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Keeping Our Bearings

The coming war over the global positioning system

By David Whitman

The war against the Taliban made heroes of soldiers and pilots-and of 24 small satellites, broadcasting feeble navigation signals from thousands of miles up. The global positioning system, or GPS, guided bombs to their targets with stunning accuracy and helped ground forces get their bearings and call in airstrikes in unfamiliar terrain. Now planners for a possible war in Iraq anticipate that Saddam Hussein's forces will try to neutralize that advantage by jamming the GPS signals, potentially sending bombs astray and disorienting soldiers.

A 2001 report from a commission chaired by Donald Rumsfeld before he became defense secretary concluded that the Iraqi military has jamming technology, and foreign news accounts suggest that Baghdad has already tried to jam air patrols in Iraq's no-fly zones. Last month the Wall Street Journal reported that a $39.99 jammer available on the Internet might be enough to make U.S. precision-guided bombs and missiles miss their targets. Military analyst James Zumwalt has even predicted GPS jammers could soon "have the same impact as did the stone used by David to slay Goliath."

Most military experts, however, think that GPS jamming may prove less deadly in practice than David's slingshot. Thanks in part to existing antijam features, new technology, and some simple tactical maneuvers, the military may be able to protect its alleged Achilles heel. Even successful jamming wouldn't necessarily hobble U.S. forces, say officials. "You can't buy a $40 jammer and send a JDAM [a GPS-aided bomb] awry," says Col. Douglas Loverro, the Air Force's Navstar GPS systems program director in El Segundo, Calif. "Just because the GPS is jammed, the bomb still falls-all we are arguing about is how close [it hits]."

Swamped. GPS, perhaps the biggest advance in navigation since the compass, is easy to jam because the signals from the distant satellites are so weak-akin, say, to a 25-watt bulb from 11,000 miles away. A more powerful local source easily swamps them. Mario Casabona of Electro-Radiation Inc. in Fairfield, N.J., a company that builds low-cost antijamming devices, says his "rule of thumb is that if a country has a RadioShack, it will have a jammer. You can build a jammer for about $500." A low-power 4-watt jammer built by the Russian firm Aviaconversia can, with a clear line of sight, block a receiver from picking up GPS signals for up to 124 miles away. The U.S. military, meanwhile, has become far more dependent on GPS since the Gulf War in 1991, when troops used GPS receivers to navigate the trackless Iraqi desert. Today, the armed services have more than 500,000 GPS receivers, most of them on precision-guided missiles, bombs, and other munitions.

Many GPS-equipped weapons have some built-in protection. GPS satellites broadcast on both a military frequency and a commercial frequency used by civilians. And while military GPS receivers usually use the civil code to acquire the military "P" frequency, it is much harder to jam a military receiver once it has locked into P code, because that signal is more robust. "It is probably 1,000 times harder to knock you off signal than to block you from acquiring GPS," says Colonel Loverro, which means that a jammer that can block GPS acquisition for 100 miles can jam the military signal for a few miles at most. Typically, planes carrying JDAMs lock on to the military frequency well outside of jamming range.

Even if the Iraqis did succeed in jamming the military signal, the JDAM has a backup inertial navigation system that doesn't rely on GPS. Guided by inertial navigation alone, a JDAM's accuracy decreases from an average of about 40 feet to about 100 feet. In Baghdad, 60 feet might make a tragic difference between bombing a school and blowing up a military installation. But for targets that require a surgical strike, other precision weapons that don't depend on GPS, such as laser-guided bombs, could be used.

Null and void. Besides these backup technologies, the military has ways to actively thwart jammers. One might be to track the source of the jamming signal and destroy it. Another is a technology added to many planes since the Gulf War: "nulling" antenna arrays. The antenna arrays can block reception of signals from the direction of the jammer, allowing the receiver to "hear" GPS signals from other directions.

Lockheed Martin and Rockwell Collins have developed an even more powerful countermeasure called G-STAR, which will be installed in one missile type starting next year. The G-STAR, which sounds like something fresh out of Star Wars, partly or fully blocks the signal from a jammer and then redirects the GPS receiver through "beam steering" to look for other nonjammed satellites. In the coming decade, the military will also field a new generation of more powerful GPS satellites, which will reduce the jamming threat.

For now, GPS jamming may hamper ground troops more than pilots. Soldiers lugging hand-held GPS receivers or maneuvering GPS-guided artillery and tanks won't have the luxury of locking on to the military signal before they come into jamming range. In most cases, though, a jammed GPS receiver simply won't work, alerting the troops not to trust it. Soldiers are also trained to practice crude versions of high-tech antijamming measures. They can crawl behind a jeep or humvee, using its body to partly block the signal coming from a jammer on the other side. Or they can stick their GPS receiver in a coffee can so they can "beam steer" toward satellites away from the jammer.

As Colonel Loverro points out, "ground troops did maneuvers for years without GPS," relying on visual clues, scouts, photographs, maps, and military intelligence. With no foolproof means to prevent jamming, either on the battlefield or in the sky, troops may sometimes have to improvise.