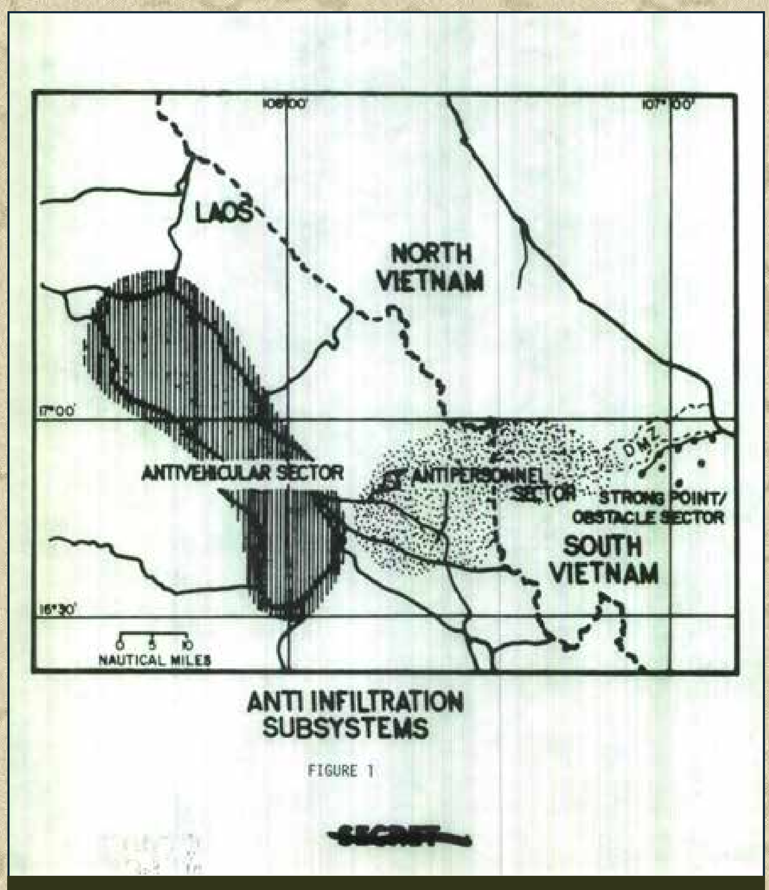
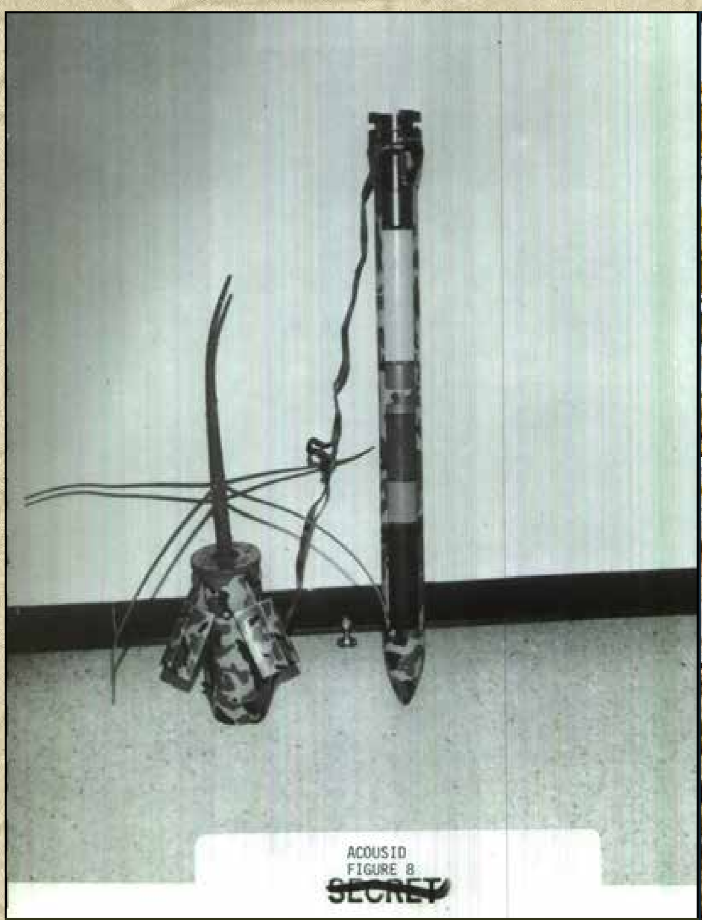
U.S. Sensor Technology in the Vietnam War

