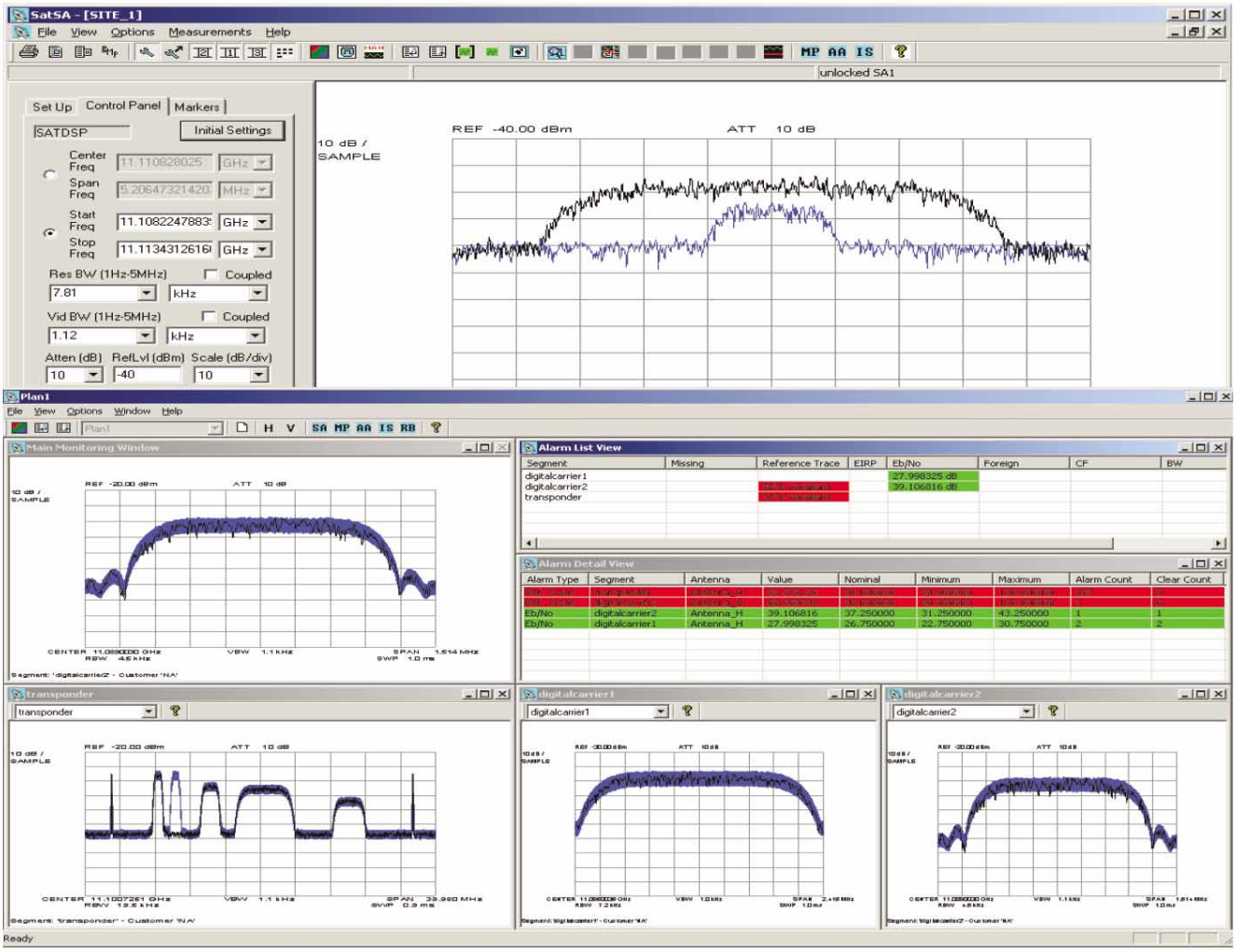

Draft CSA screen. Photo courtesy of Integral Systems.

Learning from the customer

California-based SAT Corporation specialises in the development of radio frequency interference systems for both military and commercial terrestrial and satcom use. Helen Jameson speaks to Bob Potter, President of SAT Corporation about the importance of interference detection and mitigation, and what part it is playing in the military.

Question: Can you begin by telling us more about your company, Sat Corporation?

Bob Potter: SAT Corporation was formed out of a small company that was called Systems for Automatic Tests. That company was actually formed by former Hewlett Packard engineers. They provided automated test systems for mixed signal integrated circuits. By the late eighties, it became apparent that there were two businesses – one was the automated test systems and the other was automatic RFI detection for terrestrial and satellite applications. One of the original founders then spun out a company that he named SAT Corporation to concentrate on RFI detection systems. The company was incorporated in 1991. At that point we concentrated solely on interference detection analysis systems and separated into two parts – one terrestrial and one satellite. Throughout the nineties, as the company grew, the relationship with Hewlett Packard remained, and we became software vendor for HP's RFI system which was known as the E40-500 which they sold successfully through the nineties and which allowed us to concentrate more on the satellite side.

