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JOURNAL

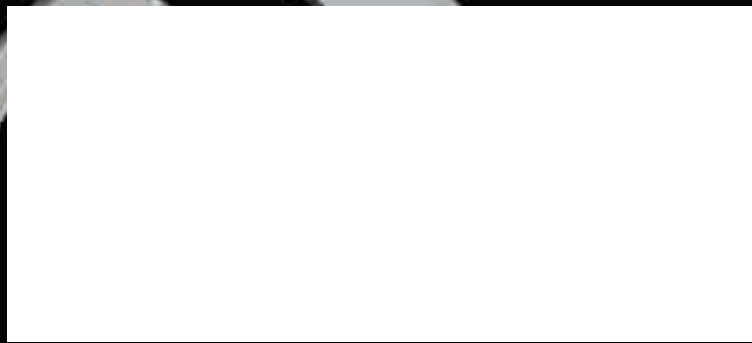
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**THE YEAR'S
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The year's very best

Each year, the C4ISR Journal scans the industry and intelligence community for the technologies and organizations that we believe are having the most impact in defeating terrorists, preventing attacks, and enabling troops to make the right decisions on the battlefield. We call these winners our Big 25, and we divide them into five categories: **Sensors** gather ISR

data; **Innovations** are promising technologies that have been tested at a substantive level but have not been fielded; **Organizations** are government agencies or groups that are addressing intelligence-related problems; **Network Systems** route information where it needs to go and help people make sense of it; **Platforms** are the aircraft, ships or ground vehicles that carry the sensors.

SENSORS

ASTOR (AIRBORNE STANDOFF RECONNAISSANCE)

A radar and transportable ground station for analysts.

Who: Raytheon; Royal Air Force-Army 5 squadron

Why: The contractor and U.K. military faced the challenge of completing development of this radar while flying versions of it operational on Sentinel aircraft in Afghanistan. During the U.K.-led Operation Moshtarak in Helmand province earlier this year, ASTOR provided overwatch of convoys and cued unmanned planes to track insurgents. Its synthetic aperture radar images and moving target indicator maps have been valuable supplements to the overstretched Joint STARS coverage. Royal Army operators analyze the images in the tight confines of trailers converted into ground control stations. The U.K. deployed the aircraft for operational rehearsals in November 2008. One or more of the aircraft have been there ever since.

ARTEMIS/TACSAT-3 (ADVANCED RESPONSIVE TACTICALLY EFFECTIVE MILITARY IMAGING SPECTROMETER)

A spaceborne camera flown on the TacSat-3 satellite to identify the spectral signatures of ground features or objects, including freshly dug dirt that can indicate improvised explosive devices.

Who: Raytheon; Alliant Techsystems (ATK); Air Force Research Laboratory

Why: After a yearlong test, Air Force Space Command and U.S. Strategic Command declared Raytheon's ARTEMIS sen-

sor and its ATK-built TacSat-3 host satellite to be operational. Central Command is now tasking the instrument through the same software and chain of command it uses to assign airborne ISR coverage. ARTEMIS searches for evidence of roadside bombs by analyzing spectral signatures. ARTEMIS is the first real-world application of an operationally responsive space instrument. The mission also amounts to a test of the military's ability to fly a reconnaissance satellite and manage coverage. The military typically has relied on satellites operated by the National Reconnaissance Office and the interagency committee that tasks its sensors.

LAPAN-TUBSAT

A 50-kilogram, video-camera-equipped satellite built for Indonesia.

Who: Technical University of Berlin; Kappa optronics GmbH of Goettingen, Germany; National Institute of Aeronautics and Space of Indonesia (abbreviated as LAPAN).

Why: This satellite proves that full-motion video can be gathered from space affordably from low-cost satellites, and that video can be a useful surveillance tool for pipelines, coastlines and in humanitarian crises. The resolution is fine enough to spot vehicles, ships and groups of people.



INSITU

The NightEagle kit gives night-vision video capability to a ScanEagle remote-controlled plane.

The Pentagon's Operationally Responsive Space office requested a demonstration of LAPAN-TUBSAT video late in 2009, and is examining the possibility of launching a "pearl string" of similar low-cost satellites. In addition, a second Indonesian TUBSAT is scheduled for launch in 2011 with a finer resolution video camera. The first satellite for Indonesia cost about \$1.5 million, not including the rocket to launch it. The next one will cost about \$3 million.

NIGHT EAGLE

A middle infrared camera conversion kit for ScanEagle remote-controlled planes.

