

BEYOND THE FENCE

PERIMETER INTRUSION DETECTION SYSTEMS (PIDS)

CommandSpace Technologies &
Concept of Operations
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EXECUTIVE SUMMARY

Positive surveillance and control of the battlespace around military facilities is critical to maintain the proper function and safety of personnel, as well as the mission of the facility. The varied and rugged terrain found in many current conflict zones provides a unique challenge to any surveillance and security system. The application of proven surveillance technologies, paired with the appropriate data fusion, infrastructure and concept of operations, are required to provide the necessary situational awareness of the facility and its surroundings.

Surveillance and security systems that give military operators the ability to *See First, Understand First and Act First* provide a significant leap forward from currently available installations. Implementation of CommandSpace integrated systems from ICx Technologies immediately provides this leap in capability.

Once the problems of surveillance and security are segmented into three operational objectives, the potential solutions to integrated security requirements become easier to deal with and understand. In order to *See First, Understand First and Act First*, appropriate technologies must be applied to each task.

The technologies that allow one to *See First* are ground surveillance radar systems, unattended ground sensors and traditional intrusion detection sensors. The next technologies required are those that give an operator the ability to *Understand First*.

These would be multi-spectral cameras paired with simple video analytics giving operators the ability to verify and identify potential targets. Finally, the ability to *Act First* is supported by command-and-control systems that leverage the fusion of all available sensor data into actionable information that is displayed in a Common Operating Picture (COP). A COP displaying real-time, actionable information can put first responders in the right place at the right time to prevent or forestall

detrimental actions at the facility. The required capabilities and technologies put information directly into the hands of the decision makers and first responders, when ever and where ever they are in the facility. Some technologies may also have the ability to not only detect and assess a threat, but to actually respond to the threat immediately with non-lethal force.

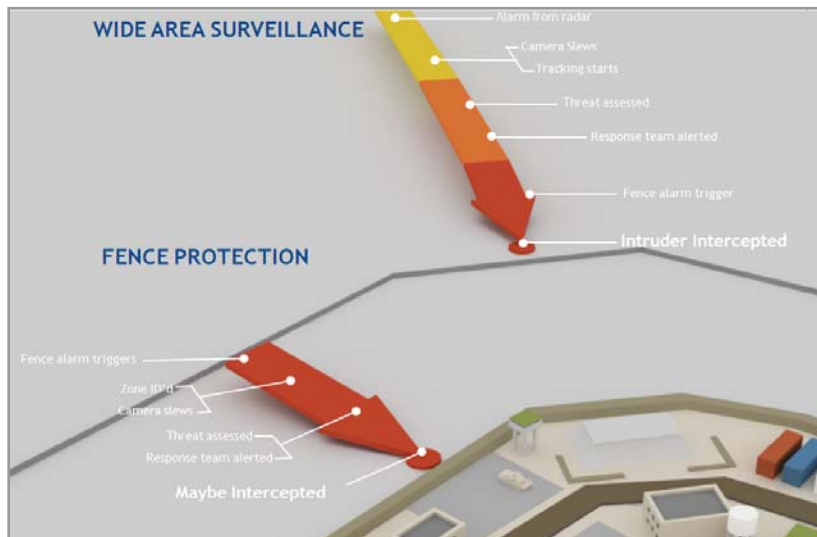


A description of individual technologies and their capabilities is below. These technologies afford radical results in the area of force multiplication. By shifting the traditional sentry approach away from extensive deployment of personnel — either in vehicles or on foot — to the selective, targeted use of fewer people complemented by information from radars and cameras, the field commander is able to have greater numbers of other specialties critical to the mission.

SEE FIRST

GROUND SURVEILLANCE RADAR

Traditionally, perimeter security is provided by a physical barrier that may or may not be sensed and monitored. If configured as a sensor platform and monitored for intrusions, a security fence can be prohibitively expensive to install and maintain. It is also quite prone to false alarms. In addition, a security fence can only provide information about where an intrusion *was*. Once the perimeter is breached, security



personnel are forced to rely on other alarms and sensors to track the progress of intruders. Unfortunately, at this point an intruder may have already reached their objective. Physical fences serve well as boundary markers and barriers; they do not make good sensor platforms.

The solution to this dilemma is to utilize sensor systems that give

security personnel knowledge of the entire space they are required to protect. The only sensor system that can reliably provide this information is ground surveillance radar, which gives operators insight into not only their perimeter, but the areas both within the perimeter and beyond.

The entire ICx family of radars offers 360 degree surveillance coverage with very low false-alarm rates. All ICx radar offerings (350m, 1,400m, 4,400m and 12,000m) are interoperable, to optimize every deployment scenario. Line-of-sight characteristics vary considerably in many cases and a range of solutions may be required.

