The Local Oscillator

The Newsletter of Crawford Broadcasting Company Corporate Engineering

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Something New

Itôs hard to believe, but here we are at the end of another year. One might argue that we must be having fun, since time is flying by. I think I would agree with that. Even with all the changes and uncertainty in our industry, this is indeed a fun time to be a broadcast engineer. Our equipment is feature packed and much more reliable than in years past, we can monitor and operate much of it from our mobile devices, and thereôs always something new coming down the pike.

One example is some new and very cool equipment from our friends at Wheatstone that weôre playing with. In our Denver shop, we now have a processing IP Blade running on the bench with a Nexgen workstation. While this is a couple of years behind ñcutting edge,ò it is new to us and something we are having to learn from the ground up. With the difficulties we had to overcome to get it working, it was anything but ñplug and play,ò but the things we learned with this demo unit I donôt anticipate anywhere near the issues with real-world installations.

So what does the Wheatstone IP Blade do for us? First and foremost, at least from my perspective (which is always focused on cost/benefits ratios), it gets us out of the old PC ï sound card ï switcher ï processor arrangement that we have used for years with our Nexgen audio servers. And that is a very good thing, since we are in many locations still running on the ASI 4000-series sound cards that we got with our original Nexgen purchase/installation. Those cards are obsolete and not supported under Windows 7, and itôs difficult to find a computer with both a PCI slot and sufficient vacant real estate under the hood to house the card. What that means is that the clock is ticking on most of our sound cards ï when the audio server or workstation hardware has to be replaced, the sound card will have to be replaced as well, at a cost equaling if not exceeding that for the PC hardware.

Nexgen can ñtalkò to the IP Blade over a gigabit network connection and provide all audio I/O through the Blade, thus eliminating the sound card. The blade can also be controlled by Nexgen so that different input sources can be routed to one or two outputs. In a typical CBC installation, we use Broadcast Tools or Sine Systems analog or AES switchers to perform this function, controlled by Nexgen via RS-232. Sources would include the studio, the audio server mix and one or more satellite feeds. When running in the satellite mode, Nexgen takes care of all the source switching through this arrangement. The IP Blade will do both functions ï audio I/O and source switching ï in one 1RU unit.

Satellite feed audio levels can be all over the map, and I mean both from feed to feed and within the same feed. Of course our own in-house levels are always perfect, but in the event that they are not, some kind of automated soft gain riding is needed. Some of the Broadcast Tools switchers provide AGC functions that are useful for this purpose, but I have never been happy with the way they sound. Wheatstone IP Blades are available with integral Aura8 processors, which provide for sophisticated multiband processing of up to eight channels. So now weôre talking about a single, 1RU unit that replaces a sound card, a switcher and an audio processor. That got my attention.

Our friends at Wheatstone sent us a processing blade along with drivers and hardware key for Nexgen, and we got the workstation and blade set up and everything talking. We continue to play with this setup on the bench, trying out different things and learning how things work. Once we had things working properly I was comfortable enough with it to take the next step, budgeting for a full implementation of this new hardware in our Denver

studio facility. I chose Denver because I want to participate in the installation and understand the hardware and its operation before we think about implementing it in other large CBC markets.

As part and parcel of this Denver implementation, we will install Wheatstone 8-channel Evolution control surfaces in the three production rooms. These will replace two aging Mackie 24.8 mixers and one 32.8 mixer, all of which are beyond their scheduled replacement dates.

How can we get away with replacing those big Mackies with an eight-channel control surface? The truth is that we don't use but a few of those channels anymore. We don't do cassettes, we don't do DATs, we don't do MDs, we don't even do CDs anymore. Everything is pretty much done in Audition or Nexgen, so we simply need a mic channel, perhaps a channel or two for external sources and then four stereo channels for Nexgen. Each blade (which the Evolution surfaces will interface with) provides 8 stereo channels in and 8 stereo channels out, and like the G6-series control surfaces in our control rooms, each channel is completely configurable as to source, mix-minus, etc.

Jay Tyler from Wheatstone is planning a trip to Denver later this month to go over the project with us, and we very much look forward to learning all we can from him.

Moving into the IP Blade world represents a big change for us, one we believe will have long-term benefits throughout the company going forward.

Budget

At long last, the 2014 engineering budget is done. Overall it is a conservative budget, taking care of what needs taking care of without a lot of electives.

A good bit of what's in there is facilities maintenance ï roofs, tower paint, driveways and parking lots. Nothing exciting about any of that, but it's all necessary to keep our sites and facilities functional and in good repair.

I do, however, plan a remote control upgrade throughout much of the company, replacing the old Burk ARC-16 systems with new ARC Plus Touch systems. We have ARC Plus systems in place in Denver and at KBRT, and they are great. Any site that has IP connectivity back to the studio (and outside world) is eligible for this remote control upgrade. Installation should be a snap employing the device that interfaces the existing IP-8 panels to the new ARC Plus units (something Burk developed a couple of years ago at our request). Once fully implemented, our engineers can access the sites from anywhere with an Internet connection and on their smartphones. Operators at the studio will access them using a web browser.

The New York Minutes
By
Brian Cunningham, CBRE
Chief Engineer, CBC – Western New York

Hello to all from Western New York! It is hard to believe that this the last report for 2013! It feels like this year has flown by, in a New York Minute! It was not that long ago we were gearing up for the spring thaw and looking forward to starting many new outdoor projects this year.

Looking back, we had a good year, with no major breakdowns in either of the Western New York markets, but thatôs not to say that we were trouble free. I guess the biggest headache we experienced this year was the heat, and our inability to keep the A/C working comfortably at the Rochester FM transmitter site. To date, we still do not have a good working air conditioner at this site, but collectively, we have come up with a plan to help minimize heat build-up inside the building next year. During the winter months, contractors will be busy insulating the attic area of the building and adding thermal controlled fans to evacuate heat from this area, along with repairs to our existing 4-ton A/C, which will help the unit run more efficiently.

Because of a late start, we were unable to complete the painting of the five 245-foot free-standing towers at the WDCZ site in Buffalo. The contractor was able to complete three towers before the weather changed, and they do look beautiful! I canôt wait to see the remaining two completed, and all five towers bright and shining!

