

## **Silviculture Instrumentation Tech Tips**

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### **2. Laptop, Landline, Cell Phone, Modem, Datalogger: How Do You Tell Where the Problem Is?**

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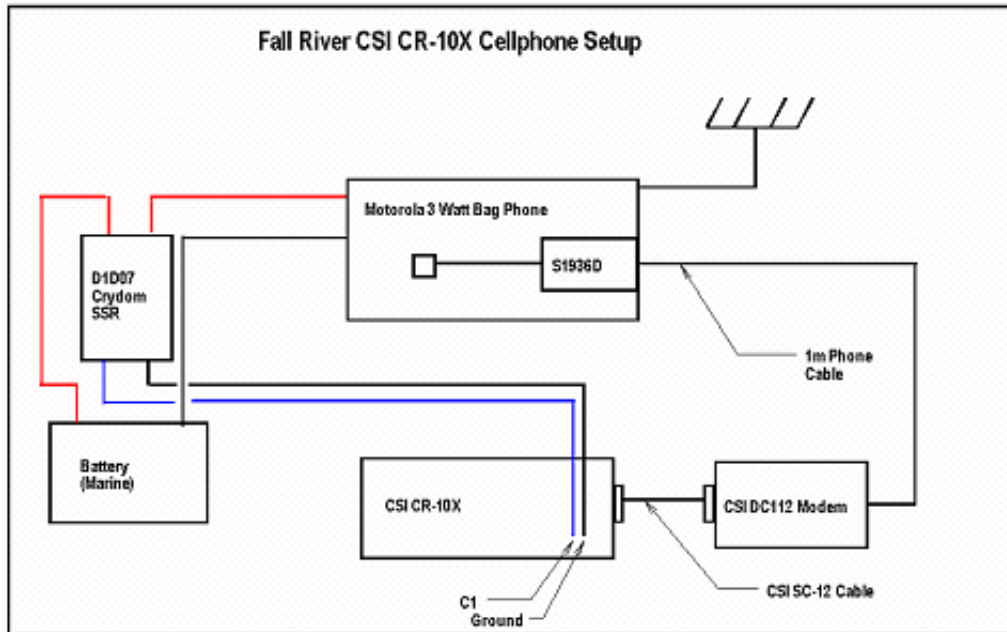
***The Short Version.*** The cell phone link to one of our remote weather stations stopped communicating. I got different messages from three different phone companies and my laptop computer each telling me what the problem was: “All lines are busy” or “Message number so-and-so...” or “Telecommunications command failed.” None of the information solved my blocked communications. I made initial calls to all these companies, and couldn’t find anyone who’d take responsibility for MY problem. I tried to fix it myself, but the labyrinth that is our current cell phone system involves a LOT of people and a LOT of equipment. In my case, all I could do is confirm all my equipment was working, and start calling for help. The problem turned out to be some kind of an overactive software switch in a major piece of phone company equipment that interacted with analog cell phone systems everywhere. I have no idea what the actual fix was, except that it involved some program code. The engineer who finally solved the problem told me that most of the time people get burned out trying to track down the problem and quit. But the “squeaky wheel gets the grease” and often the real solution can only be tracked down by persistent customers who are willing to keep surfacing problems. In this Tech Tip, I explain some of the trouble shooting that you can do at your ends of the line and introduce you to the many people involved in solving my problem.

***The Full Story.*** When the phone system and a modem work correctly, it’s very easy and convenient to call up a remote station and have a week’s worth of data arrive at your PC in a matter of minutes. At one of our remote sites, we have a cell phone connected to a Campbell Scientific (CSI) CR-10X datalogger by way of a CSI model DC112 modem. We communicate with the CR-10X by way of a laptop dedicated to the modem link. The PC has a 56k PCMCIA modem. We use this laptop as a dedicated modem PC, in order to provide full-time modem services without a network connection. (A network connection could compromise our network security by providing a so-called “back-door” to the network itself.) At first glance, the connection scheme for the laptop-CR-10X communication is straightforward: PC to PCMCIA card, PCMCIA card to land line and

then, then, then the signal arrives at the CR10X cell phone. To some, this connection scheme quite possibly makes sense. This Tech Tip points out that you may need to understand some of the then, then, then part of the process. What's missing is how the signal goes from your desk to site miles from the nearest phone line. Or maybe more to the point at hand, WHO gets the signal from the desk to the site? This may seem like nothing more than an academic question, until your PC to CR-10X link quits working and you have to troubleshoot it yourself. There may be a few more partners in the link than would appear. The first question is not as simple as it sounds: "Where do you start?"

