USAF photo by SSgt. Ashley Reed

The ROVER

By Rebecca Grant

As a B-1B headed in to drop ordnance on a target in Afghanistan in early May, MSgt. Randall Hunt, a joint terminal attack controller, knew something wasn't right.

Hunt was listening as another JTAC received a grid coordinate from the B-1B crew. The other JTAC read out the number over the radio during the nine-line briefing for close air support. But the grid was wrong, Hunt quickly realized.

How?

"I was looking at the sensor feed from the B-1 and compared what I heard in my ear to what I was seeing in the ROVER monocle," he said.

As it turned out, the other JTAC had accidentally "passed a grid that was 600 meters off," Hunt explained. Worse, Hunt and his fellow JTAC were only 100 yards away from the grid that was going to get bombed. With the ROVER, Hunt instantly helped the second JTAC check for the correct grid. A potential disaster was averted.

All this rapid cross-check and correction was thanks to a technological achievement that's never even been a formal program of record: ROVER, which stands for Remotely Operated Video Enhanced Receiver.

Big Safari

"ROVER is probably one of the best investments ever made," said former Secretary of the Air Force James G. Roche, who headed the service when the project was started.

"It allows us to transmit large amounts of data rapidly to the cockpit, where the pilots get visual representations of our targets," said SSgt. Michael Hickey, a controller assigned to the 607th Air Support Operations Group, in a 2011 press release from the 51st Fighter Wing at Osan AB, South Korea.

Today's ROVER 5 device—smaller than most laptops—pulls in video, imagery, and other data from more than 40 types of aircraft and fuses them into a single picture of the unfolding battle. Best of all, the crews in those aircraft see the same view as the controller on the ground.

A total of 18,339 ROVER devices have been delivered or are on order. ROVERs are in the hands of Special Forces, JTACs, soldiers, marines, and civilian first responders. They're mounted on Civil Air Patrol aircraft and Apache helicopters and are slated to be installed in Navy DDG-51 Arleigh Burke-class destroyers.

It didn't start out that way, however. In fact, the first ROVER wasn't even intended for troops on the ground.

ROVER began on the AC-130 gunship as a strap-on method to pipe in video from Predator remotely piloted aircraft. These special operations gunships supported nearly all the major Northern Alliance offensives against Taliban forces after Operation Enduring Freedom began in October 2001. Gunships orbited over target areas for extended periods to provide close air support and overwatch for forces on the move. They flew racetrack patterns over their target area before firing and were keen to avoid the shoulder-fired surface-to-air missiles lurking below. Liaisons monitored Predator video and often tried to describe over the radio the potential threats and targets they were seeing.

Roche recalled his frustration as he and USAF Chief of Staff Gen. John P. Jumper closely monitored the war in Afghanistan. Officials realized there was a serious communication problem.

In one mission, the talk-on to the target "became a screaming match" between the gunship crew and those who could see the actual Predator video feed.

Then-Col. James G. Clark and the Air Force's Big Safari program office were directed to get the gunships the Predator video needed.

Big Safari, a special Air Force Materiel Command unit known formally as the 645th Aeronautical Systems Group, at Wright-Patterson AFB, Ohio, was in charge of fast, secret modifications to special mission aircraft. They'd worked Predator, too.

Lt. Col. R. Kevin Hoffmann was commander of the Big Safari detachment at Edwards AFB, Calif., in November 2001. "We got the call on a Thursday, and the gunship arrived on Monday," he recalled.

The Big Safari solution was to pop out the forward escape hatch panel on top of the gunship's cockpit area. C-130 experts who knew how to perform rapid installations teamed up with Predator operators from the government and General Atomics to add a C-band receiver on the outside of the hatch.

The slim, aerodynamic antenna was barely noticeable atop the AC-130. Inside went a black box to handle the video feed, with cables that snaked back to display screens mounted in the command module area. A 15-inch display hung over the other banks of screens.

"The gunships were already talking to the Predator guys," said Hoffmann, but "the idea of seeing what the [intelligence, surveillance, and reconnaissance] aircraft were doing—no one had done that."