The contractor we had hired to repair the tower foundations while the towers were being painted kept putting us off for some reason. He suddenly quit taking my phone calls and would not return messages left for him to call with a start date. It quickly became apparent that there was something terribly wrong, and my suspicions were confirmed when I received a notice from his insurance company that he had been cancelled due to non-payment. Evidently, his company was experiencing cash-flow problems, and as a result lost the majority of his experienced manpower due to non-payment of wages. With no help, there was no way he could fulfill all his contracted agreements. We were forced to find another contractor to perform the work, and by the time we had another company locked in, it was too late in the year to perform concrete work. So this project will have to carry over into next spring for completion.

We were truly blessed this year to receive a visit from Cris to our Western New York stations. It had been quite some time since he was able to see things here firsthand, and several big projects had been done without his personally seeing the results, such as the talk studio remodel and new transmitter building installation at WDCX and the addition of WDCZ 970 here in Buffalo. I would like to see him more often, but scheduling and the cost of travel makes regular visits difficult. Cris seemed to be pleased with all he saw, and left confident things were in good hands.

WDCX-FM / WDCZ(AM) – Buffalo, WDCX (AM) – Rochester

One problem to make note of here is a sporadic recurring problem with our Nautel ND-5 at WDCX(AM) in Rochester. I would welcome any of your suggestions as to how we can alleviate this problem ï perhaps you have experienced the same symptoms with your rig, and found a solution.

The problem is, whenever there is an imbalance in phases, whether a brown-out or just lower voltage on one phase, the main circuit breaker will trip off, which results in a ride to the transmitter to recycle the main transmitter breaker. This may only happen once every six months, or several times a month, usually depending on weather conditions which affect power distribution to the site. I have double-checked all electrical connections between the main disconnect and the transmitter for tightness and replaced the transmitterôs main breaker, thinking that it may have been the cause of the trips, but they still

continue. If you have any suggestions, please e-mail me at brianc@crawfordbroadcasting.com. Any help would be greatly appreciated!

That about wraps up another month here in the great Northeast, and until we meet again here in the pages of *The Local Oscillator*, be well, have a Blessed Christmas and a Happy New Year!

The Motown Update

By
Aaron McEachern
Chief Engineer, CBC–Detroit

Merry Christmas from Motown!

Last month, with the assistance of Russ Harbaugh, we did the biennial recertification of the sample system for the WRDT(AM) day site. We pulled the toroids from the ATUs and found them all to be in spec. Then we swept the sample lines and they passed with electrical lengths and impedances within the prescribed tolerance.

We then reinstalled the toroids and found the antenna monitor to be 60 degrees out of phase and the ratio to be approximately half what it should be for tower three! We inspected the lines and re-swept them and found inconsistent results from our initial sweep. We re-swept the other tower lines and found they we consistent. In the ATU building of tower three there is a matching section of sample line. It was my first suspect, as the line in to the building has a molded connector from Andrew. Also, the matching line has a bend to connect to the transformer. I wiggled the connector connected to the line to the building and found changes to the sweep, but the sweep indicated the line was open when we had a terminator on it.

I removed the suspect line from the ATU and inspected the connectors and found both of them to be loose. By opening them up and filing the cable shield as close as I could to the retainer spring, I was able to make a good connection. I reinstalled the line, this time with a 90-degree elbow on the toroid end to relieve the pressure on the connector, and then we re-swept the line and found it in spec again. I wiggled the line as much as I could, and the problems did not return.

When making the reference field strength measurements, I found a few to be in hard spots. One was approximately two feet from the right lane of the expressway. Thereôs nothing quite like taking a measurement with traffic flying by! I am sure glad I only have to take them every two years with the stationôs moment method licensing!

In the studio building I am preparing for the installation of a new Avaya phone system. In planning the installation, I quickly realized just how packed with equipment our telco room was. There was not a square foot available, let alone a space to install a wall rack for the new phone equipment.

As I am still relatively new to this building, I went through each piece of equipment and found many unused old circuit termination points and was able to remove the old equipment to make way for new.

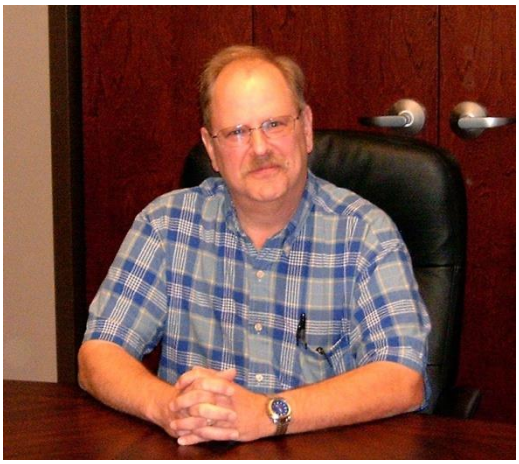
This month I will be working on installing a wall mount hinged rack and prewiring the system into patch panels to help the installation go smoothly.

WMUZ telco room -- not a square foot available for the new phone system

News From The South

By
Stephen Poole, CBRE, CBNT, AMD
Chief Engineer, CBC–Alabama

Iôm writing this a few days before Thanksgiving, and believe it or not, weôre expecting icy weather in Alabama. We may even get a dusting of snow. Must be global warming.



An Appeal to Vendors

When I create an account at your website, I usually check the box that says, ñSend me special offers.ò But please donôt take that as an invitation to send me several email messages a day. ñSpecial offersò means ... *special offers*. Occasional stuff. Filling my inbox with one message after another is actually annoying. I am tempted to stop doing business with you when Iôm annoyed.

Be assured of this, too: Iôll never check the box that says, ñClick here to receive special offers from our partners.ò Iôve learned the hard way that this can cause a flood of spam in my inbox. Please respect that choice on my part as well.

Someone has managed to put me on a spam list, even though I never accept that option. I donôt know if itôs someone Iôve ñconnectedò to on LinkedIn, or have ñfriendedò on Facebook, or one of the support forums I visit online. But Iôm getting hit with 100-200 unwanted email messages per day.

I may end up changing my email address. I hate to do that, but a couple of times now, Iôve missed important messages that have been buried in the spam. Our spam filter is pretty good at blocking it, but I have to go into the Zimbra ñJunkò folder to make sure that a legitimate email hasnôt accidentally been trapped, too. Itôs a pain in the neck.

Projects, Projects, We Gots Projects

We have three big projects to finish, hopefully by the end of the year. The first is a repair: the top bay at 101.1 WYDE-FM has some holes in it and needs a replacement arm. The second is strengthening the guys for tower #2 at 850 AM WXJC, so that it will hold a Dragonwave link.