Part 1 of 3

The Ho Chi Minh Trail originated in North Vietnam and wound through Laos and Cambodia into South Vietnam. (Office of the Secretary of Defense Graphics)



An Air Force report circa 1968, depicts IGLOO WHITE sensors in Laos and South Vietnam. Note: the Strong Point Obstacle Sector appearing below the DMZ is never constructed as planned. Sensor technologies slated for the "McNamara Line" are utilized for perimeter and patrol defense instead. (Defense Technical Information Center)



Left: An Acoustic Seismic Intrusion Detector. This sensor detects sound and movement. These capabilities enable sensor technicians to listen to voices and the movement of vehicles, or use vibrations from passing footsteps and wheels to pinpoint the enemy's location and monitor activity on the ground. (Defense Technical Information Center)

Right: An Acoustic Seismic Intrusion Detector remains suspended high above the jungle floor by its camouflaged parachute. (National Archives)

In 1966, Secretary of Defense Robert McNamara tasked a group of prominent American scientists to study options for interdicting the Ho Chi Minh Trail. Of the solutions proposed, McNamara settled on sensor technology.

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The North Vietnamese Army (NVA) constructed a substantial logistics network known as the Ho Chi Minh Trail (the Trail) to infiltrate manpower, weapons, ammunition, and materiel into South Vietnam along an approximately nine thousand mile network of ancient footpaths and dirt roads. The Ho Chi Minh Trail served as the NVA's supply route through Laos and Cambodia and, in response, the U.S. launched air interdiction campaigns. In 1964 and 1965, the U.S. Air Force conducted Operations BARREL ROLL and ROLLING THUNDER, respectively, to disrupt NVA operations at junctures along the Trail. The NVA proved difficult to target, with much of the Ho Chi Minh Trail running through dense rainforests that concealed the NVA from airborne assets under a natural jungle canopy.

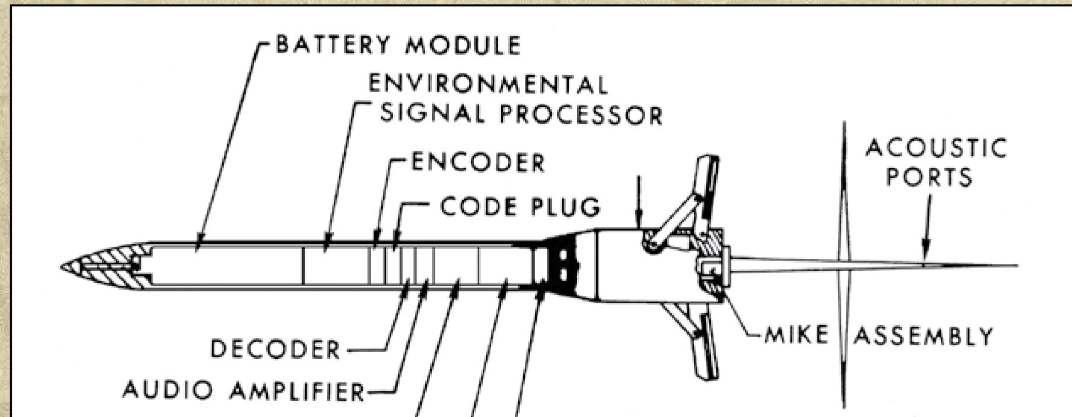
In 1966, Secretary of Defense Robert McNamara tasked a group of prominent American scientists to study options for interdicting the Trail in hopes of offering alternative solutions vis-a-vis strategic bombing. Of the solutions proposed, McNamara settled on sensor technology. He established the Defense Communications Planning Group (DCPG), which was a Department of Defense (DOD) joint task force whose mission was to develop sensor technology capable of operating in the unrelenting heat, monsoons, and dense jungles of Southeast Asia.

