Schrodinger's CATSS

Dr Hans-Christian Gran, Chief Scientist, and Dr Bjorn Arne Johnsen, Research Director of the Protection and Material's division of FFI in Norway talk to CBRNe World about a new box of tricks

FOR the last four years one of the flagship projects to come out of FFI [Norwegian Defence Research Establishment] was CATSS [Chemical Atomic Toxic industrial chemicals Surveillance System]. This was their network of detectors that could be deployed remotely and provide an unmanned protective net. As time has gone on, however, the emphasis has changed from being a system that was another way of utilising existing detectors (initially Smiths' LCD, Dräger's Multiwarn and Automess) and become about the network, with the actual detectors being third or fourth down the line. FFI is not, for all its strengths, an ECBC or a Porton Down, and the team have had to produce a product with far less resources that their other Nato allies. What this has meant is that the CATSS system's evolution has been steady and instead of being confronted by change has embraced it – meaning that the system is now versatile enough to being composed of varied sensors, such as TI, cameras or acoustic devices, rather than just CBRN ones.

CATSS will soon be undergoing trials with the Norwegian Army

©FFI

The core business of the system is still CBRN, however, as Bjorn Johnsen explained. "The system has changed; it used to use an LCD and a Multiwarn," he said. "It now uses two LCDs, and they are sampling constantly, within the LCD pump rate, and this has proved sufficient for the three scenarios we have constructed it for. These are: mortar fire with 1-10 rounds impacting on the base; a TICs release upwind of the base; or a grenade or mortar round with some form of radiological content.

"The last scenario is perhaps the most important, as it is far more difficult for the soldiers to ascertain than the other two. There need not be any tell-tale visual signs like the other two, and it would only be picked up by the sensors. Our studies on these scenarios have showed that it increases the survivability of the personnel considerably."

The idea of forward-deployed sensors is not new; some chemical agent detectors, such as Proengin's AP2C, have been designed with the idea of remote deployment inherent, while countries are also devising networks of sensors and detectors to provide critical infrastructure protection, such as the UK's ISMS and Canada's VP Bio. There is also a detector already on the market that provides 24/7 NBC detection – Smiths' NBCerberus which was launched three years ago. Yet to focus on the detectors is not what CATSS is about; as Hans-Christian Gran insists, CATSS is primarily about the software. "Cerberus is bigger and for different applications; CATSS is lighter and man-portable," he said. "We are currently working with Smiths, but it is down to the customer; it is a modular system allowing you to put any other sensor in. 'Any sensor' can mean acoustic or camera; they don't have to be CBRN. The next one is likely to be Smiths' stand-off FTIR, and we will add that to the mix and see what it will bring. It won't be in the sensor housing; instead it will be in the force protection package."

While the specific sensor might be further down the list, in terms of the current CATSS package it is important. Smiths LCD is a good example of the cutting edge of Ion Mobility Spectrometry (IMS), and IMS false-alarms on certain chemicals – as do other technologies. This traditionally has been dealt with by combining it with a different piece of equipment that false alarms on different substances; therefore if both systems alarm it is most likely a genuine alarm. This philosophy was borne out by the original decision to include Dräger's Multiwarn, which would have allowed this orthogonal detection. The two LCDs used in the system are set to different chemicals; one chemical warfare agents (CWA) and one toxic industrial chemicals (TICs), which provides a wide coverage but still does not deal with this issue. Dr Gran agreed, but suggested that the choice of detectors was to show the applicability of the network, rather than the final decision.

Even back in 2003 CATSS was a C and R system, but was interested in bio – but no more than interested. In that time bio detection has come on a long way, and it is now far more likely that the bio detector of five years time would fit inside a CATSS-type envelope, than it was three years ago. Dr Johnsen admitted there was still a desire there, but they hadn't got round to looking at prospective solutions. "We've not even done any looking; just talking," he said. "The most promising candidate is Smiths' SBS. Air sampling for forensics has not been thought of, but it is a possibility, though we did think about air sampling, for chem as much as bio. We are also thinking about the

possibility of biological standoff being incorporated into the package; FFI does a great deal of work on bio stand-off and are part of the Stand-off working group in Nato."