The final project is the biggest: weôll be installing a ñdouble-hoppedò 6 GHz Dragonwave link between 93.7 WDJC-FM and 101.1. To make the 50 mile trip, weôll have to put a relay in the middle, near Warrior, AL. The antennas have arrived; weôre just waiting for a crew to become available for the work. And weôre still waiting on the radios themselves, which, like the link used at the new KBRT facility, use fiber instead of CAT5.

Once we have that Dragonwave link running for 101.1, we can finally get rid of that trouble-prone T1 line. For backup, weôll be using WDJCôs HD3 signal, which carries 101ôs audio. We purchased a nice Scala Yagi and had it mounted on 101ôs tower for that purpose. We should be good as gold with this, because even sitting on the ground (as shown in figure 1), we had crystal clear reception on our Day Sequerra receiver inside the transmitter building. Beautiful.

Figure 1 - Even before we mounted it, we were receiving WDJC's HD3 clear as a bell!

Some Background On Intel Microprocessors

Call this another in that never-ending series, ñThings You Might Want to Know Nowadays, At Least in Rough Outline.ò You donôt have to be a programmer to find this type of stuff useful.

You know how this works in principle, of course: your computer has RAM in it, as well as a hard drive, for bulk storage. A microprocessor reads from and writes to those devices, following the instructions in the various programs that youôre running. But letôs take a closer look at some of the fundamental principles. Iôll be focusing on the Intel x86 series, but what I say applies in general to most of them.

A single core in a microprocessor will contain *registers*, which are temporary, internal memory slots. The size of these registers will usually be the same as the ñbitnessò of the processor: 16 bits on the original 8086, 32 bits on the 80386, and 64 bits on the x64 series.

While your computer is in operation, these registers are being loaded, incremented, worked on and compared millions and millions of times per second. When you type a character in a word processor, program code will fetch that character from the keyboard and store it in one of these temporary locations. Other code will write that character from that internal register to the display and/or to a file.

To a Computer, Everything Is a Number

Youôve heard some people say, ñTo a microprocessor, everything is ones or zeroes.ò While this is technically true, itôs easier to grasp if you say, *everything is a number*. You see a text string such as, ñHello World,ò but your computer stores it as a string of numbers.

The classic ASCII character set assigns the value 64 to the ñ@ò symbol, 65 to uppercase ñA,ò 97 to lowercase ñaò and so on. If you look at an ASCII table (thereôs one on Wikipedia), youôll see that uppercase characters are actually assigned lower values. Now you know why the ñsortò function in your word processor or spreadsheet will put ñUppercaseò before ñlowercaseò in a list.

Nowadays, with internationalization and much larger processors, the simple 8-bit ASCII character set is obsolete. Some languages (especially Asian ones) have hundreds or even thousands of characters. Unicode (the most common for us is typically UTF-8) was developed to expand the character sets to, at last count, over 110,000 different unique characters.

A Simple Program

Figure 2 shows a very simple program in 16-bit x86 machine language from back in the DOS era. It finds the end of the text string, ñHello World,ò and then stops.

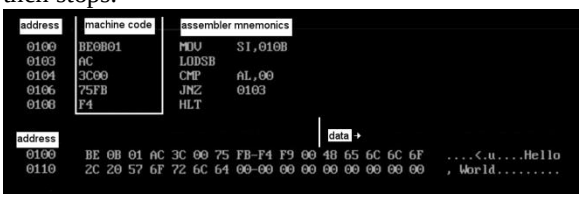


Figure 2 - An ancient DOS code sample for discussion.

Whether I write a program in C, or Cris writes it in VB6, or one of our Web guys writes in PHP or Javascript, the final, ready-to-run result will ultimately be translated into machine codes like these for the processor. Each coding defines a simple, fundamental task: fetch memory, add two numbers, compare two values and so on.

It goes without saying that it takes many, many of these instructions to make a useful real-world program. Even the simplest command, such as, ñdraw a line on the screen from here to there,ò might require thousands of these instructions at the processor level. Of course, thatôs why even a simple Solitaire program can be many thousands (or millions) of bytes in size.

The Program In Memory

Because it can easily represent a single byteôs worth of binary data in two characters (00 to FF), most x86 programming tools show these machine values in hexadecimal, or base 16. The top half of the image shows the instruction codes. The memory addresses are to the left: 0100, 0103, and so on.

The addresses jump in strange-looking increments because, in the Intel x86 family, different instructions have different lengths. (No, Iôm not kidding. I wish I was. More on this in a moment.) The first one, which MOVes the address ñ010Bò into the Source Index (SI) register, takes three bytes. See the 6 hex characters in the box labeled ñmachine code.ò

As proof that microprocessor designers donôt live on the same planet as the rest of us, the next instruction, Load Single Byte (LODSB), only needs a single byte of machine code (AC)... but does two things. First, it loads one of the processorôs internal registers, the AL register, with the contents

of the memory address pointed to by SI. Second, it then automatically increments (adds one to) SI, so that itôs ready and points to the next byte in memory.

At address 0104, we compare (CMP) the byte that was fetched into the AL register to the value zero. This instruction needs two machine bytes.

Making a Logical Decision

That CMP instruction non-destructively subtracts the specified value (0 in this case) from the AL register, setting certain flags inside the processor. One of these is the zero flag, which in this context means, ñthe compared values are precisely equal.ò The JNZ (Jump if Not Zero) instruction will go back to address 0103 if the zero flag is *not* set ï i.e., if the compared values *aren't* equal. Weôll use LODSB to fetch the next byte and increment SI once again, then compare again, over and over.

Eventually, weôll reach the first byte after ñHello Worldò that is equal to zero. CMP sets the zero flag, so the JNZ instruction does *not* return execution to address 0103. We fall through to the next instruction at address 0108, a HaLT command. The program stops executing.

The bottom half of the image is a data dump of the 32 bytes of memory from 0100 to 011F. Note that the first several bytes are the machine codes that you just saw. Iôve marked where the data starts at address 010B with character #48, or uppercase ñH.ò The remainder of the data block after the string is padded with zeros.

If you were to execute this program, it would start loading bytes one a time, comparing each with zero, then halting when it hits the first zero after ñHello World.ò After halting, the SI register would point to the next byte *after* that zero byte in memory.