Who: Boeing's Insitu subsidiary

Why: When U.S. forces needed the ability to see at night through humidity, Insitu devised a conversion kit so that field technicians could switch out the nose video cameras on ScanEagle aircraft in about two hours, making them NightEagles. The ScanEagle's standard nighttime video cameras are tuned for seeing through smoke and dust. Canadian forces and U.S. special operations command have purchased the NightEagle kits. U.S. Special Operations Command liked them enough to order upgraded kits for delivery this year.

OPTICAL BAR CAMERA

A fine resolution film camera carried by U-2s.

Who: Goodrich ISR Systems

Why: OBCs are saving lives by regularly mapping all of Afghanistan to depict new construction, erosion or destruction of buildings. Analysts use the maps to identify possible choke points that the Taliban might try to use to ambush patrols or convoys. In addition to tactical mapping, the U.S. provides OBC images to Egypt, Israel and Syria to help verify troop locations under the 1979 Camp David peace accord. The OBCs are a 30-year-old design, but still reliable and valuable in the absence of a digital equivalent. Inside each camera is a spool containing two miles of film that is gradually exposed to create a series of still images that are stitched together digitally



U.S. AIR FORCE

An Optical Bar Camera is placed in a U-2 spy plane.

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during ground processing. The turnaround is not fast — a matter of days — but it is fast enough for many applications.

INNOVATIONS

FELIN (FANTASSIN A EQUIPEMENTS ET LIAISONS INTEGRES OR INTEGRATED COMMUNICATIONS EQUIPMENT FOR THE INFANTRYMAN)

An integrated kit of communication devices and optics to be carried by French troops, making them a seamless network.

Who: Sagem Defense Securite

Why: The FELIN kits are placing French forces at the cutting edge of networking. For voice communications, the soldiers will wear osteophones — headband-mounted sensors that pick up vibrations on the speaker's cheekbones. Likewise, incoming sound is vibrated on the wearer's cheekbones and the vibrations travel to the ears. The osteophones allow the wearer to speak softly and still be heard. Removable, palm-sized computers mounted to webbing on the wearer's vest will receive maps, orders, video and other data and display it. The computer can display images from the soldier's weapon sight, a

feature that allows him to place his weapon around a corner and view the images with the protection of a wall. Troops are training with FELIN, and the contractors are delivering them in anticipation of a first combat deployment to Afghanistan or Chad in 2011 or early 2012.

IRONCLAD

A USB flash drive that allows the user to run his entire desktop, including applications and data, on another computer.

Who: Lockheed Martin; IronKey

Why: The device could give intelligence workers on the road easier and more secure access to the data and applications that reside on their work computers. When a small IronClad drive is plugged into a host computer, the device uses the host's processor and display to create a full Windows operating environment with the same network protections as at the office. No data flows through the host computer's hard drive; therefore, there is no "finger-print" left behind. If someone were to crack open the surface of the device, he would discover that the circuitry is encased in epoxy. The device is certified as "tamper proof" by the National Institute of

Standards and Technology, although Lockheed is still in discussions with the National Security Agency for its blessing.

LEAPS (LIGHTWEIGHT EXPEDITIONARY AIRBORNE PERSISTENT SURVEILLANCE SYSTEM)

An experimental, miniaturized wide-area surveillance camera system.

Who: Logos Technologies; Office of Naval Research

Why: Because of its small size, this multi-camera-system could make wide-area surveillance more widely available to troops. Today's wide-area surveillance camera systems weigh hundreds of pounds and must be carried by relatively large planes: Shorts 360s in the case of the Constant Hawk surveillance aircraft and Reaper unmanned planes for the forthcoming Gorgon Stare sensors. In April, Logos announced airborne component tests of a system that, when fully developed, could weigh less than 50 pounds. The company flew the system aboard a leased aircraft over Swansboro, N.C., and gathered 20 hours of motion imagery of five sites, from rural areas to densely populated areas. Unlike Gorgon Stare, the camera is black-and-white only, but if engineers succeed,



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numerous Shadows could be equipped with it instead of handfuls of Reapers and Constant Hawks.

PHANTOM EYE

A high-altitude, long-endurance prototype aircraft to be propelled by two internal combustion engines modified to run on hydrogen.