Under the command of Lieutenant General Alfred Starbird, U.S. Army, the DCPG brought together technical experts from across several agencies within the U.S. government, DOD, governmental laboratories, and commercial manufacturers to fast-track the research, development, and deployment of acoustic, seismic, electromagnetic, and infrared sensors to Southeast Asia. The result produced two methods of sensor use, static and fluid. Static sensors were embedded in the ground or hung in jungle canopies to relay information about enemy locations and movement along the Ho Chi Minh Trail; sensors were also used in support of a fluid combat environment as seen in the Battle of Khe Sanh.

Static Sensors

In 1967, the United States began building a static sensor trip wire across the panhandle of Laos and the northwestern border of South Vietnam. Nicknamed IGLOO WHITE, this clandestine sensor project was designed to detect enemy movement anywhere in two large sections of the Ho Chi Minh Trail. An antivehicle sector covered the road network in a 100 kilometer x 40 kilometer region of central Laos, and an antipersonnel sector blanketed the trail network in a 100 kilometer x 20 kilometer area extending from eastern Laos into the western portion of South Vietnam, just below the demilitarized zone (DMZ).

The functional components of IGLOO WHITE were several thousand sensors dropped by aircraft throughout the anti-infiltration



Cutaway drawing of an Acoustic Seismic Intrusion Detector III. (National Museum of the U.S. Air Force)

zones to detect enemy foot or vehicular movement. Some sensors detected seismic disturbances created by passing trucks, others used microphones to pick up nearby voices, and still others detected both seismic disturbances and voices. F-4 Phantoms, CH-3 helicopters, and other aircraft dropped sensors (designed to look like plants) that struck the ground like lawn darts, burying themselves up to their antenna. Acoustic sensors delivered by camouflaged parachute would catch in trees and hang high out of sight in the foliage. All sensors were autonomous. They were equipped with battery packs and transmitters in addition to their sensors.

Orbiting aircraft, such as an EC-121R "Batcat" or the Beech QU-22B worked with signal relay platforms and navigation systems to continuously monitor the sensor fields and transmit their signals to the Infiltration Surveillance Center (ISC) in Nakhon Phanom, Thailand. The ISC processed and interpreted the data signals through two IBM 360-65 mainframe computers—the most powerful computers available at the time—to produce reliable intelligence data for planning interdiction operations. An analyst stationed at the ISC compared the flow of data from the sensors through the ISC's computers to an arcade akin to a modern day video game system.

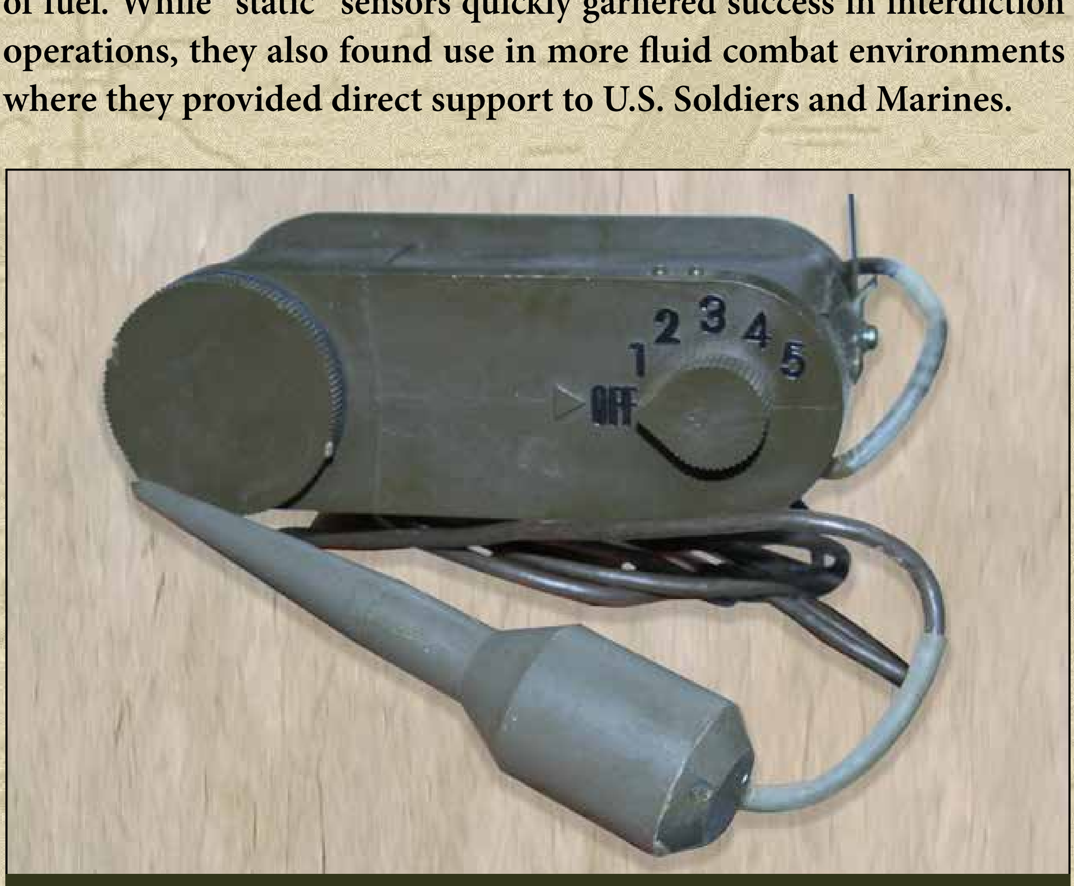
An EC-121R "Batcat" orbiting above the Ho Chi Minh Trail. The aircraft receives sensor signals and transmits the signals to Task Force Alpha's Information Surveillance Center, Nakhon Phanom, Thailand. (National Museum of the U.S. Air Force)