Hereôs the neat part, and of course, this is another reason why computers are so useful: they can tirelessly execute zillions of these instructions, over and over, very quickly. Even the original IBM PC, which operated at a dismal 4.77 MHz clock rate, could execute this little snippet of code in less than 100 microseconds. A modern processor with a 2 GHz clock and other optimizations would complete this silly little program in *nanoseconds*.

What Could Go Wrong?

If youôre sharp, you can already see some real world problems with this. Because the x86 family has variable instruction lengths, chaos will result if we start executing in the wrong place. For example, if some error caused the processor to start at address 0101 or 0102 ï in the ñmiddleò of that MOV SI, 010B instruction ï it would probably run amok.

Hereôs an even better one. Because everything is a number to the microprocessor, if we didnôt stop execution with that HLT instruction, *the processor would actually keep going and would start trying to execute that text string, "Hello World."* It would treat those ASCII values as instruction codes!

In real life on a modern processor, a problem like this will result in a fault and/or a hung program. In the old DOS days, youôd get a computer that would hang so hard, it would require a power-down reboot. Newer operating systems and processors have memory and other protections that help prevent locking up the entire computer, but itôs still a bad thing. What if the program manages to write some bogus data to the hard drive before it finally faults or hangs?

You might think that such an error is extremely unlikely. On a new machine, on a good UPS, with quality components, that is the case. But what if the machine is getting old? What if your power supply is starting to go bad and one byte is written to memory incorrectly? What if youôre trying to execute a program directly from a scratched CD or DVD, or from a defective thumb drive? All it takes is *one code byte* out of place and youôll get faults and hangs.

A Final Example: Buffer Overflows

Youôve no doubt heard of malicious software using ñbuffer overflowsò to attack your computer systems. To see how these work in principle, remember what I just said about everything being a number to the processor. Now look again at the memory layout in that example program in figure 2.

Suppose that we rearranged this so that ñHello Worldò is actually something entered by the user. Letôs move it to where it is stored before the program code in memory. Unless the program carefully checks the input data, it would be possible for the user to enter too many characters. Weôd overrun the end of that 11-byte block (just big enough to hold the string, ñHello Worldò) and *start overwriting the program instructions.*

This isnôt a theoretical exercise; Bad Guys can (and have) done this. Some years ago, there was a flaw in one of the optional modules for the Apache Web server software, which we (and a lot of other people) use for our own websites. When your browser wants a page or an image, it sends a ñGETò command to the Web server. This vulnerability allowed a malicious ñGETò command to be very, very long, overwriting memory with bad instructions.

This flaw has since been patched, but it

caused some real problems for the people who administer web servers, believe me. Long after that problem had been fixed, I could look at the logs on our web server and see where Bad Guys were still probing for that weakness. Thereôd be a ñGETò command in the log, followed by thousands of bytes of what looked like gibberish ... but which was, in fact, malicious code.

Remember, this example was from the ancient DOS era, but it does illustrate the basic principles. Modern processors include memory protections and other mechanisms to help with problems like the ones Iôve described here. Lord willing, Iôd like to get into that in a later article.

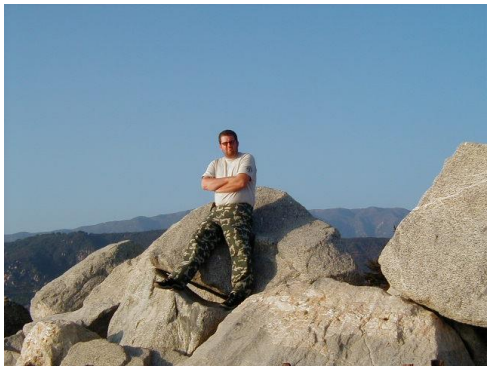
Until next time, have a Merry and Blessed Christmas!

Mainland Memoirs

By
Bill Agresta
Chief Engineer, KBRT

Seasonôs Greetings from the Southern California!

After running the KBRT Ranch transmitter site on that crazy island for 12 years, I thought I had seen it all. What I witnessed just before and during the Thanksgiving holiday is a whole new chapter on insane that beats by a long shot anything I have ever seen before! A simple delivery of dirt turned into such an insane show of bad choices and knee jerk/panic reactions that I began to pinch myself, wondering if it was all some kind of crazy dream.



Since completing work at the new site, we have experienced some erosion on the Sierra Peak road, which cuts through our site between towers 1 and 2, enough that some of the radials and strap that cross under the road were beginning to be exposed. It was just a matter of time before those got torn up (or stolen), so we needed some fill dirt and recycled concrete to rebuild the road bed with a sufficient pad between the driving surface and the buried copper. I ordered 100 yards of fill dirt from a local contractor to get the project started.

I met the dirt delivery driver at the gate at the bottom of the mountain at 8:00 AM on the Wednesday before Thanksgiving. He asked if his rig would make it up the hill. I told him that we have had many trucks up the hill while building the site and not run into any serious issues, then told him he could follow me up if he wanted to try. We proceeded very slowly, so I figured he knew the situation. If he wasnôt comfortable he would have the opportunity to back out of the situation and make another attempt or back down to a turn-around spot.

We hit a spot on the road that had washed out recently, a spot I had not noticed before, so we stopped to look at the situation. He accessed the situation without panic and felt we could proceed past it, although one rear tire might be very close to the edge or even hang over a bit. About then, a Forest Service ranger pulled up behind the rig and we discussed the situation together. The driver decided that he should proceed forward. We moved forward without issue and then came to the one hair-pin turn on the road where we stopped again.

The ranger explained that this is the worst of the turns on the way up and I agreed, stating that in the past all the trucks that made it past this point got to the top without issue, swinging wide in the area provided. The driver decided to proceed and made the turn without issue, I was rather impressed at how easily he got around the turn, so by now I had figured we would make it to the top easily from there.

Then we hit the second turn. It looked to me like he had plenty of room to finish the turn and proceed, but he stopped mid-turn and got out of the truck rather panicked and began to say that he was slipping and his trailer was about to flip over. At this point he was afraid he was going to flip over towards the inside of the turn or the passenger side of the rig. It did not look to me that there was any issue and several mountain bikers concurred ï he was hardly at a lean at all and still had plenty of room to the inside embankment.

At that point the driver began to unhook the dump trailer from the truck. He said that he needed to get rid of the weight in the truck or he was going to ñlose it,ò so he proceeded to drive the truck without the trailer to our site and dump the ten yards he had in the bed. After that he returned to the trailer, his trick now facing downhill, but in the process he created a big issue ï he has taken all the weight from the truck but the trailer was still full and thus too heavy to pull with the empty tuck that was too light to get enough traction.