Who: Boeing

Why: This aircraft will use two Ford truck engines modified to burn hydrogen in an effort to satisfy the intelligence community's desire for a plane that can fly at high altitudes for days at a time. Hydrogen offers good fuel economy, and the exhaust would be water rather than carbon — not an inconsequential consideration for a craft that could fly for days. Boeing is confident about the performance of the engine after testing it in a chamber at Aurora Flight Sciences to simulate flight at 65,000 feet. In July, the company unveiled the craft at its St. Louis facility, albeit without its engines installed. Boeing's Darryl Davis explained that a larger version after the prototype could stay aloft for 10 days at a time. Three of our four of them could provide continuous coverage, eliminating the need for the U.S. to maintain UAV bases abroad and a global supply chain. Boeing plans to disassemble the Phantom Eye prototype and ship it to NASA's Dryden Flight Research Center to begin taxi tests culminating in a first flight in early 2011.

X-51A WAVERIDER

An experimental hypersonic aircraft that flew for 143 seconds in May over the Pacific Ocean.

Who: Boeing; Pratt & Whitney; Air Force Research Laboratory

Why: The X-51A WaveRider flew under hypersonic-engine power for 10 times as long as NASA's X-43 in 2004. Though it did not fly as fast as the X-43, the X-51A has given engineers fresh confidence about the feasibility of keeping an "air breathing" engine lit with combustion gases rushing through the engine at supersonic speeds. A Mach 5 to 7-class reconnaissance-strike plane suddenly looks more technically possible. The WaveRider circulated fuel in its engine to cool it, just as an operational engine would need to do to survive the heat and friction of hypersonic combustion. Engineers were shooting for 240 seconds of powered flight. They achieved 143 seconds before the craft overheated and telemetry was lost. The next WaveRider flight is scheduled to take place by the end of the year. The craft are designed to be low-cost, expandable demonstrators.

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French soldiers demonstrate the FELIN integrated communications and optics system.

SAGEM

ORGANIZATIONS

U.S. JOINT FORCES COMMAND ISR INTEGRATION DIVISION

A division of Joint Forces Command's Intelligence Directorate.

Why: The ISR integration division plugs critical intelligence gaps and prepares forces for deployment. It has addressed technical challenges facing intelligence operators and troops by developing new full-motion video equipment and exploring digitally aided close air support. This year, the division helped a Navy SEAL unit prepare for deployment by conducting a field event with various ISR equipment and communications devices. The division also carried out the seventh annual Empire Challenge ISR demonstration on behalf of the undersecretary of defense for intelligence. The division operates a mobile test lab called the Joint Battlespace Awareness Intelligence, Surveillance and Reconnaissance Integration Capability (JBAIIC), which is jointly operated by JFCOM and the Naval Postgraduate School.

NATIONAL CYBERSECURITY AND COMMUNICATIONS INTEGRATION CENTER

The U.S. government's cyber-attack watchfloor, opened in October 2009.

Who: U.S. Department of Homeland Security

Why: The center is on the cutting edge of the country's preparations for responding to cyber attacks against its critical infrastructure, including the banking system, telecommunications network and the power grid. The country's annual Cyber Storm exercises, in which businesses and government agencies practice their reactions to cyber attacks, will take place here.

NATO CONSULTATION, COMMAND AND CONTROL AGENCY

The NATO organization that oversees alliance-approved information technology development work

Who: NATO

Why: NC3A's staff of international experts has given the allies the technical ability to share information more readily than ever before. Fiber optic cables have been laid and satellite dishes erected. Servers to link the disparate networks of the allies are



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being installed, as is a system for sharing full-motion video. The Afghan Mission Network, a single network for ISAF members, is almost fully in place. It is now largely up to the allies to establish a culture and policies that demand sharing.

NATIONAL RECONNAISSANCE OFFICE MISSION SUPPORT DIRECTORATE

The Chantilly, Va.-based organization that coordinates the work of NRO field representatives.

Why: NRO field representatives help troops, commanders and intelligence analysts apply imagery and signals intelligence to complex operational problems, particularly in the geographically complex Afghanistan region. In some cases, they provide hardware and software tailored to solving specific intelligence problems.

STABILITY OPERATIONS INFORMATION CENTERS

Hubs of computers and networking equipment staffed by analysts who draft detailed reports about life in specific Afghan districts.

Who: Defense Intelligence Agency

Why: These teams of civilian Defense Intelligence Agency analysts (some coalition partners have now joined them) are the major element of Maj. Gen. Michael Flynn's effort to refocus the ISAF intelligence-gathering toward understanding the Afghan population.

Staff members attend the opening of the National Cybersecurity and Communications Integration Center on Oct. 30, 2009 in Arlington, Va.