**Where did I start?** -- I started with the laptop. What was happening was the PC modem would dial the number on command from the CSI software and then, over the laptop speaker, you could hear the modem ring once and would be replaced by a voice, which said, "Welcome to XYZ Wireless. All lines are currently busy." Or sometimes "Error message number so-and-so. Or sometimes the laptop would put up a fuss and pop up a telecommunications failure message. There was no consistency to which message came up and when. I thought that the last thing I'd have to worry about was some kind of failure in the cell phone network. I asked our purchasing agent for a name at XYZ Wireless. He recommended I talk to Ms. A. He said that she had helped him work on several other problems. I called and talked to Ms. A. The first piece of information she gave me took me by surprise -- the number that we call to get the field site cell phone was not one of her accounts, it was a competitor, 123 Wireless. She said that the problem was probably on my end. But she still volunteered to help. She said that I'd need to be pretty sure that the trouble wasn't in my gear or in the company that serviced the landline at my desk. My desk phone service was provided by a third phone company. My officemate was out. I used the laptop/modem arrangement to dial her phone and listened to the phone ring. Good enough proof for me to eliminate the landline phone company. Next, I had to eliminate the field cell phone from the list of potential problem-makers.

Cell Phone -- The cell phone in this application had originally been a Motorola analog "Bag Phone," familiar to most as a large, black unit. The wiring layout was unique to a CSI installation (Figure 1).



**Figure 1. The cell phone-modem-CR-10X wiring scheme for our remote installation. Note that this is a ‘home-built’ package, not the commercial version from CSI.Field Site**

**Cell Phone** -- The bag and battery had been removed from the bag phone, leaving a flat black package 20 cm x 10 cm x 3 cm. Our reason for using such a large phone is the power output: 3 watts, more than most pocket cell phones. The first challenge was to find out what parts are in the cell phone end of things. The connection layout is logical, to a point. There was an antenna clamped to the CSI tripod cross member, with a cable running inside the CR-10X enclosure. The cell phone electronics were mounted inside the enclosure. There was a connector on the electronics package for the other end of the antenna cable. It was securely fastened. The voltage to power the cell phone was checked and it was at the required 12 volts. There was a “piggy-back” electronics package connected to the cell phone electronics, which bridged the gap between the cell phone electronics and the CSI modem. The modem then connected to the CR-10X. The piggy-back package turned out to be a Motorola model S1936D rj11 interface, also called a dial tone generator. It seems that cell phones, unlike regular landline phones, do not produce a dial tone. Modems, on the other hand, need a dial tone to operate. The S1936D provided that dial tone. The S1936D has another handy feature. A regular analog desk phone can be plugged into it in the field so the cell phone can be checked for incoming and outgoing calls. After plugging an analog phone into the S1936D, a quick call to my office Voice Mail number confirmed that the transmitter end of things worked. However, a call from my pocket cell phone to the CSI package (that I was standing beside) got the same familiar response that I had gotten at the office: “Welcome to XYZ Wireless. All lines are currently busy.”

**Eliminating the Field Cell Phone from the List** -- I resolved the immediate dilemma by removing the whole cell phone installation from the weather station and taking it into the

lab. The system worked fine in the lab. I talked to Ms. A, and told her that the equipment on my end was running ok. She suggested I run a test from three different cell phones, each one subscribed to a different wireless company. That way, I could resolve if it was a cell phone traffic problem or a roaming problem. All three wireless phones connected with the CSI package in the lab. I called a cell phone technician and got instructions on how to check out the programming in our field phone. The technical aspects were documented in a book available on the web<sup>1</sup> (this is a VERY useful reference for servicing analog bag phones). The field phone checked out fine. Just to be sure, I got another bag phone, programmed it with the 123 Wireless cell phone vendor, checked it for proper operation and then installed it in the field. I confirmed my installation procedures with the technician who had installed the original field cell phone at the site.