Then the driver decided to call in his mechanic. After the mechanic arrived, the two of them proceeded to shovel, by hand, all the dirt from the passenger side of the trailer (where he thought he was going to flip), to the driver side. After this they stood around for quite some time, eventually calling in some more guys with shovels. They asked these guys to shovel away dirt from the inside embankment, so I figured he was going to turn the truck around, hook the trailer back up and continue up the hill. This would have been a great idea before he decided to dump the load from his truck, but now he had no weight and I figured he stood a good chance of being pulled over the side by the weight of his loaded trailer.

By now, after trying to convince the driver to call a professional tow company several times, I decided to back way off because I did not feel the

situation was safe, and I also did not want to have any part in what was quickly becoming a very dangerous situation. Out of nowhere the driver and his mechanic decided to swing the fifth wheel of the trailer clear around, now aiming downhill and attempt to make a U-turn.

By now I was standing quite a ways from the truck, knowing eventually something unpleasant was going to happen. With that in mind, I put my camera into video mode, thinking this rig was probably going to roll over on the road.

Next the mechanic and driver hooked the trailer to the truck (which was still headed downhill) and began to swing the entire rig around. Several issues immediately became clear to me. One, they had just piled all the dirt to the driverôs side and as they came around, that side of the trailer was going to be on a steep downhill. The other is that the wheels from the fifth-wheel would be perpendicular to the turn, thus not providing any lateral support to keep the trailer from rolling over. I kept wondering if I was missing something here. It seemed so insane that I kept thinking they must have something else planned that I did not yet realize, but noé they continued the turn until the inevitable happened, very quickly as the trailer reached horizontal with the road ï it flipped over.

At that point, having had enough, they decided to go home, I rode my motorcycle back up to the transmitter site, got the truck and proceeded down the other (Blackstar Canyon), side since the east (Skyline Drive) side was now completely blocked with the overturned trailer.

Circling back around on surface streets, I quickly made a sign and got some caution tape and headed back up the Skyline side to the trailer, wrapped caution tape around it then put a sign on the gate below saying that the road was blocked two-miles ahead.

Thursday morning (Thanksgiving Day), I opened the gate at 9:00 AM. They brought out a couple of wreckers, even though it was Thanksgiving Day. They brought a small and a very large wrecker, and though they, too, had some issues, in time they eventually got the trailer on her feet, onto a tilt bed trailer and back down the hill.

NOW, to find a way to get a few simple loads of fill dirt to our transmitter site!

Until next month, the Lord bless you and keep you; the Lord make his face shine upon you and be gracious to you; the Lord turn his face toward you and give you peace.

The Chicago Chronicles

By
Art Reis, CPBE, CBNT, AMD
Chief Engineer, CBC–Chicago

First of all…

From both Kathy and myself: Blessings to you readers of *The Local Oscillator*, and of this column, during this most glorious of Christian Seasons. Embrace the spiritual, inasmuch as possible ignore the secular, and know that the greatest Blessing to come into the world, and your life, was birth of the Savior of all of us who will accept them. We know that God has blessed both of us beyond our wildest imagination, and that our only obligation to Him is to do His will. May it also be with you.

New and Improved

Regular readers to this newsletter may recall that, several months ago, our Rockford/DeKalb station, WYRB(FM), began having reliability issues. The transmitters themselves were not so much the problem, though they did have an issue or two, but rather our T1- based STL links would conk out, taking the station off the air several times. In all, we lost either or both of our T1 lines a total of eleven times in about four monthsð clearly unacceptable. Add a few lightning issues along the way, and a rather bad reputation was coming on for the station. Clearly, something had to

be done.

And it was. Corporate decided the time was right to upgrade, and it did. Enter one new transmitter, a Nautel NV5, and one replacement STL system. The Harris Intraplex STLs, which had been on line for maybe a dozen years or more, would be retired.

In early October, equipment began to arrive, first, an MCI motorized antenna switch and right after that, a Tunwall controller to operate and interface it with the remote control and transmitters. Then the NV5 came in. Replacing the Intraplexes was a double package of equipment: Adtran MX-410 T-1/Ethernet Interfaces, and World Cast Horizon NextGen codecs. Actually, the MX-410s came to us via the wunderkinds down in Birmingham, Stephen and Todd, who programmed those boxes to perfection. Many of you read about that in last monthôs *Local Oscillator*.

There were a few things which James Kelly, my partner in this project, and I learned about the NextGen codecs that we didnôt get from the manual. We first learned the hard way that it was a no-no to set up IP addresses with both ports programmed to the same subnet. Thatôs something the factory told us. OK, we said, so hey, weôre feeding two separate T1 circuits with these things. Letôs just put one of the T1s on a new subnet and call it a day. As it turned out, the T1 line between Hammond and the transmitter site was the logical choice for the second subnet, since the other path, from Lansing to the Kirkland site, included our Trango over-the-air STL, which was already a part of our original subnet. It was then that one of the Adtran MX-410s features came in very handy ï a built-in four-port switch. All of our NextGen boxes at each site go through those Adtran switches. That saved a lot of fussing with outboard equipment.

A word about Sur Stream here. This is a really nifty system, but with a drawback. The idea is to use two separate STL paths to send the same audio from Point A to point B, supplying full redundancy, but SureStream takes it a step further. Both streams are on the air at the same time, time compensated and all. If either STL path fails, the audio continues seamlessly. The system will send an alarm to personnel if programmed to, but no listener would ever notice a thing. Really cool.

And the drawback? The system works well if either T1 line, or any of the Adtrans, fail. But if either of the SureStream boxes fail, the system is dead in the water. SureStreams cannot be used in the same path with a non-Sure Stream box. We looked at that, and decided on a third level fail-safe.

Try to follow me here: In addition to our main FM/HD-1 WYRB audio, we also have a pair of multicast programs on WYRB, WSRB is programmed on HD-2 and WYCA on HD-3. WorldCast taught us (again, not in the manual) that it is feasibly, actually easy, to feed a T1 line with a NextGen box, attach a non-NextGen box at the transmitter site end, and get successful audio throughput. It worked, so thatôs how we feed multicast audio up the lines, NextGen box at the studio, regular Horizon box at the Kirkland siteð instant redundancy for the multicasting. Almost. An

New NV5 transmitter and rack layout (WorldCast NextGen codecs are visible at the lower right).