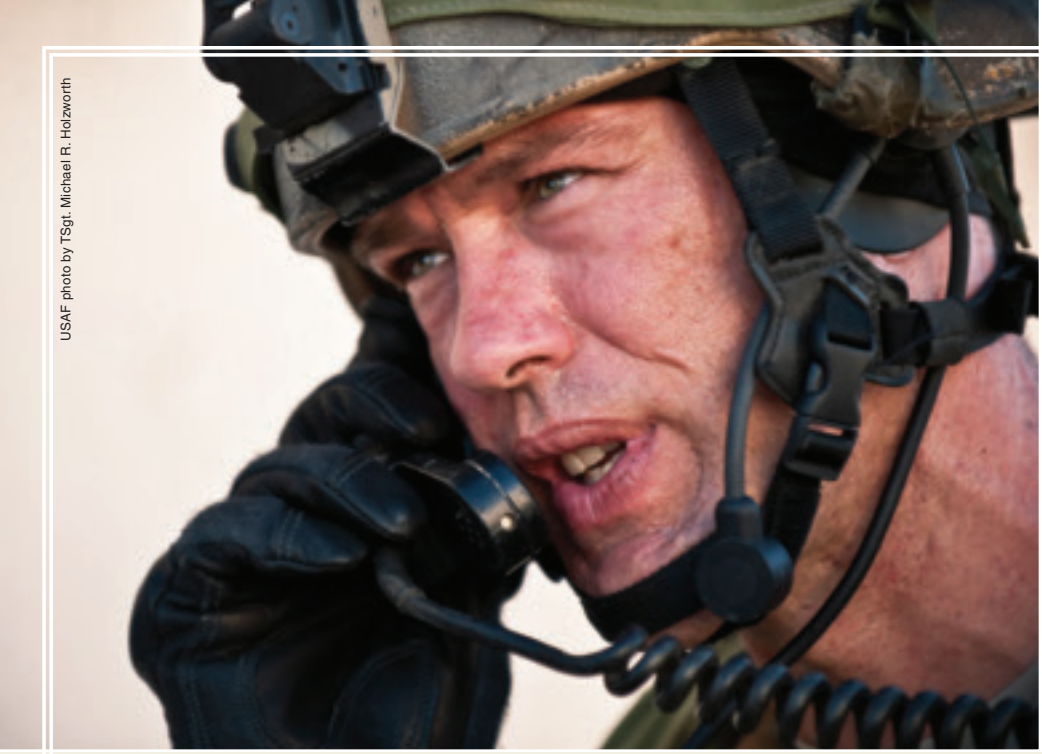
The Big Safari team modified the gunship in two days. It "flew flight tests on Wednesday and took off to return to Hurlburt [Field, Fla.,] on Thursday," Hoffmann said. Engineers from Big Safari sent drawings of how to modify the hatch back to Hurlburt, where four gunships were soon ready to enter the fight.

"It was a great combat need we'd never thought about before," said Col. Charles Menza, a longtime ROVER guru in the Air Force's acquisition directorate.

USAF photo by MSgt. Andy Dunaway

The small system spreads intel to those who need it most, with an outsize impact on the battlefield.

Above: A B-1B deployed from Ellsworth AFB, S.D., over Afghanistan. Here: GBU-38 munitions dropped from a B-1 slam into an al Qaeda facility in northern Iraq. The ROVER's rapid delivery of real-time information has improved communication between the ground and air assets immensely.



USAF photo by TSgt. Michael R. Holzworth

TSGt. Donald Urqhart, a joint terminal attack controller with the 5th Air Support Operations Squadron, calls in a simulated air strike during a Green Flag-West training exercise in 2011. Demand from the field brought the Army on board, and they now field their own version of ROVER, called OSRVT (One System Remote Video Terminal).

ROVER was a huge success. The modification gave the gunship crew extra time to look over the target area while still on approach. Airmen could pinpoint threats displayed on the Predator feed and fire as soon as they were in range, silencing would-be attackers.

About a month later, in December, Big Safari received a surprise visitor: Army Chief Warrant Officer 2 Christopher Manuel, in Dayton, Ohio, on leave. He told startled personnel at the 645th that he was going to be assigned to search caves in Afghanistan. Now he was home for two weeks, and he wanted to take to his unit a way to see Predator video while on the ground.

Manuel's request was for something new: a method to push an overall view of the battlespace directly to a team on the ground. At the time, only liaisons in distant command centers could actually see the video imagery from Predator and other platforms.

The Big Safari office hastily convened a meeting on how to take the system from the gunship to a portable device. By Jan. 23, they were ready to test the prototype on the Predator training range.

Thus was born the man-portable ROVER family.

ROVER 2 looked like leftovers pulled from a garage sale: a square, pale gray antenna connected to a video decoder and a receiver with open pins and cables. At nearly 50 pounds, the weight of the batteries, radio, and Panasonic Toughbook was considerable. But ROVER now had receivers and antennae for multiple C-, L-, and Ku-band wavelengths.