The ICx family of radars is the system-of-choice for perimeter and wide-area protection. The ICx STS-350 is the only radar that has passed U.S. government detection and false-alarm testing for crawling, walking, running and vehicle intrusions.

STS-12000 GROUND SURVEILLANCE RADAR

The ICx STS-12000 long range radar is the all-weather, round-the-clock, unmanned solution for 360 degree situational awareness; against personnel it sees out to 10,000 meters and sees light-truck types of vehicles out to a 12,000 meters radius from the radar. Deployed as a fixed installation or mounted one of the ICx mobile platforms for portable operations, it uses personnel-safe, low-power technology to sense people walking or running in any direction relative to the radar, as well as seeing vehicles traveling at all speeds from slow to an excess of 70mph. All ICx radars maintain a range accuracy of 3 meters or better at maximum range and an angular accuracy of less than 1 degree. The STS-12000 has a terrain-following elevation profile of plus/minus 15 degrees. This performance is for both land and water areas. A key capability that the radar embodies is the continuous updating of new or changing activities, which provides commanders real-time situational awareness within and beyond the area of operation. Any new activity sounds an audible alarm at the control station. These alarms alert the monitoring personnel without their need to constantly view the display.

The STS-12000 radar feeds the radar data to the command post where it is displayed on the command and control screen. Multiple STS-12000 radars work in networks that can also include the STS-4400, STS-1400 and STS-350 radars as gap fillers. Data from all the radars in the network are displayed and controlled from a single view on the Resolution software. The screen shows the precise locations of the suspected intruders, their direction and speed and a record of their tracks. The resulting alarm provides instantaneous annunciation warning on the screen and an audible tone to anyone within hearing distance that a potential intrusion event is occurring, and immediate appropriate action is initiated.



STS-4400 GROUND SURVEILLANCE RADAR

The STS-4400 in single or multiple unit deployment provides human (walking) detection at 4000 meters and vehicle detection at 4400 meters. Crawlers are detected to more than 200 meters in 4-inch grass and to more than 300 meters over smooth desert, concrete, etc. The radar can be set up and running in several minutes. In operation, the STS-4400 radar creates a high-resolution radar map over an area of 360 degrees. Targets are detected by the changes they cause to the "clutter map." This method detects moving

objects/people at very low speed and in any direction, typically within 5 seconds or 6 meters of displacement. The STS-4400 can detect and track up to 32 targets simultaneously.

Once setup is complete, the operator establishes detection and alarm areas. Any target that enters a detection area is tracked. Any target that enters an alarm area raises an alarm and, according to the configuration, steers one or more cameras onto the target for visual tracking, assessment and planned response. The operator can assign priorities to specific alarm areas with those areas closest to the perimeter typically set with highest priority.

STS-1400 GROUND SURVEILLANCE RADAR

The STS-1400 is a low-cost, low-power, high-resolution, continuous-scan, microwave-radar sensor. With all weather, all light-level capability and high resolution (0.6 meter range resolution), the STS-1400 can detect crawlers as far away as 200 meters, personnel at 1000 meters, and vehicles at 1400 meters. Every second, the STS-1400 will monitor and update more than 6 square kilometers (2.3 square miles). Up to four remotely stationed radar sensors can be networked to a single central radar server. For arrays of more than four radars, the outputs of multiple servers can be used together. The data may be displayed at multiple consoles via Ethernet TCP/IP access. It is a highly accurate radar sensor with less than three false alarms in a 24-hour period.



STS-350 GROUND SURVEILLANCE RADAR

The STS-350 provides a rapidly deployable, portable or fixed radar option that can be used in a variety of roles such as: mobile deployments; critical radar coverage between long-range radar emplacements; and installation/tower self-protection. The STS-350 is an all weather, all light-level system with high-range resolution (0.5 meter range resolution), the STS-350 can detect crawlers as far away as 200 meters, personnel at 300 meters, and vehicles at 350 meters. Every second, the STS-350 will monitor and update more than 385,000 square meters. Up to eight remotely stationed radar sensors can be networked to a single central radar server. The data may be displayed at multiple consoles via Ethernet TCP/IP access. It is a highly accurate, government-tested radar sensor with less than three false alarms in a 24 hour period.



UNATTENDED GROUND SENSORS

Other intrusion detection sensors can be integrated into the battlefield surveillance and security system. Existing alarms, fence sensors, unattended ground sensors (UGS) and legacy alarm points can be used as part of a System of Systems approach.