RDL silence sensor stick-on circuit will actually switch the multicast audio from the main feed to the backup, in case of. The point here is that one of those backup non-NextGen boxes figures into this scheme.

As it happens, we happen to have another couple of NextGen boxes available, so one of them has been pressed into service as a second backup to the SureStreams. It sits in the studio site rack with the same audio as feeds the Sure Streams, but with no CAT5 connection to it in normal operation. It is programmed to feed that second non-NextGen box which is used in HD-3 service, the one not normally

on the air. In case of Sure Stream failure, the Ethernet connection for the backup subnet can be manually moved from the Sure Stream box to the backup NextGen box. The audio output is then switched by remote control at the transmitter from the output of the Sure Stream to the output of the emergency box, which gives engineering time to find out what killed the Sure Stream system.

There's yet a *fourth* layer of audio backup, in the form of a 360 Systems DigiCart, pre-programmed with songs and image liners, ready to go on air at a moment's notice, and with a playlist function that can be changed remotely at will by the station PD . Very nifty. If silence is sensed on the incoming audio, an RDL silence sense relay, monitoring the output of the Sure Stream codec will, after a preset interval, start up the DigiCart and put it on the air. At least the station will have audio on the air while engineering scrambles to find out where the backhoe fade came from.

The NextGens, whether equipped with the Sure Stream feature or not, also has front panel input and output VU meters and headphone jacks with switched input and output feeds, but *no* volume control, go figger, and as mentioned earlier, both analog and digital audio capability. They can be set up for either PCM linear audio or APTx compressed. Sure, you can try the linear setting and listen to the audio coming out for a few minutes, and it will sound awesome, but unless you're running just one audio stream up that T1, I don't recommend keeping it. The magic number with a T1 circuit is, as many of us know, 1.544, as in MHz of bandwidth. PCM linear takes up a bit more than 1 MHz by itself. Take it from me, the APTx encoded audio sounds every bit a good as the linear, but uses only about 275 kHz bandwidth for a 256 kB sampling rate, which also sounds awesome. That also allows up to four audio streams to go up and down the STL, with enough bandwidth left over to make transmitter site remote control, PAData, and transmitter AUI usage practical. Try that with an Intraplex.

With this setup now at WYRB, we should without a doubt have a far more reliable air presence than heretofore. A few wrinkles still have to be worked out, including a VSWR problem on the NV-5, but the place should be darned near bullet-proof in a very short time.

Thanks to Cris Alexander, the folks at Corporate, and especially to the engineering department at our Birmingham stations, for their help in making this all happen.

Finally..

Forgive me for this next, but when I told it to Lee Edwards at Crouse-Kimzey, he almost fell out of his chair laughing, and he dared me to put it into this month's issue. OK, Lee, here it is.

Two days after the horrific tornados which struck the Midwest and particularly Illinois (one of them came with six miles of my house!), this little prayer came into my head, and it wouldn't go away: "Dear Lord, while I know that everything you do is for the best, and that it's really a sin to try to second-guess you, I just have to believe that with that tornado of Sunday, November 17, you nailed the wrong Washington."

I have to go now. I'll be back with you in the New Year.

The Portland Report
By
John White, CBRE
Chief Engineer, CBC–Portland

Last month I highlighted the restoration of a historic WX2 field intensity meter. At the close of the column I left the reader with a teaser. I had found the IF frequency had been retuned significantly lower than its intended 455 KHz.

As I retuned the IF back to 455 KHz, the third, second, and first

IF output transformers tuned with no problem. However, any attempt to tune the mixer IF transformer could not bring it much above 430 KHz at minimum capacity of C20. See simplified schematic Figure 1.

That schematic also shows some of the differences between the WX2 and the later 120E version of

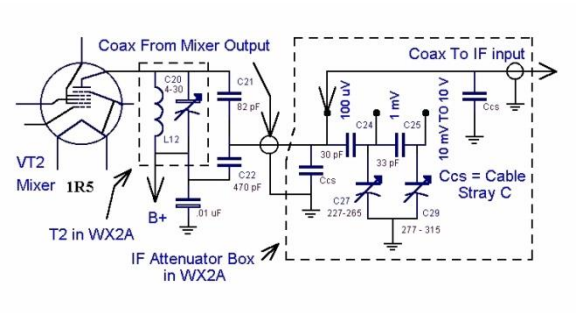


Figure 1 - Simplified Schematic

the instrument. In the WX2, a typical IF transformer (containing L12 and C20) is separate from the attenuator and substituted for the individual components contained in the attenuator assembly as was done in the 120E. C21 and C22 are mounted at the transformer providing the connection to the attenuator assembly.

Our symptoms are that IF transformer T2 won't tune higher than about 430 KHz with C20 at minimum but otherwise does tune over the range of 417 to 430 kHz, so the mixer IF transformer is tuning very low with limited adjustment range. The question is, what is causing this problem?

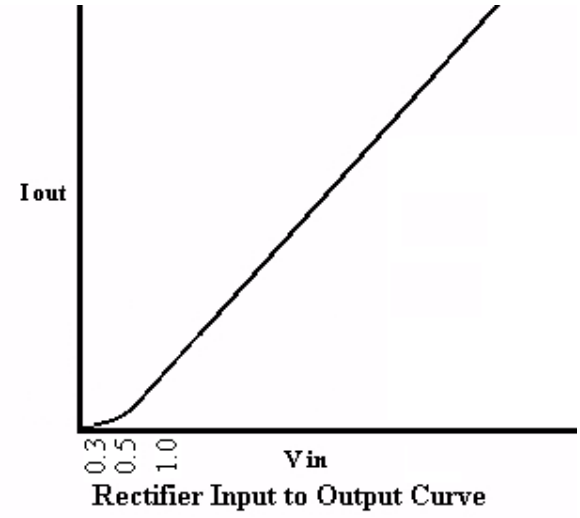


Figure 2 - 1N38A linearity curve

The primary determinant of frequency consists of L12 and C20 in parallel. For L12 to cause the problem would require a failure mode that would increase inductance, which is quite unlikely. Similarly C20 would have to increase capacitance. Given that it tunes smoothly that also seems unlikely.

External to T1 we have the 1R5 mixer tube and C21. I eliminated the 1R5 by temporarily swapping with another tube and observed no change.

