, scratchy listening experience, and you will not find many people listening to shortwave radio or distant AM stations these days.

Maintaining a higher average modulation is especially an important consideration for lower power broadcasters operating on the AM band today. This is because as the distance from the transmitter increases, so does background noise.

When a listener to a weaker AM station has to turn the volume up, they also turn the volume up on background noise that is inherent to standard analog AM broadcasting.

In contrast, in the analog world of AM broadcasting, a station with a higher average modulation level will have greater effective coverage will be more listenable at greater distances because the listener will not have to turn the volume up on their receiver as high as on a poorly modulated station.

ABOUT THAT SOUND

Running so-called good levels in the air studio is only one aspect of building the painting of a radio station. Audio processing artifacts actually created the sound of an era.

In the 1960s and 1970s, the pumpy vacuum cleaner sound and reverb were often key components of the songs that were popular at that time. Today, digital signal processing is often used to recreate that sound, helping us recall nostalgic feelings.

By the time multi-band processing, along with separate processors for microphones, became common place, technology found a way for talent to sound big and full, without that constant sucking sound. Those of us who worked on-air at that time will not soon forget how big our voices were made to sound in the headphones (and leading many of us to considerable hearing loss today).

The important point is that the dynamic range was being restricted in all cases. Newer technology, lower noise gear and source audio along with better-designed studios allow us to modify the dynamic range so that it was less obvious to listeners.

Restricting dynamic range and manipulating audio to function as an end product, is in fact, an art form, with many different stages of artistry.

The end result is clearly apparent when I punch up a station that clearly stands out with a round full, yet crystalline sound – and, as the programming transitions, the sound never degrades. I *know* there is a certain brand of processor in use, likely with a certain pre-set appropriate for the format designed by the manufacturer.

Then if I go to Station B and it sounds good but, in comparison, very flat and lifeless, I would tend to return to Station A, even if the programming content was less desirable.

WHERE IT STARTS

The sound of a station really starts in the recording studio. Actually, that sound starts the very first time an artist uses his voice or plays an instrument – still in purest analog form.

There is but one chance to capture it properly at that stage and as needed, mix it properly with other instruments, and balance the dynamic range. In fact, the earliest engineers were referred to Balance Engineers.

If you are listening to a station that sounds great, full of punch, guts, pristine, and crisp without sounding harsh, or whatever words you want to use describe, it is due to a combination of things including a good engineer at the station, good equipment, and good control or manipulation of the dynamic range and tonal balance of audio from the original recording studio.

A voice-over recording in a Production studio certainly falls into the same category but so does the rest of the programming content.

TRANSFER TO DIGITAL

Most often, analog audio passes into a digital domain at least once. In recent years, taped or vinyl copies of audio tracks have been generally replaced by CDs, or other digital copies that can be downloaded.

Digital audio on a standard Compact Disc or .wav file typically has a dynamic range of 90 to 100 decibels. A standard analog VU meter has not even half that range – perhaps showing (as you can see above, about 25 dB).

A typical cassette or reel-to-reel tape recorded above that range would be distorted, or be really hissy if recorded below that range.

With widespread use of home-burned CDs, often there is not much consideration paid to dynamic range. It is often determined by whatever level the source recording was made when it was first transferred to a digital format.

Consumer-oriented CD burning software has made some effort to help the average person make their CDs sound a little more like commercially produced CDs. They have a process called normalizing.

NORMALIZING EFFECTS

Normalizing does not reduce the dynamic range. It merely moves it to a different (usually higher) level.

It is also not audio compression in the sense that we think of it.

What it does is find the highest peak in a song and sets that peak to a level determined by the user.

Whatever the percentage of increase is, the entire song will be increased by that same amount. For example, if that peak was at 80% and you normalized it to 95%, a 15% increase would be applied across the board. Thus, a segment of audio that peaked at 50% would then be increased to 65%.

MORE THAN JUST LEVELS

Normalizing does not make audio sound more "punchy."

By normalizing, one would merely get a louder CD; it would not seem perceptively louder, because the overall *average level* was not changed. Only the peaks were raised.

For a signature sound, you need true audio compression as well as a modification of tonal balance. Today, software is readily available that can modify an existing sound recording in such a way that it can closely approximate of what most advanced processors are capable.

Modification of the actual dynamic range is a standard attribute, but the methods of modification so as to introduce little or no undesirable artifacts (or to introduce desirable artifacts) are some of the coolest facets that evoke an emotional response.

PUNCHING IT UP

With today's audio processing, the audio does not always return to analog until it gets to the transmitter or receiver.

This means careful handling of the audio in the program chain is important to maintain quality and avoid cascading algorithms that can really muddle a station's sound.

Have you ever noticed the snap of bass drum in a popular music song recorded 30-40 years ago still can be heard clearly over the radio today?

If so, there is no doubt key roles were played by the recording engineer who sat patiently in that studio, the one who set up a certain microphone a certain way, as well as the maintenance engineer who painstakingly aligned the recording machine all played a role in how that radio station can have that sound at that moment.

If at any point along the journey, the raw analog waveform were seriously clipped or otherwise grossly damaged in such a way that is audible, that station would not sound as good at that moment. Of course, audio restoration is also an art form in itself, but restored audio that has been seriously damaged can never come close to audio that has remained pristine from the microphone to the speakers in the car.

LISTENING TO THE MASTERS

It is instructive to consider the work of some of the pioneers in recording and audio processing techniques.

Although many of them have passed away, their efforts led to where we are today.