UNDERSTAND FIRST

MULTIBAND SURVEILLANCE CAMERAS

ICx imaging solutions are currently deployed throughout the world, including in conflict theaters for base and asset protection. They are also found at scores of nuclear facilities to compliment existing security systems; they are at numerous ports, airfields, and offshore oil platforms, as well as critical infrastructure.

The ICx family of thermal cameras offers continuous zoom, CCD pan-and-tilt imaging and integrated thermal and EO images called VisionSense. ICx cameras provide 24-hour surveillance using high-performance cooled and uncooled thermal imagers. The DefendIR uncooled cameras are highly modular and configurable with different lenses, sensors and controllers to match mission requirements. An optional high-lumen spotlight is also available for illuminating and deterring incursions.



The ICx family of thermal cameras offers best-in-class continuous, optical zoom capabilities, integrated CCTV with stabilized pan-and-tilt for superior image quality and presentation. A proprietary feature of all ICx EO systems is the VisionSense display function. This allows thermal and CCTV images to be viewed simultaneously in a single overlapping image. This feature is particularly effective when viewing objects that have similar thermal contrast to the background temperature.

Also available are long-range, high-performance Orion camera systems. Orion is a high-resolution, cooled thermal imager with continuous optical zoom, pan-and-tilt, CCTV and laser range-finder integration options with a long life. Both the DefendIR and Orion integrate seamlessly with radars to provide slew-to-cue capabilities with proven results in multiple deployments.

DEFENDIR UNCOOLED, DUAL BAND THERMAL IMAGER

The DefendIR is an industry-leading, mid-range thermal imager that can see in complete darkness and through a multitude of environmental conditions including smoke, rain, snow, dust, and dense fog. The DefendIR is based on forward looking infrared (FLIR) technology. Through the innovative use of VisionSense, which combines video feeds from both a visible light (CCD) camera and an infrared camera, the user can mix and merge the two visual sources. This generates the ability to penetrate glare, as well as to see through windows, glass or water. Featuring a sleek integrated pan-and-tilt design, the camera is capable of continuous 360 degree panning and a +/- 80 degree tilt withstanding temperatures ranging from 40° to +60°C. It supports most protocols used in commercial and military applications, and can be easily integrated into existing fiber, wireless or IP networks. Offering 15 lens and detector combinations, each camera can be customized to meet detailed range-performance requirements.

ORION COOLED THERMAL IMAGER

The Orion is a long-range “cooled” camera utilizing the same FLIR technology developed for the U.S. military. The Orion camera is ideal for both day and night perimeter security. It offers the best range



performance in its class, boasting a 100mm to 550mm continuous optical-zoom lens. Featuring an integrated, stabilized pan-and-tilt design, the camera is capable of continuous 360 degree panning and can withstand temperatures ranging from -40°C to +60°C. The Orion has a rugged housing which is environmentally sealed to meet both NEMA 4 and IP65 specifications.

Requiring only four screws and one cable, ICx cameras install with little effort. Their light weight and small power draw add to the ease of installation, use and to the mobility of the system. ICx cameras are field-tested and in use in operating environments ranging from current conflict theaters, to maritime facilities, airfields, ports, and nuclear facilities.

Like its “uncooled” counterparts, the Orion easy integrates with existing security systems and technologies. It supports most protocols used in commercial and military applications and can be integrated with fiber, wireless, or IP networks. The Orion also interfaces with radar, VMD, UGS (Unattended Ground Sensors) or other trigger devices to provide a slew-to-cue solution.

ACT FIRST

COMMAND AND CONTROL

The proposed system will be controlled from a central command center through the use of an adaptable and scalable command-and-control software suite called Resolution™, which is integrated seamlessly with radars and cameras and video analytics. The Resolution command-and-control system receives sensor data and video from the surveillance sensors and overlays alarm information directly onto a geosynchronous map of the surrounding area. Resolution enables users in a command center to remotely control and visualize the radar tracks and camera output. The flexible and configurable design of our towers, sensors and software allow ease of integration with a wide array of new and legacy surveillance equipment. Our solutions have the versatility to be scalable as threats and required coverage expands.

Resolution from ICx is a flexible video-display platform that can be deployed to manage the command-and-control security infrastructure for critical facilities as well as for enterprise-wide video systems. Its architecture supports multiple users, complex privilege hierarchies, and hundreds of sensors and output devices.

Resolution can be deployed using a video display wall or as a stand-alone terminal display. Resolution provides ease of control for multiple cameras, alarms and event management, recorders and situation awareness sensors. It is scalable and compatible with legacy and new equipment – simultaneously controlling analog and IP inputs. Resolution supports the seamless integration of new and existing assets to support the larger common operating picture (COP). Resolution can also display radar track data as provided by ICx radars. This track data can be used to “slew-to-cue” associated video cameras providing the operator near instantaneous assessment of targets.