Looking at Figure 1, C21 is in series with C22 and the two form a voltage divider between the high impedance mixer plate and the attenuator assembly input. Notice that the value of C22 is quite large (low reactance to ground). In this way the voltage divider presents a lower source impedance to the IF attenuator. Any stray capacitance or change of components in the attenuator is likely to be small compared to C22. The only likely remaining fault component is C21, which is effectively in parallel with C20. Bingo. Once C21 was replaced with a new 82 pF capacitor, the transformer tuned properly.

Now we can begin alignment of the instrument. I used the same technique to tune the IF that I used to test the IF stage gain. Begin by removing the second IF tube and inserting a 455 KHz signal from the generator at the second IF plate. Then adjust the third IF output transformer, T5, for maximum indication on the instrument's field intensity meter. Working backwards, inject at the first IF plate and adjust the second IF transformer T4 for maximum indication. Once at the mixer input (RF stage plate), adjust the mixer IF transformer (C20). Set the range switch to 10 uV prior to adjusting the mixer (first IF) transformer.

Note, the IF plate terminals have 60 volts present. A blocking capacitor is required at the injection point. Also, the IF transformer at the injection point cannot be adjusted as the signal generator 50 ohm impedance swamps out the parallel resonant circuits.

The next item to check is linearity. Based on the 120E specifications, the WX2 linearity should be within 3 percent. One of the major contributors to non-linearity is the output IF transformer impedance and the 1N38A meter rectifier. Consider Figure 2, a typical germanium diode curve. Below about 0.3 peak volts, little or no current flows. As voltage increases above 0.3 forward volts the current increases until at about 0.5 volts the current output becomes essentially linear with the voltage input. In order to avoid that non-linearity problem, the WX2 designers scaled the indicator meter from 1 to 10 (depressed zero), placing the non-linear readings off scale below the minimum meter reading.

Attenuation	Minimum	Nominal	Maximum	Check
+-0 dB	---	10	---	
-3 dB	6.87	7.08	7.29	
-6 dB	4.86	5.012	5.16	
-10 dB	3.065	3.16	3.255	
-15 dB	1.736	1.79	1.844	
-20 dB	0.97	1.0	1.03	

Table 1 - Linearity table

For the linearity test and adjustment, we need the data from the table above and a precision 50-ohm switched attenuator such as shown in Figure 3. Not shown is the photograph is a 50 ohm BNC termination at the injection clip leads. Additionally, a 6 dB attenuator is placed between the switched attenuator and the test injection cable. The termination and fixed attenuator insure that the precision switched attenuator is presented with a 50 ohm load. Table 1 shows the expected reading for each attenuator setting along with the maximum and minimum reading.

With the test equipment attached at the mixer output and the signal generator set to 455 KHz, adjust the instrument indicator to full-scale reading of 10 on the field strength meter. The generator output and the fine gain control can be adjusted from mid range to produce a precise full-scale reading. Now add loss from the switched attenuator as shown in the table. At each setting check the actual reading against the limits of the table. Note, the -20 dB setting is expected to produce a reading of exactly 1 on the meter. If there is significant departure from linearity, check the IF output transformer T5 tuning and the 1N38A meter rectifier. If the indications are otherwise linear, the mechanical ñzero setò adjustment can be used to make small corrections at 1 on the meter. Several checks at 10 and 1 may be required to get precise readings at both.

At this point the IF adjustments are nearly done. The final IF adjustment task is setting the IF attenuators. The two IF attenuators are simple capacitive voltage dividers. In the simplified diagram, the attenuators are made up of C24/C27 and C25/C29. These attenuators are used in the 1 mV and 10 mV positions.

For those not familiar with small vacuum tube technology, the 1T4 can be viewed as an oversized field effect transistor. The input signal grid is analogous to the gate. The grid is a fairly low capacitance high impedance input terminal. Typically no grid current flows and a small change of grid voltage will cause a larger change of plate (drain) current. Typical grid input impedance can be tens of thousands of ohms and plate output impedance generally in the thousands of ohms. The IF attenuators are not loaded significantly by the 1T4 grid.

Figure 3 - Switched attenuator

To make these adjustments, begin with at least 40 dB of attenuation selected in the switched attenuator and inject an IF signal at the RF stage. Adjust the signal generator output and instrument gain for precisely 10 on the 100 uV position. Now, while maintaining the signal generator output constant, switch to the 1 mV position. The reading will drop to 1. Next reduce attenuation by 20 dB. The meter should now indicate exactly 10. If not adjust C27 to obtain a reading of 10.

The second IF attenuator is adjusted by switching to the 10 mV position and reducing attenuation by an additional 20 dB. The meter should again indicate exactly 10. If not adjust C29 to obtain a reading of 10.

At this point the IF portion of the meter has been adjusted.

Perhaps this is a good point to stop until next month for a discussion of the RF portion of the instrument. We will also investigate a historic publication. Next month look for the magic meter and Antenna factor A_f.

Rocky Mountain Ramblings
The Denver Report
by
Amanda Hopp, CBRE
Chief Engineer, CBC - Denver

ARC Plus Macro

Right around the time change in early November we noticed that the KLVZ day transmitter site was coming on when it should be off. As we all know, this is a bad thing. Not only does it sound terrible, we could be causing interference to other stations. Thankfully it was very obvious when it would happen so we could shut it back off again.

As soon as I noticed the problem I began digging. What could it be? Another macro running to turn the day site back on? Was it a status action or a meter action doing this? Everything looked normal. The issue was occurring at the same time every day, implying some scheduled event. It followed the time change by happening an hour earlier ï what I mean to say is that it occurred at one time in November before the change to standard time, and after the time change it started occurring one hour earlier. At the evening pattern change the day site would go off and the night site would turn on as scheduled, and a few minutes later the day site would come back on.

I spent several evenings babysitting the site, making sure the day site was off when the night site was on, and I really dug into the ARC Plus programming. After looking through every station, every macro, status action and meter action, I found nothing out of the ordinary.

Finally I gave up and called Burk. Their tech support is always very helpful. They had me send over the setup file and immediately noticed that one of the ñrun on demandò macroôs schedule time was blank. For those of you that use the ARC Plus units that are programmed using AutoLoad Plus, remember this: if the schedule time for the macro is blank, the macro is corrupt! It is a simple fix: just select a time from the pull-down menu. In this case, I selected ñRun on Demand,ò and this fixed the issue. Even though the corrupt macro was in the ARC Plus at the night site and should not have had any authority to turn the day site on at night, for some reason because of the corruption it did. Once I fixed it, everything began working perfectly again.