For example, among the giants in the recording industry was the late Roger Nichols, an 8-time Grammy Award winner for his technical achievements. He was responsible for the sound of every Steely Dan song you have ever heard and countless other artists you have heard on the radio; even Frank Sinatra!

Before succumbing to cancer in 2011, Nichols was extremely active in his later life, teaching an audio mastering class, creating custom plug-ins for Pro Tools, and writing a book. His family arranged for publication of his book, ***The Roger Nichols Recording Method*****.** More info is at www.rogernichols.com

On the British side, Geoff Emerick, who passed away last year from a heart attack, was responsible for a large body of work at EMI (Abbey Road Studios) and elsewhere that gave the Beatles and others their legendary sound. That sound rivals any studio recording made today.

Emerick wrote a book a few years ago called *Here, There and Everywhere."* The book gives tremendous insight into how he achieved great sound even when technology was "primitive."

Another related book that helps the reader get back to basics is: *All You Need is Ears*, is by Sir George Martin, who passed away in 2016 at age 90. His son, Giles, is apparently following in his father's footsteps with remarkable re-issues of the elder Martin's earlier work.

MASTERS OF THE MIDWEST

On the radio side here in the Midwest, the legendary signature sound for AM radio in the 1960s through the early 1980s came from Windsor, Ontario, Canada.

CKLW, at 800 kHz, covered a large portion of the U.S. and Canada with its 50 kW signal. Ed Buterbaugh was the engineer who achieved a superb multi-band processed sound early in the development of the technology.

You *knew* the station was the loudest on the band, but you could not hear the processing – at least not dur-ing the music.

One of Ed's magic boxes came from Gregg Laboratories and the mind of Greg Ogonowski. To this day, there are many folks who will tell you there was no finer sounding AM station than CKLW.

Buterbaugh's magic touch would later arrive at ABCs (now Cumulus) WJR in Detroit where he would remain until his retirement. I met Ed a few times before his untimely death on 2008.
While I personally never worked with Ed, he referred to me as a "highly qualified broadcast engineer," which I have always felt was quite an honor coming from him.

USING A VERY IMPORTANT TOOL

The title of Sir George Martin's book, *All You Need is Ears*, refers to the most important tool in any engineer's toolbox: Ears.

By listening carefully, I developed a reference point of Ed's CKLW sound in my mind. And I believe I came very close to achieving it using the equipment and technology at my disposal.

The sound of the ill-fated *Radio Aahs* kids' hit format on the AM Band in Detroit was one I loved working on.

With a weak 500 Watt AM signal, the heart of that sound was an older model AM Optimod combined with just the output stage only of a CRL processor. I spent a few weeks adjusting and listening to the format.

Despite the low operating power, WCAR at 1090 kHz had a very hot and big sound – yet you really could not hear the processing at work. Also, in our primary coverage area, no one would have ever guessed it was only 500 Watts of RF.

PUTTING IT TOGETHER

The basic exercise is to reduce dynamic range, but fooling the ears into thinking everything was normal all without creating listener fatigue that often results from over-processing.

Although many engineers do not have time for critical listening these days, I do suggest they pick a pre-set that sounds good from the manufacturer, set it and forget it.

Each facility is different. A pre-set may be a starting point, but how does one sound the absolute best in their market?

PRACTICE MAKES GOOD SOUND

Having worked for various independently owned operators over the years, one of my specialties is making those stations sound good with a minimal budget.

It does not take much effort to make a radio station sound better than someone's iPod, so why do not we do it!? The simple and short version answer is (again) "We Simply Don't Have Time."

Maintaining a radio plant today is both easier (solid state gear) and much harder when one guy and one guy alone is responsible for the technical plant of 3, 4, 5, or more stations.

Assuming the engineer makes the time and does care, the toughest part to improving the sound is the least expensive: listening – and I mean critical listening. What is it specifically about that sound that is right or wrong?

A QUICK TEST FOR QUALITY

As a test, compare a CD recording to whatever is playing on the radio. If the CD sounds perceptibly better than the radio, then you have some work ahead of you.

Unfortunately, there is no single magic tweak that will give you the desired sound.

You probably can guess that different processors have different adjustments and different approaches (and from different eras depending on how old your gear is).a

A 10-year-old well-maintained Optimod can dominate your market if the engineer puts in the time and effort to really hone the sound of that station, taking into consideration the type of music (format) and all the factors mentioned earlier.

It helps to have a reference point like I did, but it is not a requirement. The main thing is to listen carefully.

While our ears are the most important evaluation tool for achieving that sound, a modern day processor can make achieving that ”magic sound” much easier.

Personally, I am a huge fan of the wonderful equipment coming out of the Telos Alliance in Cleveland. Today, they are way more than just great telephone audio and Omnia (AM and FM) processors. I also have installed their streaming products, including their ZIP/Stream box at a number of facilities.

WHAT HAUMANS LOVE

The reality is humans love dynamic range.

They also love big, bold, in-your-face radio stations where the dynamic range has been scientifically restricted but it still sounds better (in their mind) than their iPod.

This is in the perfect-world scenario. But there are some who prefer to believe than anyone under age 40 today actually hates radio. Therefore, they put the minimum effort to make audio that draws listeners.

The trick is to give them something to like about radio: Better programming with real, live talent, plus a better sounding air product – or at least one maintained by people who have time to care.

What about your audio streaming? Can you make it as good as your air sound? We will discuss this matter in an upcoming article.

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Bob Burnham is currently Chief Engineer at WLUN-FM in Midland, MI and a consultant to the Specs Howard School of Media Arts in Southfield, MI. He restores, archives and markets "old time" radio drama and comedy to fans coast-to-coast.

You can contact Bob at bob@brcoadcast.com

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