While Smiths is currently ruggedising the current design, the device will remain split into two components: the upper 'bucket' which contains the detector suite and the lower one which contains the computer and the power. The system can be either mains or battery powered, but there is a great deal of opportunity in the lower bucket. FFI has identified power requirement and battery size as two of the major components that need to be dealt with in the move from prototype to product, and with a decrease in battery size and further miniaturisation of the computer suddenly there is two-thirds of a 'bucket' to be filled with further sensors. "Currently the computer takes up two thirds of the second container," said Dr Gran, "but there is a large possibility that this could be extensively miniaturised, leaving the spare capacity for other detectors. With this in mind we have started integrating cameras, meaning that we can cue in stand-off detectors and have also worked with another company to do analysis of the images – to do gait analysis, for example, that can tell you whether a certain person has left a building, or how many people have entered compared to left. All the software work will be finished in May; we need to finish the GUI interface and the company Lenco Software is working in collaboration with FFI to do this."

Despite the fact that the design won a Red Dot award – an international design award – for its feel and handling, there are problems inherent with it. The detectors sample the air that passes between the two buckets using the pumps inherent in their design; this can mean that the air sampled is not large and is not, perhaps, a wholly accurate appraisal of what is in the atmosphere. This could be solved by bringing in a larger, powered air intake that would be able to pump the air across the sensors(though the flip side of this could be an oversaturation of the dectector). Perhaps more importantly the sensor is a sealed unit, meaning that heat loss is difficult to achieve, which might be fine in the wilds of Norway, but in hotter climates, such as Iraq, it could see internal temperatures soaring to a level that will either cook the detector or the computer. "There is no desire to have powered air intake to enhance detector capability, but there is no reason why it couldn't be modified to allow this. The problem would be the trade-off between the increase in detection off set by the need for it to be decontaminated," said Dr Gran. "We have taken it down as far as -28 and the highest temp externally has been 25-28," he continued. "We have managed snow, ice, rain, etc, but there could be a problem with the interior temperature in places like Iraq."

Yet it is the impact on the network that the team have put the most effort into; since every module has a met station, it is able to track wind speed, sunlight and temperature – some of the most important variables in downwind modelling. Dr Johnsen confirmed that the system would be able to take this data and feed it straight into the system, so should there be an attack, those at most risk can be identified and get the earliest warning. "If several sensors alarm then there is software that can pinpoint the concentration to also allow accurate location of the attack," he said. "It is possible, and we are working with a company to include this, and while it has yet to be formalised it is still very promising. Volatility, wind speed, type of agent, sunlight and many other parameters are analysed to try and calculate the probability and location of a lethal dose. We are interested in local met, which is not covered by ATP45, which only takes the operational air flow, and the system is smart enough to get real-time met data fed into the system to alarm the hottest zones."

> We shouldn't ask the military to work out the best place for these sensors; they have more important things to do and it needs to be simple and correct for them.

Currently the system is planning to start a trial with the Norwegian Army. "CATSS has not been purchased by the Norwegian Army yet," explained Dr Gran, "but the plan is to produce a test system – eight units/one camp. Currently we have a grand total of four units and have been doing the field tests with 1-2 units. The tests will enable us to produce further units, better GUIs with all the user experience, improve the battery/power requirements and adapt it to the needs. We will also hook it up to other sensors and gain valuable operational usage and user requirement data. We are also going to use mathematicians to understand how we can use HPAC, and some terrain modelling to work out the important parameters for sensor siting. We shouldn't ask the military to work out the best place for these sensors; they have more important things to do and it needs to be simple and correct for them. These algorithms are important and we will be concentrating on getting them right."

The commercial arrangements for further development, marketing and sales are still under consideration. One possibility is to make a commercial venture out of the CATSS system and market it to international customers. This is not the first time research establishments have done this, and to some extent it seems to be a trend, but is clearly daunting for the CATSS team. "Currently an organisation called Campus Kjeller is looking into whether it will be a company, consortium with a licence and who will own the IPR, that sort of thing," said Hans Christian Gran, "they are advising but the final decision will be made by FFI, Smiths and Lenco. They will then help us produce the items and become profitable. The exact relationship with Smiths, with non-compete clauses etc – has yet to be finalised but Smiths see the possibilities in this."

It will be interesting to see how CATSS develops as a commercial entity. One thing companies are sensitive about is IPR and allowing other parties to tinker with their insides and see how they work; the EU Impact consortium found this out when they tried to do a similar CATSS-type programme. The financial constraints of CATSS might be swapped for IPR and competitive ones. There is a demand in the market for this type of system, but it has to be robust and interoperable. CATSS' biggest trials are still to come. Modular systems are fine when their modularity is finite – when only one aspect is changed; it is when the system is plugged into a multinational site, where demands for information, information protocols and user requirements are all different – the sort of things that are expected on operations – that problems occur. Whether it is flexible enough to deal with these challenges will ascertain whether FFI's CATSS will sink or swim.