KLVZ Night NE-IBOC

For the KLVZ night site we still use the good ole Nautel NE-IBOC as combination exporter and HD exciter. Do you remember those first-generation boxes? Several years ago they moved on to something smaller and better, but for this one station we kept the old one (the day site has the new units).

About a year ago it failed and we sent it in to get some work done. At that point Nautel was still providing limited support for the unit. Now, however, that is no more. Nautel has abandoned this piece of equipment. Now, while I am sure they have good cause for it, itôs no good for us. We need this to work in order to keep the KLVZ night signal operating with HD. We canôt justify the purchase price of the newer units for just the night signal for that station.

Over the last month or so we have begun having to reboot the unit frequently to keep it working. We would tune in early in the morning before pattern change and find the station transmitting in analog. Either Keith or I would make a trip out and reboot the unit because it was frozen, then we would put the transmitter back on the A exciter, which is set up for digital. Then the next day weôd have to do it again.

At one point we installed a Broadcast Tools AC Power Sentinel Pro 2. This unit has two power ports and an Ethernet connection. It allows me to plug two pieces of equipment in and then log in over the network and reboot when needed. We plugged our Omnia in as well as that NE-IBOC. So every morning when I had to reboot I just logged in and told it to reboot the power, and that is what it did.

But eventually the NE-IBOC began freezing within minutes of boot-up. I found the installation files and reinstalled the software on the unit, thinking this would wipe whatever is causing the issue. That worked, for a day or two. Then it was back to

freezing several times a day.

Unfortunately, there is no real way for us to replace the motherboard or anything else as a complete reinstall of the operating system would be needed. I have tried that before with absolutely no luck. We were stuck. We made the decision to just turn the unit off and reconfigure the A exciter for analog. I do hope that one day we can upgrade to some newer equipment, but for right now, KLVZ is analog at night.

Wheatstone Blade

Our friends at Wheatstone sent us a demo unit of the Wheatstone Aura8 IP Blade. I must say, trying to figure this out has been fun. We have a Nexgen workstation set up on the workbench and the blade nearby. It was quite difficult at first to get things working. We wanted to test this out with Nexgen because we have plans to start putting the blade system in play throughout the facility next year, which means we will use them with Nexgen in many of the rooms.

Wheatstone says we need to keep the blade on a separate network so as not to cause packet flooding. However, those of you who know how Nexgen works, in order to talk to Nexgen the computer needs to be plugged in to the same network. So we had the computer working with Nexgen and since the blade needed to work with Nexgen, it, too, was on the same network.

For the first week or so we had no flooding issues. Then again, we were having issues getting it to talk. We would get one thing working then something else would quit working. Finally we figured it out and everything was working. We were able to play music from Nexgen and see if on the blade. However, people began running screaming, ñWeôre off the air!!ò Okay, what is going on? Playing the audio killed the connectivity on our STL codecs, this despite our having choked down the Nexgen port on the switch from 1 Gbps to 100 Mbps. We began trying to figure out what to do. I believe my dad spoke to Stephen in Birmingham and he had the brilliant idea to add a second NIC. Why didnôt I think of that? Oh wait, I know, networking isnôt my strong suit!

We added the second Gb NIC and made that one for the Wheatstone network, leaving the other NIC for Nexgen access. After a few hiccups, this seemed to work. No more stations dropping off air when we play audio.

We are still having a few issues and we are working to figure them out. If we can get them figured out soon, we would like to put this blade in a production room to see exactly how it does being used on a daily basis. I guess that will be a project for next month.

A Look Ahead

I pray you all had a wonderful Thanksgiving and that the storm system that is supposed to be hitting much of the country over the holiday week did not cause too much trouble for anyone.

That about does it for this month, so until next timeé thatôs all folks!!!

KBRT • Avalon - Los Angeles, CA
740 kHz, 50 kW-D/0.2 kW-N, DA-1
KCBC • Manteca - San Francisco, CA
770 kHz, 50 kW-D/4.3 kW-N, DA-2
KKPZ • Portland, OR
1330 kHz, 5 kW-U, DA-1
KLZ • Denver, CO
560 kHz, 5 kW-U, DA-1
KLDC • Brighton - Denver, CO
1220 kHz, 660 W-D/11 W-N, ND
KLTT • Commerce City - Denver, CO
670 kHz, 50 kW-D/1.4 kW-N, DA-2
KLVZ • Denver, CO
810 kHz, 2.2 kW-D/430 W-N, DA-2
KSTL • St. Louis, MO
690 kHz, 1 kW-D/18 W-N, ND
WDCX • Rochester, NY
990 kHz, 5 kW-D/2.5 kW-N, DA-2
WDCX • Buffalo, NY
99.5 MHz, 110 kW/195m AAT
WDCZ • Buffalo, NY
950 kHz, 5 kW-U, DA-1
WDJC-FM • Birmingham, AL
93.7 MHz, 100 kW/307m AAT
WEXL • Royal Oak - Detroit, MI
1340 kHz, 1 kW-U, DA-D
WLGZ-FM • Webster - Rochester, NY
102.7 MHz, 6 kW/100m AAT
WRDT • Monroe - Detroit, MI
560 kHz, 500 W-D/14 W-N, DA-D
WMUZ • Detroit, MI
103.5 MHz, 50 kW/150m AAT
WPWX • Hammond - Chicago, IL
92.3 MHz, 50 kW/150m AAT
WSRB • Lansing - Chicago, IL
106.3 MHz, 4.1 kW/120m AAT
WYRB • Genoa - Rockford, IL
106.3 MHz, 3.8 kW/126m AAT
WYCA • Crete - Chicago, IL
102.3 MHz, 1.05 kW/150m AAT
WYDE • Birmingham, AL
1260 kHz, 5 kW-D/41W-N, ND
WYDE-FM • Cullman - Birmingham, AL
101.1 MHz, 100 kW/410m AAT
WXJC • Birmingham, AL
850 kHz, 50 kW-D/1 kW-N, DA-2
WXJC-FM • Cordova-Birmingham, AL
92.5 MHz, 2.2 kW/167m AAT

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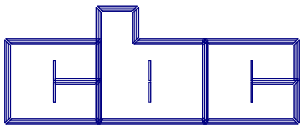

Corporate Engineering

2821 S. Parker Road • Suite 1205

Aurora, CO 80014

email address: crisa@crawfordbroadcasting.com