The Resolution software platform is able to “plug-and-play” with more than 200 different models of surveillance cameras and with *all* ICx radars. Off-the-shelf drivers are available for analog- or digital-camera technology, standard GPS tracking systems and GIS software packages. Resolution can also be configured to provide “hierarchical” C2 nodes with a “common operational picture.”

An integrated surveillance system can provide both primary and backup surveillance command stations. Resolution command and control software seamlessly interconnects each command node in the control



system with the surveillance sensor network. The intuitive graphics interface allows operators to manage sensor inputs, conduct analysis and control the sensor network. Geospatial maps can be imported from any source and geo-referenced to the geography. Each command station of this sort would contain, at a minimum, a Resolution Security Client, Resolution Device Driver Server and a Network Video Recorder. Recording for the facility would be available at the primary command post. This ensures that video is

archived at the lowest possible level preventing a catastrophic loss of data. All of these command nodes can be networked with standard Gigabit-Ethernet networks or wireless IP networks. Remote systems can be connected in either fashion via internet protocol.

During operations, targets are acquired by the ground surveillance system, ground operators are notified by alarm, and intruder tracks are displayed on the operator’s console. Intruder information, geo-location, speed, and heading are displayed with the tracks. Simultaneously, intruder-location information is transmitted to the surveillance camera. The camera slews to the target and displays an image of the target. At this point the operator can decide if, in fact, the target is friendly or unknown and requiring more information. Or, it could be hostile. The target can be classified by the operator as “friend or foe” and the target’s track information will display this classification.

System alarms are recorded in the Resolution database. Images associated with those alarms can be retrieved and replayed by operators as needed. Further, “alarm zones” can be established through Resolution that display intruder alerts associated with those zones. These zones are completely configurable and business rules can be established to “turn zones on or off based on time of day”. The zones can be easily reset by operators to reflect changes in the environment and operational changes.

Resolution is widely deployed to manage the command-and-control security infrastructure for critical military and government facilities as well as municipalities and state-wide transportation systems. Its architecture supports multiple users, complex privilege hierarchies, and hundreds of sensors and output devices.

NON-LETHAL RESPONSE

ICx offers cameras that integrate two or three spectrums of light for imaging, detection and warning. The Illuminator camera includes a CCD color camera and a 12-million candlepower, strobe-capable spotlight. The Both system can be controlled through the Resolution interface. In operation, the Illuminator can be cued to a target by radar or analytics, the target verified via the lowlight CCD camera and pinpointed/warned via the spotlight. The spotlight can also be set in a strobe mode that can interrupt suspicious activities when trained on the target.

INTEGRATED SYSTEMS

CERBERUS™ - SELF CONTAINED MOBILE SURVEILLANCE PLATFORMS

Cerberus is an unmanned, mobile surveillance platform, autonomously powered and ideal for applications in which rapid deployment is mission critical. Cerberus is designed to address perimeter, border, and point surveillance applications, primarily with regard to force and asset protection. The combination of relocatable, wide-area surveillance along with agile command-and-control capabilities make the Cerberus a force multiplier. The inherent flexibility and portability of Cerberus allows its adaptation to a wide range of sensors and command and control options, depending upon mission requirements. Rugged, dependable and supportable, the Cerberus platform is always ready to provide operators the ability to “See First - Understand First - Act First” under any situation.

Each system comprises the following:

- Aluminum trailer that can be towed by a standard lightweight or half-ton pickup truck, or military equivalent
- “Skid mount” pallet option for truck bed integration
- Variable height and design sensor mast
- On-board ICx C2 Node providing sensor connectivity, communications and power management

- On-board diesel generator with integrated power distribution infrastructure;
- 12/24 Volt battery system with an auto-start feature for the generator (generator is automatically started to recharge batteries, when predetermined battery depletion level is reached)
- On-board environmental enclosure with PC rack mounts and climate-control
- C-130 Transportable and sling load capable

The sensor package for the Cerberus varies according to range and detection requirements. Three versions are available as standard configurations, the Sx, Mx and Lx. The sensor packages vary while the command-



and-control node, along with an integrated power- and sensor-management package, remain standard.

The Cerberus trailer physically comprises the trailer and sensor pallet. The sensor pallet can be removed from the trailer and loaded onto the bed of a standard one ton pick-up truck or equivalent vehicle. The sensor pallet dimensions are 48" W x 96L x 83" H. This gives operators the flexibility to use the trailer-mounted system as a towed unit which can be detached from the tow vehicle and left in place as a detached sensor node. Or, the system can be loaded into the back of the reconnaissance truck and used in a mobile "shoot and move" mode.