**Cell Phone Companies --** I called Ms. A back and she said the problem lay in the fact that the field cell phone was subscribed to 123 Wireless, which had no coverage in our remote field area. She told me to get a map of the 123 Wireless coverage area and confirm that. A call to 123 Wireless confirmed what Ms. A. had told me. I constructed a map and found that the 123 Wireless coverage was a few miles shy of reaching the field site. The problem, according to Ms. A., was that the field package couldn't connect with its parent signal, so it was trying to 'roam' to complete the call, but for some reason was not connecting with the XYZ Wireless system. She said that she couldn't confirm where the problem was, but that I needed to get 123 Wireless to issue a 'roaming trouble report' to her company. She had gotten me this far, under the impression that it wasn't her company's problem, and ironically, she needed a trouble report from 123 Wireless to act on it.

A call to 123 Wireless's local number got me Mr. B. He said he'd issue the roaming trouble report and then told me to call back in a day. I called back and found they had been having trouble finding the solution. They worked on it while I was on the phone and found the problem. The "fix" lasted about a week.

**The Solution --** When I called Mr. B. to report my problem had returned, he told me to contact Mr. C. Mr. C. said he was familiar with the problem and that it occurred because of some electronic operating gear that had been replaced at XYZ Wireless and there was some kind of problem in the new equipment. Whatever the problem was, it was temporarily solved by the end of the day. We had two additional cell phone problems with the weather station over the next four months. The symptoms for the first recurrence were the same. I called Mr. C. back on both of them. He solved the second problem and the system worked fine for several months. The third problem was different, with unfamiliar messages. I called Mr. C. and he told me that the sudden appearance of Caller ID in the competitor's gear had been the problem, but only failed in conjunction with analog phones. In a subsequent conversation with Mr. C., he shared with me that our problem had become a focal point for solving this problem on a larger scale (meaning states, possibly) and that without our persistent involvement, might have continued on without ever being surfaced. Once I tabulated the crew of people that I know had helped,

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<sup>1</sup> Larsen, Mike. 1997. The Motorola Bible. 2002. September 25.  
<http://home.swipnet.se/OsbyMikro/motbible.txt>. 55 p.

the size of the team that had been involved in the solution turned out to be larger than I had originally thought (Table 1).

**Table 1** Organizations who were members of the team that solved the weather station Datalogger-Modem-Cell Phone-Computer Problem

Organization	Staff Members	Service
Land Line Phone Co.	Account representative	Made phone connectivity checks
XYZ Wireless	Two account representatives and two engineers	Advice on roaming, cell phone troubleshooting,
123 Wireless	Three engineers	Acted as intermediary between companies, coordinated solution, followed up on customer satisfaction, brought solution to XYZ Wireless
Cell phone repair shop	One Technician	Gave assistance on cell phone check out, supplied critical part for cell phone troubleshooting.
Campbell Scientific	Three engineers	Troubleshoot modem, datalogger and signal connection issues.
USDA Forest Service	Computer specialist, software specialist, instrumentation specialist	Confirmed that everything was working on our end.
Research collaborator	One technician	Set up datalogger/cell interface, helped to troubleshoot problem.

**Conclusion --** As a final caveat, it should be noted, that when you set out to solve a cell phone problem, make sure you collect all the data you can before calling a cell phone company for help. The more information you can provide, the faster the troubleshooting process will go. Remember: Each cell phone installation is unique in how the signal gets from the field site to the lab, and if you run into trouble, you may not be able to solve the problem on your own. You'll need to do some homework beforehand in order to give your new team members all the help you can, so that you can proceed as quickly as possible. The solution chronicled here involved several dozen phone calls, two days in the field, and involved several cell phone hardware and software "sidetrips," like stepping through the cell phone setup procedure to make sure it's programmed correctly. When you set out to find out where your problem is, you need to be able to definitively prove the problem isn't in your own gear, before you can expect an account representative or engineer to embark on a project that may turn out to be as extensive as this one turned out to be.