Troubleshooting Examples: "Divide the Problem"

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Introduction

It's typical, isn't it? While you're trying to get sound check up and running, a new "buzz" turns up in the audio system. Now you have to get rid of it quickly. Or you're trying to add another mix for monitors, and it's supposed to be easy, but it just isn't working. You have the extra Aux available, a send channel in the snake, and a spare amplifier channel, and it's all hooked up, but no sound comes out of the associated monitor speaker. What's up with that? There you stand, having used all of your allotted time for this "minor" task, and seemingly nothing to show for it. Problems often seem to creep in, and you have another puzzle to solve when you really want to be doing something else.

Yes, you're going to encounter problems when you're working on technical systems such as an audio system in a church or at a concert. However, there is a basic approach for dealing with equipment and system problems that will help you tackle these difficulties. It won't make them go away like magic, but it is invaluable for resolving technical difficulties in a structured and efficient manner. This basic approach is known as "Divide the Problem."

Divide the Problem – What Is It?

In the approach we call "Dividing the Problem," we try to isolate the source of our difficulty in steps. We do this by checking a smaller portion of the system to see if the problem is there, or if it follows with the remainder of the system. (Others may call this approach "Divide and Conquer.") During this process, we use equipment, cables, or sections of the system that we know are good (or that we've tested to verify that they're good) to help check other items of unknown status in the system. At each step, we divide the problem down to a smaller set of possible culprits, and deal with possible multiple causes, one step at a time.

Engineers & technicians who use this approach creatively are able to apply it, often subconsciously, to deal successfully with a wide range of difficult problems. However, persons less experienced with this approach must sometimes think very intentionally about applying it's principles in a particular situation in order to develop the habit of "Dividing the Problem."

Often, people seek to solve technical difficulties by checking for various possible causes in a random and unstructured way. While perhaps this is okay to briefly start with for a particular situation, we need to quickly move beyond this initial stage if it doesn't solve the problem within a few minutes.

One way to look at the structured approach of dividing the problem is to ask yourself this question as you go along: "How do I divide what I'm looking at into two halves, so that I can check each half separately?"

Okay, so that's the definition, but how is this applied in a real life situation? The best way to describe this is with some specific examples.

How it Works: Example 1 – The New "Buzz"

You put the microphones in their stands, and get everything cabled on the stage, while the band hooks up their instruments and checks their tuning. Then you set gains and start un-muting the channels. However, when everything seems set to go and you turn up the master fader, you feel a sense of frustration as you hear a loud, audible buzz in the system.

Now where did that come from? It wasn't there last week!

Well, frustration doesn't solve our difficulty. Instead, let's see how we can "Divide the Problem."

Step 1: Is the problem at the input to the console ("first half" of the system) or after the console ("second half" of the system)?

Determine the answer to this question by muting all input channels. Does this fix the problem? If so, then we know that one of our inputs is causing the buzz. If not, we need to look at the equipment and cabling connected to the console outputs, or the console itself.

(For this first example, to make the explanation easier to follow, we'll assume the problem is in the input side of our console, specifically in only one input channel.)

Step 2: After muting all inputs and finding that the buzz is eliminated, we now want to divide the problem down to which input is causing the buzz. We start un-muting individual input channels until the buzz comes back. That's the channel we need to look at in more detail.

Step 3: Divide the problem down further; is it the cables or the instrument connected to the offending channel? In this particular case, we have an electronic keyboard connected through a direct box (DI) into the system. To check which remaining "half" is causing the buzz, we mute the channel, have the musician disconnect the instrument cable from the DI, and then un-mute the channel. Is the buzz still there? If so, you need to track down the problem in your mic cable, snake channel, or DI by dividing the problem further.

Step 4: If the buzz went away with the instrument disconnected, then try reconnecting (with the channel muted) through a different instrument cable. If this doen't help, try changing the ground lift switch on the DI. It may be that the opposite position of this switch solves the problem by either eliminating a "ground loop" (we won't try to explain this further here) or by establishing a better ground path where needed. Damaged connections inside the instrument cable may also be at fault. On the other hand, a damaged connector on the keyboard could cause the problem, so if you suspect this, try connecting the keyboard to a different input channel, through a known-good DI and cable set, and see if the problem follows the keyboard, or stays with the original input channel. (Make sure to try both positions of the ground lift switch on the alternate DI when you move the keyboard to a different input channel.)

Finale for Example 1: At this point, you should know what's causing the buzz. Dividing the problem has allowed us to efficiently find what needs to be fixed. If it's a bad cable, hopefully we have a spare. But at least we know the source of our problem.

(We've oversimplified somewhat in this first example for the sake of brevity, but hopefully the main ideas are clear.)

More Real Life: Example 2 – The Unwilling Monitor

You need another monitor mix for the growing number of musicians in the band. You have the extra aux available for this on Aux 4, an unused send channel in the snake, a spare amplifier channel, and you've scrounged up another monitor speaker. This is a piece of cake, right? But now it's all hooked up, and no sound comes out of the associated monitor speaker. You know it's probably a simple error someplace in the system, but how do you quickly and efficiently track down the cause of this problem?

Step 1: Is the problem at the console ("first half" of the system) or after the console? (Everything else connected to the console output is considered the "second half" for now.)