Awkward as it appeared, ROVER 2 was a revolution. For the first time, it delivered a real-time ISR picture to those fighting at the leading edge of the battle.

Soon, ROVER users wanted more.

"ROVER 2 only brought down Predator video," said Menza, and that was unacceptable to Lt. Col. Gregory E. Harbin.

Harbin, a liaison officer at the Combined Air Operations Center at Prince Sultan Air Base in Saudi Arabia in 2003,

DOD photo by Army SSgt. Billie J. Nelson Jr.

A gunner aboard an AC-130 loads 40 mm rounds into a Bofurs cannon during an operation in Afghanistan. ROVER got its start on gunships in 2001 as a method to allow the aircrews to view video taken by Predator remotely piloted aircraft in Operation Enduring Freedom.

knew from an earlier assignment that special operations forces were using early ROVER devices.

The combined force air component commander, Lt. Gen. Walter E. Buchanan III, sent Harbin to the US to bring ROVER devices back to downlink Predator video. Three days after he returned from the US, he was showing them to the 82nd Airborne Division in Iraq, Harbin told the *Los Angeles Times* in a 2007 interview.

Tapping sensors other than those on the Predator was the next step, and there were plenty of intel collectors flying in the area of operations. During one engagement in Iraq, Predators were grounded due to weather, but Harbin realized the ROVER operators should have still been able to access intelligence from the F-15Es that were still flying. He eventually took the case for linking ROVER to other aircraft to the top.

Michael W. Wynne, later to be Air Force Secretary, was then serving as principal deputy undersecretary of defense for acquisition, technology, and logistics when Harbin made the rounds about ROVER.

"Greg had come in with a collection of boxes," Wynne recalled. They included a Panasonic Toughbook used by construction crews. "How much of this stuff even has a federal stock number?" Wynne asked him.

Indeed, the ROVER variants were moving as fast as L-3 Communications could make them.

ROVER 3 was a breakthrough. A new software-definable radio enabled this version of ROVER to downlink from a wide array of manned and unmanned aircraft.

"We made ROVER the single point of contact for all full-motion video platforms in C-, L-, S- and Ku-band radar," said Menza.

ROVER 3 also shed weight, bringing the new collection of devices down to 20 pounds. Now they fit in backpacks.

Ingenuity at the tactical level drove the speed of development, but the timing was fortuitous in other ways. ROVER was a convergence of portable display technology, improved precision signals, and demand from the troops.

"At the same time," noted Wynne, there was a better understanding of "how to get signals to the ground. ... The technologies had come together."

Harbin saw the benefits in combat. He was working with a Marine Corps unit patrolling Fallujah, Iraq, in April 2004, when insurgents hit the team with mortar fire and rocket-propelled grenades. Harbin opened up his ROVER kit as the marines returned fire, but the laptop's battery was dead.

He raced to another Humvee and wired the ROVER laptop to its battery to reel in Predator imagery of the mortar site. This let the marines call in a strike, the Predator fired a Hellfire missile, and the insurgents were killed.

Three-and-a-Half Pounds

Demand for ROVER soared.

"The more people use it, the more it's impossible not to use," said Roche. At one point, Clark's office had 55 people assigned, with many of them deployed. Together they toted up 35,000 days in theater.

"We had guys downrange all the time," Clark said. The office set up a website so that JTACs could send in suggestions. The No. 1 request? Lighten the weight.

Meanwhile, Jumper was passionate about adding the "John Madden feature" to the ROVER. Former Oakland Raiders coach and sports commentator John Madden became famous for sketching football plays on screen during broadcasts of NFL games. Jumper was sure there was a way to do something similar with the ROVER.

Soon, the ROVER enabled ground controllers to annotate the display picture and share it with aircrews.

It took some time, but it worked, and once again, the JTACs loved it.

SSgt. Justin Cry, a JTAC from Shaw AFB, S.C., explained how he'd used ROVER in Iraq. "I can circle an area on my screen, drawing arrows for emphasis, and what I'm drawing appears on [the pilots'] screens as well," Cry told the Air Force Print News in 2005. "The pilots can look exactly where we need them to look."

In the same news article, Harbin said the Air Force "put this technology out there, and it simplifies the process of putting bombs on targets, and it's saving lives, too."

Sometimes the most effective use of the ROVER was orchestrated within the Army tactical operations centers. Such was the case one night in July 2007, at a command post just south of Baghdad. Human intelligence tipped off planners that a roadway was mined with improvised explosive devices. TSgt. Mike Cmelik, an Air Force JTAC, used a ROVER to communicate with a B-1 bomber tapped to bomb the road.