We wired the Ho Chi Minh Trail like a drugstore pinball machine, and we plugged it in every night.

— Air Force analyst, *Armed Forces Journal*, 1971

ISC operations personnel verified each enemy target and notified combat commanders who then sent the closest attack aircraft to neutralize the target. An Air Force pilot who flew interdiction missions over Laos described the ISC operations center this way, "The main control room looks like the one we saw on TV during the Apollo moon shots, or maybe something out of a James Bond movie. There's computer terminals *everywhere*…a [technician] can point a handheld red-light gun and activate one of the sensors and listen in. Sometimes you can hear the drivers' voices...or an airstrike."

The sensors on the Trail aided in the interdiction of enemy supplies and reinforcements. For example, in December 1970, a group of American forward air controller (FAC) pilots flying observation aircraft were searching for NVA trucks and supply dumps hidden in the jungles of Laos. They received word that acoustic and seismic sensors had detected heavy vehicle traffic in their area of operations. This intelligence lead to the discovery of a large NVA storage complex near the deserted Laotian village of Ban Bak. Over the next ten days U.S. airstrikes destroyed approximately 46 enemy trucks, 10,000 rounds of ammunition, 1,000 tons of supplies, and countless drums of fuel. While "static" sensors quickly garnered success in interdiction operations, they also found use in more fluid combat environments where they provided direct support to U.S. Soldiers and Marines.



The Patrol Seismic Intrusion Detector uses a spike (seismic sensor) inserted into the ground by hand to guard a patrol's camp perimeter. The small box contains a battery, transmitter, and antenna. The transmitter indicates near-by vibrations picked up by the sensor. The vibrations are transmitted over a long wire (over 200 yards). Each spike [sensor] transmits a different beep providing the operator with a clear indication of the enemy's location and movement. (Secretary of Defense Graphics)

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An Airman deploys an Air Delivered Seismic Intrusion Detector from the side door of a CH-3E helicopter. The device senses ground movement and determines whether the source is a person or a vehicle. January 1969. (National Archives)

U.S. Air Force personnel load acoustic sensors into a rearward firing dispenser, July 1968 (National Archives)

An Air Force F-4D pilot of the 25th Tactical Fighter Squadron prepares to airdrop sensors above the Ho Chi Minh Trail. January 30, 1969. (National Archives)