Question: The military is using satellite communications at an increasing rate as the applications offered are so flexible. Is this use of satellite making satellite in-

terference a much more frequent problem? Do you expect instances to increase with increased use of satcoms?

Bob Potter: When the military began to use commercial space there was an increase in interference. As in any RF communication environment, if you increase the amount of users and therefore increase the amount of spectrum being used you are going to increase the occasions of interference, and that was true when the military first went into commercial space.

There were some other issues related to that as well. Primarily, in the commercial satcoms space we used polar diversity to effectively double the spectrum. This was something new to military satcom users. The other aspect of commercial space is that the satellites are placed much closer together so therefore pointing and alignment is a big thing in commercial satcom for minimising interference. It of course takes time to align an antenna correctly and in certain situations the operator doesn't always have the time because of their operational requirements. However, now it is getting better. The reason behind this is that there are new tools available to operators in terms of auto aligning and other tools that are supplied by our sister company, Newpoint Technologies, such as remote site management which basically allows remote management of those terminals so the guys on the ground can take care of what they have to take care of and allow the operations centre operators to take care of the equipment. This is reducing the occurrences of interference tremendously.

Question: Interference is obviously a problem on the battlefield where it can be extremely dangerous. What are the main reasons behind interference?

Bob Potter: The only real study that has been carried out into this was by the Satellite User's Interference Reduction Group (SUIRG) and that was a study across commercial satellite. You are right in saying that only one percent or less of interference is malicious. The rest is really down to equipment failure and various forms of human error. The human error really comes down to being in the wrong place at the wrong time, transmitting on the wrong frequency, the wrong polarity to the wrong satellite, or all of the above.

Another form of human error could be running a test where the transmit line should be run into a termination and forgetting that it is actually connected to the antenna. The other forms of interference that you could link through to human error but are actually designated as separate entities within the SUIRG study, are cross-pol leakage which basically means that the antenna is not aligned correctly or the antenna has become misaligned due to external forces – the weather being one. Obviously, satcom on the move is another aspect where you really need the latest tools to ensure that the antenna remains aligned correctly in terms of polarity, especially in Ku-band where linear polarity, vertical and horizontal, is used. In C-band, they tend to use circular polarisation and leakage is not so much of a problem. In Ku-band it tends to be more of a problem. And because satellites are only separated by two degrees and only relatively small antennas are being used in the field it is very easy to think you are pointing at your satellite, but you don't have to be off your satellite by very much to be illuminating the adjacent satellite. So pointing and alignment are the other main areas of human error.

The final one, which is actually the biggest cause of interference, is equipment failure. The military actually do a better job than anybody else in terms of ruggedising and ensuring that their equipment works. Their equipment is subjected to harsh, rough environments and therefore equipment failure can occur. An ideal way to mitigate this is to use remote site management and to have people at an operations centre who can figure out what has gone wrong and who can do something about it. Obviously, the guy in the field will be concentrating on other things rather than checking that he has a rack of green lights. So having a team of people dedicated to keeping an eye on the equipment and antenna pointing is also key to keeping instances of interference down.

Question: What problems can interference cause for the user?

Bob Potter: It can cause anything from reduced bit-error rate which means that the link is still up and still working okay but bits of information begin to get missed. We have all been involved in a cell phone conversation where you only hear every other word of the conversation – that can happen in the field as well, when interference starts to occur. It can vary from that all the way through to complete loss of link where one side of the conversation may not be heard or nothing at all gets through. There really need to be mitigation plans in place for this type of occurrence and in order to do this they could have extra capacity reserved depending on how mission critical that link is. In the world of UAVs for example, I believe that when a link loss is experienced they turn around and go home and the mission is effectively abandoned. That can lead to all kind of consequences on the ground that I shudder to think about.

Question: Can you please tell us more about the products that Sat Corporation offer to the military to mitigate interference, especially the Monics system?

Bob Potter: Concentrating on satellite, we have two main lines. The first we call SATDSA and this is a unit that can be deployed in the field. It can be used remotely but it is more of a self-contained field-deployable unit to identify and analyse interference. Identifying and analysing interference is important because until you do that you cannot establish whether there is a problem other than the fact that your link is down. Before you decide what you have to do to get the link back up you have to figure out why it is down.

Question: How do you establish what the cause is?