At the console, verify that you have a good signal at the main Aux 4 Send output by solo-ing the Aux 4 signal and checking on the master LED meter and/or listening with headphones. You need to hear (with headphones) or see a good output signal at the console's Aux 4 Send output before checking any outboard equipment or cabling. It doesn't matter right now that you're not hearing Aux 4 through the monitor speaker yet, because you haven't gotten that far. Keep in mind, you should have an indication at the console for Aux 4 that's similar to what you observe and hear (via headphones) on one of the known-good outputs, e.g. Aux 1, when that aux is soloed.

> Tip: In addition to each channel Aux 4 knob, make sure the Aux 4 Send main knob is also turned up to a reasonable level. And for whatever source you're using to give you some signal, make sure the channel gain is sufficient, which is checked by solo-ing that particular channel.

Step 2: After you know you have a good Aux 4 Send output signal from the console (and assuming the problem continues), we divide the problem again: Is the problem in the cables and snake going to the amplifier (first half of what remains), or is it at the amplifier and later in the signal chain (second half)?

In other words, you need to make sure you're getting the aux signal all the way to the amplifier. When this is true, the amplifier signal light, e.g. channel 2 in our case, will be flashing according to the strength of the input signal, similar to amplifier channel 1 (assuming channel 1 is used for another aux signal, and that this channel is known-good). This signal light is typically found on the front of the amplifier. You need to trace input cabling and verify all input connections, until you get this light flashing. However, settings on the amplifier may also affect this. Therefore, with amplifier channel 1 working, a useful trick is to temporarily re-connect the Aux 4 signal to amplifier channel 1. You know amplifier channel 1 works, so do whatever troubleshooting is needed to get the Aux 4 signal working through amplifier channel 1.

> Tip: This last step shows another useful aspect of our troubleshooting approach; we use equipment or cables that we know are good to help divide the problem. You can also use this principle to divide down possible cabling problems, by temporarily substituting known-good XLR cables or snake channels for those of unknown status.

Step 3: When you do have Aux 4 working through your "good" amplifier channel, i.e. Aux 4 is now working through amplifier channel 1, now it's time to get amplifier channel 2 working. Match all settings from channel 1 to channel 2 on the amplifier (on both the front & back of the amplifier), until you see the channel 2 signal light flashing when you connect Aux 4 to amplifier channel 2.

> Tip: Another way to divide the problem: connect a known-good signal source (perhaps Aux 1) to amplifier channel 2 input (unknown status), and reconnect the monitor speaker from amplifier channel 1 (known-good) to the output of amplifier channel 2 (unknown status). If both channels of the amplifier are set the same & connections are the same, then you should get sound through amplifier channel 2 from Aux 1. If you're not getting sound, then keep examining the amplifier settings and output connections for channel 2 until you find the problem.

> Tip: The problem is almost never a failed amplifier or failed console function. Don't assume it is until you've thoroughly exhausted all other possibilities by dividing the problem in a very structured manner. People usually suspect the equipment first, when it's almost always incorrect connections, incorrect settings, or bad cables. Then they waste time returning equipment, when this really doesn't fix the problem. A majority of returned equipment is found to be functioning properly by most suppliers.

Step 4: After you have the amplifier channel 2 signal light flashing, if you still don't have sound at a known-good monitor speaker connected to channel 2, then double check all rear-panel speaker connections and mode settings on the amplifier for channel 2. Also, be sure you try a different speaker cable, or a completely different signal path if multiple cables are involved. Make sure all Speakon connectors are properly seated & locked. If one of these is inserted, but not fully rotated & locked, then it may not be making a good connection. This is a common problem. A similar problem occurs when ¼" speaker plugs are not fully seated. In a step-by-step manner, substitute known-good cables for uncertain cables, checking that all connections are properly seated as you go along, until you've found the problem or gone through all possible cables and connections. (Also consider that you may need to power off the amplifier, and power it back on again, to reset its protection circuitry if bad cables have been previously connected, or abnormal mode settings have been used. In other words, if you think everything is good except the amplifier, cycle the power switch for the amplifier and see if this corrects the problem.)

Finale for Example 2: By now you should have sound coming out of the new monitor channel, or know definitely why not. If you think it's because you have a bad piece of equipment, you should have verified this by substituting in a known-good unit, or alternately, connect the faulty unit in a known-good signal chain, and prove your finding. If it's a cable or snake channel, then by now you should have substituted a good cable or snake channel and fixed the problem (at least temporarily). If the cause was an incorrect setting or an incorrect connection, your step-by-step troubleshooting process should have led you to the solution.

Conclusion

The specific examples above are intended to illustrate the general troubleshooting approach of "Divide the Problem". After understanding the basic concept illustrated in these examples, many system users with moderate technical aptitude can quickly see how to apply the same ideas to a wide range of problems. However, if reading this relatively brief article doesn't get you started down this road on your own, try to work under someone else who seems to have mastered this way of dealing with system problems. As you observe them, actively think through how they apply this principle. After a while, you'll begin to catch on, and you'll start to find that the problems you encounter aren't as daunting as they once seemed. In addition, you'll start to notice that the musicians and others who depend on you will respect you as an efficient problem solver, rather than as just another person who can operate the equipment.