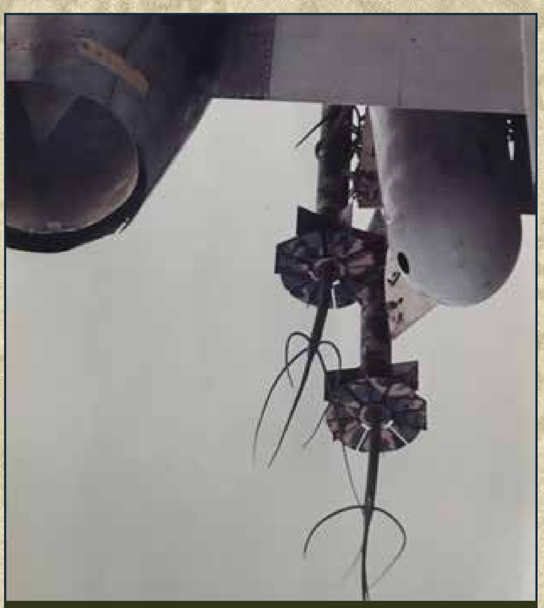
Khe Sanh was a turning point for the sensors — for their acceptance into America's technological arsenal.

— **Rebecca Ullrich,** *Building On and Spinning Off: Sandia National Labs' Creation of Sensors for Vietnam,* 1996

Sensors in the Fluid Combat Environment

In January 1968, as a part of the Tet Offensive, NVA forces massed in the northwestern corner of South Vietnam near a U.S. Marine base in the town of Khe Sanh. On January 18, 1968, while the Battle of Khe Sanh was underway a team from the DCPG demonstrated the capabilities of sensors at the Marine base. Within 48 hours the 7th Air Force dropped seismic and acoustic sensors around the perimeter. Almost immediately the sensors picked up NVA activity.

The sensors reported the movement of soldiers and equipment, and the data generated over the next few months of the battle gave the Marines such accurate information that, according to Colonel David Lownds, commander of the 26th Marine Regiment at Khe Sanh, the Marines were able to "inflict devastating firepower to break up the attack." The successful deployment of sensor technology used in concert with artillery and air power strikes around Khe Sanh demonstrated a highly effective "reconnaissance-strike system" in perimeter and patrol defenses and saved American lives. During a Senate hearing following the Battle of Khe Sanh Colonel Lownds testified that without the use of the sensors "his casualties would have almost doubled." The siege of Khe Sanh ended in April 1968. This marked a sound defeat for the NVA.



Two Air Delivered Seismic Intrusion Detectors on the pylon of a Navy OP-2E air craft prior to their being deployed in Laotian airspace over the Ho Chi Minh Trail. (National Archives)

Later in 1968, the reconnaissance-strike system was successfully deployed again in the U.S. Army's 25th Infantry Division area of operations to the north, east, and west of Saigon. According to Major General Ellis Williamson, the division commander at the time, "the division utilized sensors along with other detection methods to intercept movement of enemy forces, disrupt mine-laying and booby-trapping activity by the enemy, and to respond very rapidly to enemy attempts" to attack from Cambodia."

Air Force personnel prepare to load sensor canisters from a bomb trailer to an A-1E Aircraft. Nakhon Phanom Air Base, Thailand. June 10, 1968. (National Archives)

The U.S. Navy also tested the effectiveness of the reconnaissance-strike system in the Mekong Delta waterways of South Vietnam. In the experiment, a suite of sensors was distributed along infiltration routes to a major river that was used by the Viet Cong to move people and supplies, and the sensor fields were covered by artillery fire. The sensors promptly detected Viet Cong movement, and the U.S. launched barrages of artillery in response. Subsequently, the Viet Cong halted infiltration into the area.

The efficacy of sensor technology soon lead to its use in other regions. For example, at the same time the Vietnam War was underway subversives from North Korea conducted small-scale attacks across the Korean DMZ. Members of the DCPG and their sensor technology were tasked by the U.S. military to create an electronic fence adept at detecting enemy movement in the Korean DMZ. To this day sensors are used in the Korean DMZ and many aspects of the program remain classified.

Left: The Helicopter Emplaced Seismic Intrusion Detector. A seismic sensor detects vibrations and movement from passing footsteps or vehicles. It is designed to be launched from a pod attached to a CH-3 helicopter or tossed from its side door while the aircraft is hovering. (Defense Technical Information Center)

Right: An Air Delivered Seismic Intrusion Detector. With its nose buried deep into the ground the sensor's tail remains above the surface. The sensor blends in with the jungle foliage due to the green antenna that camouflaged it to look like a plant. (National Archives)

On the American home front, sensor technology developed for the military in the Vietnam War was shared with the U.S. Border Patrol. Sensors deployed along the Texas-Mexico border demonstrated that they could detect illegal crossings into the United States. More advanced sensors than those developed by the DCPG continue to be used on U.S. borders today.