"There's more situational awareness in the headquarters than out in the field," Cmelik said, according to a 2007 Air Force news release. "We're able to see the bigger picture" and ensure no friendly forces are in the area. Cmelik coordinated three passes by the B-1, which dropped nearly seven tons of bombs.

Rippling secondary explosions confirmed the road had indeed been a death trap laid for coalition forces.

ROVER 4 debuted in 2007, just as efforts were shifting from the roads and cities of Iraq to operations against al Qaeda and other insurgents in Afghanistan. Improved antennae and reduced weight made this new ROVER well-suited to the dismounted fight faced by US and coalition partners. This ROVER had encryption and would become the basis of a broad Army contract as well.

The state-of-the-art arrived with ROVER 5, which went into full production in 2008. At only 3.5 pounds, controllers praised its lightness and data capacity.

"Where we're fighting in Afghanistan, it allows us to carry lighter equipment, move further, and do the dismounted job in the mountains," said Hickey in the 2011 interview.

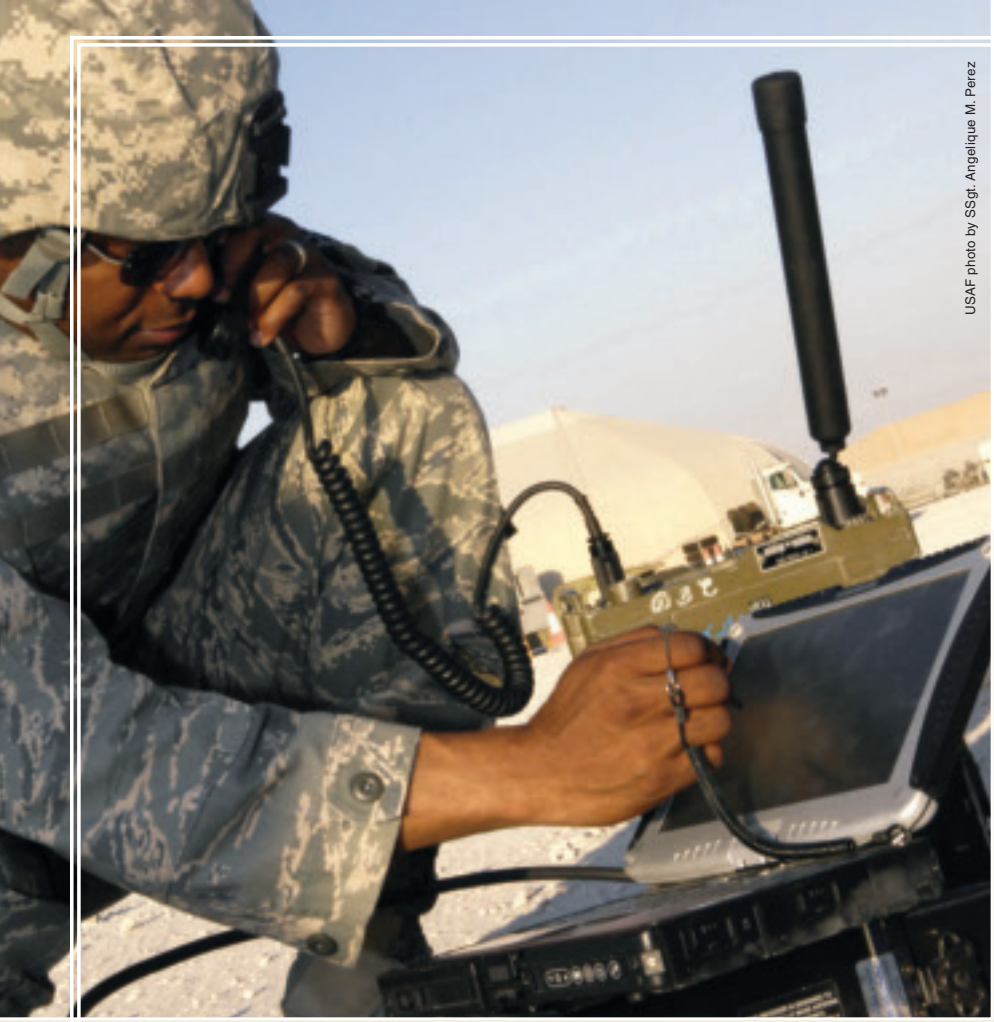
The coordination made ROVER the gold standard for close air support. According to Clark, it's now used on more than 85 percent of close air support missions.