Bob Potter: We link into planning systems so you know who is supposed to be there. So you can take a look and identify who is not supposed to be there. And the other technique that we started back in 1998 is carrier under carrier which is a signal separation technique where we can look inside individual carriers and identify whether there is another signal close that may be interfering. By separating these signals out, we can analyse them rather than just show them a pretty picture of it – analysis is important. The analysis of the interference will often show that the interferer is one of your own and the quickest way to have interference removed is to identify what type the interference is and search your database and find out who is causing the interference. This way the offender can be tracked down very quickly. We offer this ability through our products. Once interference is detected, an alarm is set off to alert those who need to know so that it can be investigated and stopped, but the goal is to prevent a scenario where loss of link is the outcome – the worst outcome of all.

So what happens when you lose link? You can use geolocation but that won't get your link back up, not in a timely manner. The other part of our product is the movement of the user to another spectrum location so that the link may be re-established. Our products can scan the spectrum and look at the plan for the next couple of hours, find a slot and get them up and running again. The other tool is to prevent interference from the user in the new slot affecting anyone else. This is called transponder compression analysis detection.

Question: How is geolocation used in Sat Corporation's products?

Bob Potter: Geolocation actually pinpoints or identifies the point on the earth's surface where the transmitter is and as such, all geolocation systems use ESP technique. They always have done. At SAT the ESP technique is ideally suited to a marriage of software with common hardware. So within one set of common hardware you have the ability to end the spectrum so that you may identify any signals that shouldn't be there and figure out whether it is an interferer or not. You can search databases to decide whether you have seen this signal before and whether it is one of your own. You can also fire up the geolocation system and pinpoint

on the earth's surface where it is coming from and then you can cross-reference that location with the list of earth stations and phone numbers and then you know who to call. Generally what happens, in the commercial world, is that you call an earth station and explain that you are receiving interference and ask if they are running some kind of test. They will always deny this but the signal will eventually go away.

Geolocation is the all singing, all dancing system and gives you the complete ability to identify the interference that is occurring and locate it and have it removed by hopefully making a simple phone call. It's the best of the best. The majority of global operators worldwide will have this system. Smaller, regional operators tend not to have the geolocation feature. This is not because the feature is cost prohibitive but because the antennas are.

It can cost a million and a half dollars to install the large, steerable antennas that are required.

In geolocation there are two main techniques. One is Time Difference of Arrival, the other is Frequency Distance of Arrival.

It takes two satellites to get a position on the earth. If you use time domain only, then it takes three satellites. And because the interferer will usually point at just one satellite, the signal on the other satellites is going to be very low and that is why you require big antennas to use digital signal processing to extract the one signal from the mass of other signals.

Question: I know that Sat Corporation place great emphasis on research and development. Can you tell us more about any particular areas you are working on?

Bob Potter: We are currently working on digital signal analysis techniques. We feel that there is less need to manage the transponders than there was ten years ago as this is being done by the earth stations with the multicarrier per carrier on the ground. That has driven what we do into the signal analysis and interference detection realm. We will continue to develop techniques for identifying interference.

We have delivered transponder compression detection – a receive-only measurement technique where we can find the current operating and saturation point of the transponder. This helps you to check that your transponder is working in the way it should be. If it is operating in a way it shouldn't be, you either have an extra signal on there that's an interferer or you have or your customers have all inched up their power a little bit and the problem with that is that you may not have the power to give another customer capacity.

The last part of the technique is analysis. If you want to drop a customer into that transponder, let's say because they are causing interference elsewhere, you can find a suitable slot to move them into that will not cause compression and modulation interference. It's those kind of tools that we will continue to develop to help our operator base both military and commercial.

The other aspect, particularly from a military standpoint is that we have been working with our sister companies this year and we have opened up the interfaces so that any one of the network management systems, the satellite control centre or the payload operations centre, are all sharing information and everyone can get a view of what is happening across the entire network. Now, on one screen, you can see what is happening from where the data is generated from the original centre all the way through the communications link, through the satellite, to where the data is being delivered to, increasing situational awareness.

Question: Where will Sat Corporation's areas of focus be over the coming year?

Bob Potter: The strategy that we follow has allowed us to grow at this steady rate and it has allowed us to keep ploughing money back into research and development. We do consider ourselves to be the leader in the interference detection. Our customer base consists of 24 plus operators around the world. Customer retention is a big focus for us. Customer support is one of our primary concerns. We must ensure that all of our customers remain happy. We basically learn from our customer base. They feedback information to us and we incorporate that into our products. We turn what we are hearing into product ideas and upgrade our products as part of our ongoing support. We listen more than we speak and then we react to what our customers have to say. ■