The teams interview members of provincial reconstruction teams and nongovernmental aid workers from international and Afghan organizations and draft district-level assessments that are published in pdf format. These are made available on unclassified networks. The reports depict the tribal allegiances, geographic features and cultural sensitivities of Afghans living in specific districts. The reports are intended to guide decisions by commanders, other intelligence analysts, aid workers and troops. The analysts began their work in Kandahar in March. DIA is creating stability operations information centers within each regional command and at a central site in Kabul.

NETWORK SYSTEMS

AFGHAN MISSION NETWORK

A single e-mail and information network for use by members of the International Security Assistance Force in Afghanistan who have had to consult separate terminals to communicate over their national networks and the NATO network in Afghanistan.

Who: Thales U.K.; Thales Telecommunications France; NATO Consultation, Command and Control Agency

Why: Working with Thales U.K., engineers at Thales Telecommunications France found a technical solution to the proliferation of networks and national security clearances among the allies in Afghanistan. They devised a system of software and hardware that accepts information from national networks and feeds it into the backbone of fiber optic cables and satellite communications operated by ISAF, called the ISAF Secret Backbone. Officials had to prove that this sharing could be done without compromising the security of the national networks. Initial operational capability in the form of the ability to exchange e-mails was achieved in July. Full operational capability will provide the ability to share data files and application.

AN/PRC-117 RADIOS

A series of software-defined radios.

Who: Harris Corp.

Why: An AN/PRC-117F radio was the last communications link for overwhelmed U.S. forces during the Combat Outpost Keating attack. The multiband 117F provides tactical satellite communications for voice and data. Its newer wideband version, the 117G, is giving forces some of the benefits of the Joint Tactical Radio System devices now. Forces

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can use the I17G to communicate around terrain obstacles and over long distances through ad-hoc networking. Users of the I17G can also view full-motion video via plug-in monacles or small, handheld displays, and extend their communications range by plugging into Inmarsat's Broadband Global Area Network via a BGAN satellite antenna.

CREW COMM

A voice over Internet Protocol intercom network that links Air Force intelligence analysts and operators at multiple locations and at security levels.

Who: Raytheon

Why: Using voice over Internet protocol, Raytheon devised software enabling headset-clad analysts to click menus on their computer screens to create discussion groups at different security levels. The security level of the discussion is labeled in color-coded format — red for security high — to avoid mistakes. Analysts cleared for access to the most sensitive collections can discuss those collections in detail, and then with a click of the mouse invite in those with lower clearances to hear the results. The Air Force declared Crew Comm initially operational in September 2009.

NETTED IRIDIUM

Push-to-talk radios providing encrypted voice communications over the Iridium satellite constellation anywhere within a 100-mile radius.

Who: ITT; Iridium LLC

Why: The Netted Iridium radios have given Marines and intelligence operatives in Afghanistan the non-line-of-sight benefit of satellite communications without the need to dial numbers on a satellite phone or wait a nerve-wracking 30 to 40 seconds

to establish a connection over the full Iridium constellation. Using ITT's push-to-talk RO Tactical Radios, users can communicate over the Distributed Tactical Communications System, known as Netted Iridium. The system was devised in late 2008 by DoD, ITT and Iridium experts. Users anywhere within the beam can receive the transmissions, which are sent in the Advanced Encryption Standard-256 format. Because the radios are used by forces on the move, and the information they discuss is perishable, this non-NSA encryption standard is adequate. ITT reports it is manufacturing 700 Iridium radios a month for the Marine Corps and agencies it is not permitted to name. The company plans to increase output to 1,000 a month.

REAL TIME REGIONAL GATEWAYS

Highly classified ground stations that receive multiple signals-intelligence collections. Software combines them to locate individuals.

Who: SAIC; National Security Agency

Why: Because of these gateways, U.S. forces can now rapidly target individuals after intercepting their communications. In Iraq, U.S. forces discovered it was unacceptably time-consuming to fuse these collections into useable products. The National Security Agency has used the Real Time Regional Gateways to speed up the delivery of information to those who need it. Data is now warehoused and transmitted in common metadata formats, allowing for data mining and creation of multi-int products, and rapid targeting.

PLATFORMS

FALCON 9

A commercially developed, expendable medium-lift rocket that flew for the first time in June.