Command and Control of the surveillance sensors is accomplished via the ICx C2 node and a ruggedized work station. If acting as a stand-alone surveillance node the Resolution software will control only the mobile system. All cameras and radars can be operated from the work station and Resolution. Connection of the system into a fixed surveillance network is also facilitated by Resolution.

Currently Cerberus systems are deployed on the southern border of the United States, and by the U.S. Army throughout southwest Asia. The Cerberus systems include integrated ground-based radars, thermal and CCTV cameras, command-and-control software and communications equipment. Options for units to be networked and/or operated remotely or from the cab of a tow vehicle are available.

CERBERUS Sx

This option provides an STS-350 radar, DefendIR thermal imager and C2 node along with the basic power and mechanical options.

CERBERUS Mx

This option provides an STS-1400 radar, DefendIR thermal imager and C2 node along with the basic power and mechanical options.

CERBERUS Lx

This option provides a third-party, 30,000m pulse Doppler radar, Orion thermal imager and C2 node along with the basic power and mechanical options.

100' COMMUNICATIONS AND SURVEILLANCE TOWER

In order to provide the proper line of sight for communications and data transfer a mobile self-guyed 100' tower is available. The system is easily transportable and takes up a small geographic footprint. The tower system can be configured to stage communications antennas and cameras as needed. The self-guyed system doesn't require a pad and can be set up by three people in less than two hours.

NOTIONAL REMOTE BASE SECURITY SYSTEM

The implementation of an ICx CommandSpace solution for a notional (2 x 3km perimeter) remote forward base is outlined below. Assumptions about power and communications follows:

Assumptions:

- 2Km x 3Km perimeter facility for Medium Size Base
- 700m x 700m Perimeter facility for Small forward Base
- Level desert terrain/Mountainous terrain
- Anticipated threat vectors - land infiltration on foot or by small vehicle (compact truck, motorcycle)
- Physical barrier around base (concertina and or fence)
- Line of sight available (10Km)
- Dedicated defense forces Hardline IP communications (Fast Ethernet)
- One central Base Defense Operations Center (BDOC)
- 110/220V power available

"Total knowledge" of the entire battlespace is difficult if not impossible to achieve with traditional surveillance technology. Semi-experienced adversaries with superior knowledge of the terrain can easily defeat sensors that are placed "on" the perimeter of the facility. Sensors that are able to reach beyond the physical perimeter and detect intruders have the capacity to raise alarms well prior to the intruders reaching the perimeter. This is critical because distance from the perimeter equals the time available to direct forces to intercept or neutralize. More distance from the target equates to more time to intercept and possibly prevent an attack. A combination of ground surveillance radars, mobile surveillance towers, EO and IR

imaging systems working together can provide a significantly “hardened” perimeter and battlefield oversight that will serve to enhance overall Force Protection.

REMOTE SEMI-FIXED SITE- LARGE BASE

In the attached figure we assume the use of two STS-12000s on a portable platform, two Orion cooled thermal imagers, connected with the Resolution VMS Command and Control system. The Resolution VMS

system is configured for two control nodes that can be co-located or remotely located within the forward site.



While a single STS-12000 mounted on a fixed tower is feasible it gives no redundancy nor does it allow for any variability in terrain features. Frequently our customers integrate the shorter range radars into the solution to make up for gaps in radar coverage based on terrain.

Mounting the 12000s on trailer systems gives the users flexibility in concept of operations. Set-up time is approximately two hours depending on existing infrastructure.

The approximate price of the shown hardware configuration is \$1.2 million. A more detailed price sheet is attached. Pricing will vary according to the actual equipment selected.

REMOTE SEMI-FIXED SITE -SMALL BASE

In this scenario the site is protected by a combination of small, short-range radars, cameras, mobile surveillance units and unmanned surveillance towers. Any of these systems can be mixed and matched to allow for maximum flexibility in the concept of operations, and for total system effectiveness.

In the diagram we are specifying the use of four STS-350s, matched DefendIRs, and a Cerberus camera tower mounting an Orion. We have also used the STS-350/DefendIR in a mobile



surveillance mode. This is accomplished by putting the STS-350 on the back of a utility vehicle, including an integrated IR camera and a C2 station.

The approximate price of the shown hardwired configuration is approximately \$1.7 million, not including the utility vehicle. Pricing will vary according to the actual equipment selected.



To request a copy of the full report, or to discuss a site assessment and system design, please contact:

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