An Air Force sergeant decodes sensor signals aboard a C-121 aircraft in support of Operation IGLOO WHITE, April 10, 1968. (National Archives)

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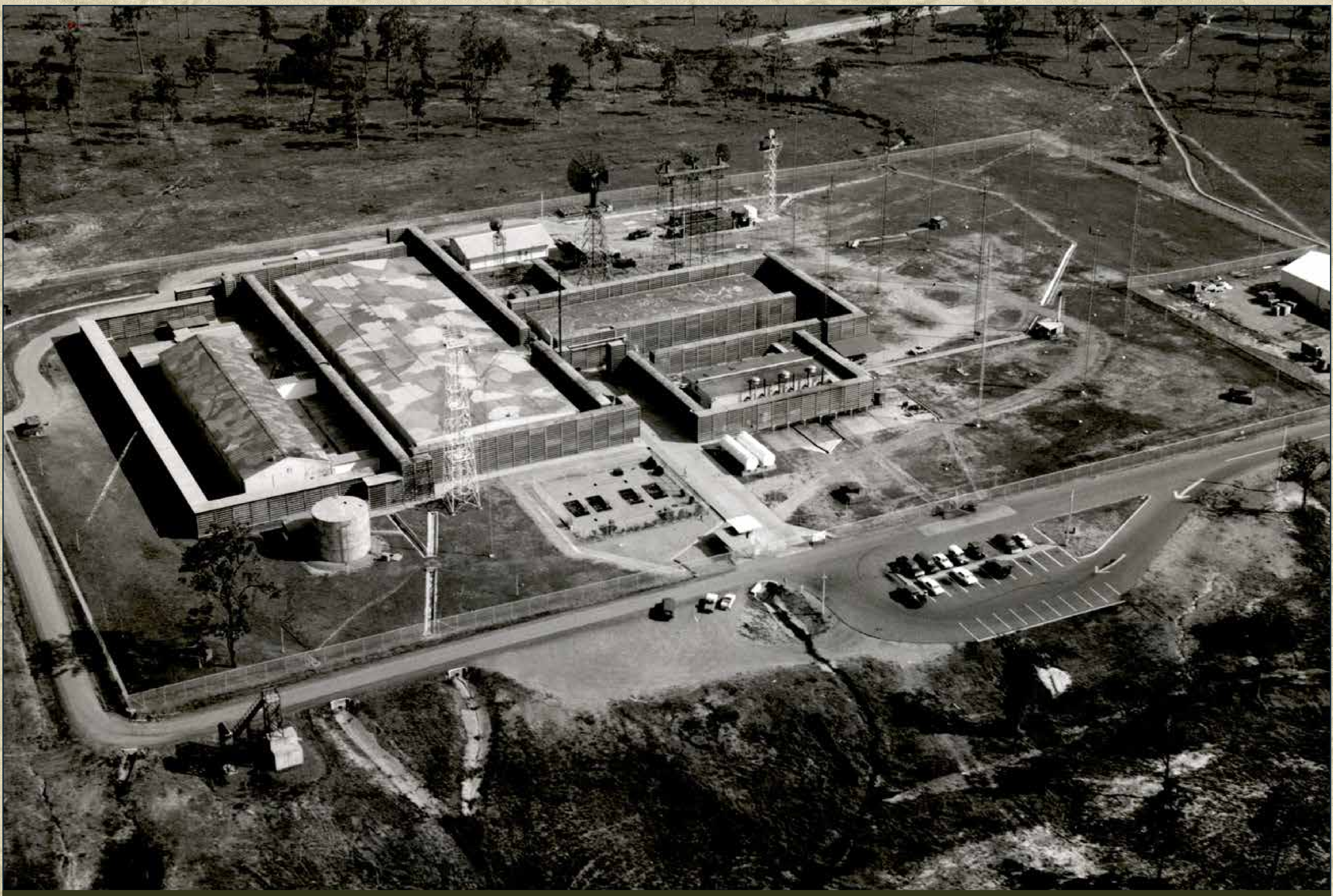
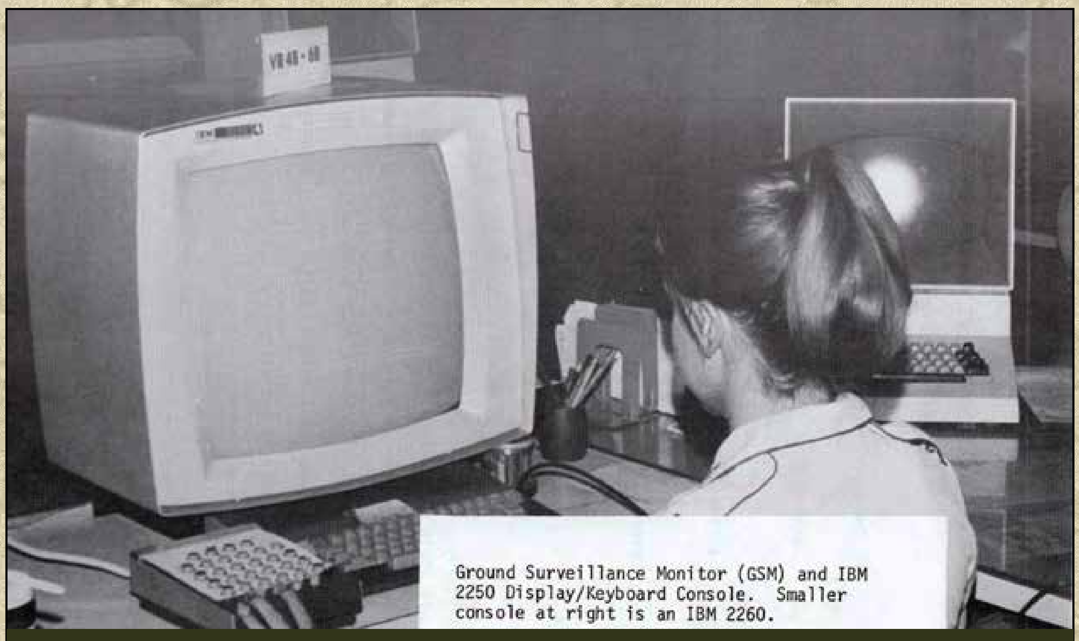
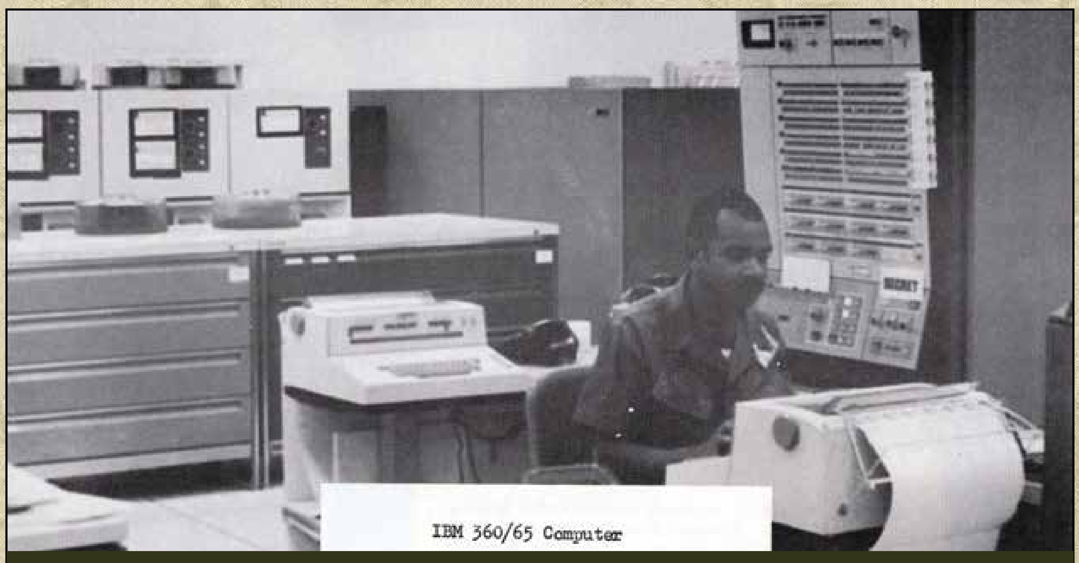