Who: SpaceX

Why: This commercially developed rocket could help reduce the cost of launching communications and reconnaissance spacecraft. Newly designed rockets often blow up or fail to reach orbit on their first attempts, but the Falcon 9 launched a test version of the company's Dragon cargo capsule into orbit June 4 on its first attempt. SpaceX capitalized on lessons learned in developing the smaller Falcon 1 launch vehicle, which conducted demonstration flights for the Defense Advanced Research Projects Agency and the Air Force. Space X and Iridium have announced that Falcon 9s will be used to launch multiple Iridium NEXT satellites, the new versions of the communications satellites that have proven valuable to

troops in Afghanistan. The National Reconnaissance Office could emerge as a major customer.

MQ-8B FIRE SCOUT

An unmanned helicopter patterned after a Schweizer helicopter and designed to be flown from frigates and the Littoral Combat Ships.

Who: Northrop Grumman

Why: Fire Scouts have demonstrated their potential to greatly expand the ISR footprint of Navy vessels. A Fire Scout conducting a military utility assessment in April from the frigate *McInerney* scored a drug interdiction when its radar spotted a suspected "go fast" boat in the eastern Pacific Ocean. The mission operator was testing the craft's settings and functions when he saw the boat and received permission to pursue it. Coast Guard law enforcement officers stationed aboard the *McInerney* seized 60 kilos of cocaine. Fire Scouts are also familiarizing the military with the challenges of flying unmanned planes near population centers, as when Navy operators temporarily lost contact with a Fire Scout near Washington, D.C., in August.

KIOWA WARRIORS

U.S. Army armed reconnaissance helicopters.

Who: Bell Helicopter; Army Program Executive Office Aviation

Why: Despite their age — the Army introduced them in 1991 and Bell stopped making them in 1996 — these two-person aircraft have the highest operational tempo and readiness rate of any Army rotorcraft. Kiowas have proven valuable in Afghanistan despite a limited flying altitude and an awkwardly placed video camera (on the rotor mast above the blades). They are second only to the Apache helicopters in combat losses, which is evidence of how hard they are being flown. Army personnel and contractors have managed to keep them ready 84 percent of the time. The Kiowas perform a command-and-control role in combat by providing ground commanders with battle information and sometimes a seat from which to direct battles in the air.

MC-12W PROJECT LIBERTY AIRCRAFT

Hawker Beechcraft King Air 350 planes equipped with full motion video cameras and signals intelligence equipment.

Who: L-3 Communications; U.S. Air Force 645th Aeronautical Systems Group (Big Safari)

Why: The Project Liberty aircraft are providing video and signals intelligence to commanders and troops in Afghanistan and Iraq as a valuable supplement to that provided by unmanned planes. The Air Force Big Safari group and L-3 Communications



ITT push-to-talk RO Tactical Radio is used to communicate over the Distributed Tactical Communications System, known as Netted Iridium.

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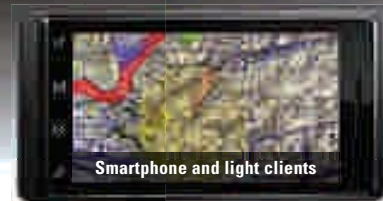
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overcome production hurdles to deliver the planes at a rapid pace. The turning point came in 2009, when the ISR Task Force ordered the Liberty team to work on the planes at four sites concurrently to make up for lost time. L-3 was able to achieve this even though it did not have experience mass producing aircraft at one location, let alone four. There are now 21 Liberty planes in Afghanistan and nine in Iraq. Seven will remain stateside for training.

U.S. NATIONAL SECURITY CUTTERS

Two 418-foot vessels, the Bertholf and Waesche, part of a planned fleet of eight similar ships.

Who: Northrop Grumman Shipbuilding; Lockheed Martin Mission Systems and Sensors.

Why: Commissioning of the Bertholf in 2008 and the Waesche in May were major steps in the U.S. effort to tie the Coast Guard into the national intelligence community and improve maritime domain awareness. The Lockheed Martin ISR and communications systems aboard the ships have improved interoperability with the Department of Defense, Department of Homeland Security and state and local



U.S. COAST GUARD

National Security Cutters Bertholf, top, and Waesche carry ISR and communications systems that have improved interoperability with the Defense Department and the intelligence community.

partners by enabling real-time tracking of vessels and aircraft and sharing of a common operating picture. The Bertholf and Waesche are the first Coast Guard vessels to be equipped with shipboard signals exploitation spaces and secure compartmented information facilities, which are necessary to protect sensitive communications

intercepts. For the Coast Guard, the commissionings were tangible evidence of recovery from the delays and cost overruns during the early years of its Deepwater ship modernization program. The Bertholf and Waesche were built in Pascagoula, Miss., by Northrop, and equipped with C4ISR equipment by Lockheed Martin. ■

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