"It was annotated on the [air tasking order] for years—'Are you ROVER-capable?'" Clark said. Controllers sometimes turned back flights that didn't have the capability. ROVER has also reduced collateral damage. "We are precisely targeting what we want to target," Clark said. "It's one more final check."

The ROVER also "quietly helped the notion of fighting jointly," Roche said.

For the Army, the spread of ROVER in Iraq and Afghanistan altered the flow of tactical information. At first, the Army was leery of the ROVER, according to Roche. Predator video was sent to big screens at Army tactical operations centers well to the rear of the battle line. Routing ISR to a higher echelon command was standard for the Army, whereas pushing a shared picture to controllers didn't fit with standard operating procedures.

Of course, ROVER enabled soldiers to take the airborne ISR picture with them. Praise from controllers in the



USAF photo by SSgt. Angelique M. Perez

MSgt. Chris Thompson, a joint terminal attack controller instructor, communicates with other troops via ROVER on the ground at al Udeid AB, Qatar. Input from JTACs led to ROVER's weight being reduced to three-and-a-half pounds. The ability to annotate the display picture and share it with aircrews—a la John Madden—is another favorite feature.

field proved irresistible. A few Army units began to buy their first ROVERs directly from Big Safari, using unit funds.

This was a revolutionary development.

Wynne explained the impact of delivering ISR imagery directly to soldiers: "The ground chaos is unique," he said. "From my class at West Point, we lost guys" in Vietnam, Wynne recalled. "You could hear them over the radio getting overtaken, and they could not figure out how to call in air support."

In the heat of battle, the intricate task of identifying positions and verbally passing the information to aircraft sometimes just didn't work. Under fire and on the radio, "they were saying good-bye," Wynne said.

Putting the image in the hands of ground commanders was a complete change for dealing with troops-in-contact situations. Small units could see the best available airborne ISR in real time and be confident that aircrews saw the same thing. "This is the OODA [observe, orient, decide, and act] loop in action," Wynne told Secretary of Defense Donald H. Rumsfeld in a briefing on ROVER.

Ultimately the Army bought into the program and renamed their ROVERs the One System Remote Video Terminal or OSRVT. And they loved it, too.

"Without a doubt, the best tool we have put into place to decrease the timelines of the kill chain is the OSRVT," said Col. Gregory B. Gonzalez of the Army's unmanned aircraft systems project office, quoted in a 2010 *Defense Systems* article. L-3 Com made the Army's OSRVT—a version of ROVER 4 and ROVER 6.

Flooded Skies

Word of the ROVER also spread outside the military. First responders became familiar with early ROVER sets after Hurricane Katrina hit New Orleans and the Gulf Coast in 2005.

"Katrina was a catalytic moment," recalled Wynne. Small remotely piloted aircraft couldn't fly over the storm-stricken area due to the number of helicopters operating there and problems deconflicting them. Controllers placed cameras on the roof of a hotel in downtown New Orleans and fed the video through ROVER.

"First responders saw activity, water, and fire trucks on their laptops. It was magic," Wynne said.

Coalition partners concurred. The wars in Iraq and Afghanistan drew in far more air controllers from coalition partner militaries. ROVER was a huge help.

"Shared FMV [full-motion video] helps to overcome situational awareness misunderstandings between air and ground and provides a common understanding of target identity," noted an analyst writing for Britain's *Royal United Services Institute Journal*. "This is important in a coalition environment, where language problems can be exacerbated by poor communications conditions and the stress of combat—particularly for the FAC [forward air controller], who may be under fire."

Australia, Britain, Canada, France, and other countries had many controllers in Afghanistan and led the way with dozens of ROVER sets. Other partners from Saudi Arabia to Latvia acquired the ROVER, too.

ROVERs in use at the Warrior Preparation Center near Ramstein AB, Germany, helped in the training of JTACs across NATO. All told, 24 NATO and ISAF (International Security Assistance Force) partners have acquired ROVERs.

The system has left its mark on the battlefield in other ways, its advocates believe. The combination of the ROVER and the many airborne sensors it taps has changed the game for adversaries, too.

"At its best, [ROVER is] giving an assured view to commanders," said Wynne.

"They know the skies are flooded" with RPAs, Menza explained. The flow of information has "limited [a] potential [adversary's] actions" and "denies him daytime and the use of radio and phone communications."

"We've complicated his combat operations by a factor of 10," he said. ■

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