Task Force Alpha's Infiltration Surveillance Center, Nakhon Phanom Air Base, Thailand, 1971. (Air Force Historical Research Agency)



An enemy target (detected by sensor activation) is confirmed through the Ground Surveillance Computer System. (Air Force Historical Research Agency)



An information technology specialist inputs sensor data in to an IBM System 360/65 [super] computer. The computer digests and analyzed the data. Only then is the information presented to a targeting board to direct air strikes against the enemy.(Air Force Historical Research Agency)

On the battlefield of the future, enemy forces will be located, tracked, and targeted almost instantaneously through the use of data links, computer assisted intelligence evaluation, and automated fire control.

— General William J. Westmorland, 1969 speech

Sensor Technology in the 21st Century

Sensor technology grew exponentially in the years following the Vietnam War and has become a key part of the U.S. military's arsenal. Modern "network-centric warfare" is the direct outgrowth of successful sensor use in Vietnam. During combat operations in Afghanistan and Iraq, sensors are networked into area surveillance and communication systems that not only locate the enemy and materiel but are capable of calling in artillery fire and close air support to neutralize threats.

A soldier sets up a tactical unattended ground sensor to monitor an area his unit just cleared. Through seismic, acoustic, radiological, and electro-optic nodes, enemy personnel and vehicles are detected, tracked, and identified. (U.S. Army)

Sensor improvements and microchips now enable faster processing of signals so that the source (people, trucks, tanks, helicopters, etc.) can be instantly recognized. GPS technology provides accurate position location. Communication systems link the sensors to fire control computers in the air (for example, drones and aircraft such as the AH-64D Apache helicopter) or on the ground (such as tanks, and even infantry based weapons). Communication systems and precision weapon guidance enable accurate attacks against targets.

The AH-64 employs a combination of sensors and armament systems to gain a position of advantage for the ground commander. (U.S. Army)

Unattended Ground Sensors (UGS) are devices that automatically gather sensor data on a remote target, interpret the data, and communicate information back to a receiver without the need for a human operator. UGS "sense" targets by monitoring their emissions. Types of emissions include acoustic, seismic, electro-magnetic waves, optical, infrared, ultraviolet, electro-magnetic fields, chemical, and nuclear radiation.

Sensor technology is now common in the private sector as well. For example, motion detection sensors attached to lights found in homes and offices activate lights by sensing movement. Sensors in a "fluid environment," such as an automobile, aid in parking, avoiding front end collisions, and detecting objects in blind spots. Wristband sensors, for instance a Fitbit, contain an accelerometer, ambient light sensor, and optical heartbeat sensor. Finally, many smartphones contain light, proximity, magnetometer, and thermometer sensors.

Operations and intelligence personnel planning an air strike. The operation is seen on the Infiltration Surveillance Center Targeting Board. (Air Force Historical Research Agency)

Conclusion

Since the Vietnam War, sensors have grown exponentially in their use and roles. In 1970, Air Force pilot Lieutenant Colonel John Halliday, who flew numerous interdiction missions over the Ho Chi Minh Trail in Laos, intimated sensor technology was ahead of its time: "Step out of the jungle and inside the [ISC] building, you step into America — but an America 15 years from now." Halliday and the others who served in support of Operation IGLOO WHITE were on the cutting edge of sensor technology, the legacy of which can be seen on the modern battlefield and in the homes, cars, and in the hands of Americans to this day. From Operation IGLOO WHITE to the battlefields of the 21st century, sensors have consistently earned their place in the arsenals of contemporary militaries, in the defense of the nation, and in everyday features of civilian life.

PFC Ariel A. Tolentino, a radio operator with the 22nd Marine Expeditionary Unit ground sensor platoon prepares "unattended static" ground sensors used to detect movement, sounds, and vibrations in the field. (U.S. Marine Corps)

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