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2021-08-26 a permanent solution

The strategic and tactical considerations surrounding nuclear weapons went through several major eras in a matter of a few decades. Today we view the threat of nuclear wear primarily through the “triad”: the capability to deliver a nuclear attack from land, sea, and air. This would happen primarily through intercontinental ballistic missiles (ICBMs), so-called because they basically launch themselves to the lower end of space before strategically falling towards their targets (ballistic reentry). ICBMs are fast, taking about 30 minutes to arrive across the globe. The result is that we generally expect to have very little warning of a nuclear first trike.

The situation in the early Cold War was quite different. ICBMs, and long-range missiles in general, are complex and took some time to develop. From the end of World War II to roughly the late ’60s, the primary method of delivery for nuclear weapons was expected to be by air: bombs, delivered by long-range bombers. The travel time from the Soviet Union would be hours, allowing significant warning and a real opportunity for air defense intervention.

The problem was this: we would have to know the bombers were coming.

Many people seem to assume that the United States has the capability to detect and track all aircraft flying in US airspace. The reality is quite a bit different. The problem of detecting and tracking aircraft is a surprisingly difficult one, and even today our capabilities are limited. Nonetheless, surveillance of airspace is considered a key element of “air sovereignty,” or our ability to maintain military and civil control of our airspace.

Let’s take a look at the history of the United States ability to monitor our airspace.

During the 1940s, it was becoming clear that airspace surveillance was an important problem. Although the United States did not then face attacks on the contiguous US (and never would), were the Axis forces to advance to the point of bombing missions on CONUS it would be critical to be able to detect the incoming aircraft. The military invested in a system for Aircraft Control and Warning, or AC&W. Progress was slow: long-range radar was primitive and expensive, and the construction of AC&W stations was not a high-level priority. By the end of the 1948, there were only a small number of AC&W stations, they were considered basically experimental, and the ability to integrate data coming from the several stations was very limited. Efforts to expand the air surveillance system routinely failed due to lack of funding.

The Lashup project, launched in ’48, made up the first major effort to build an air surveillance system. As the name suggests, Lashup was only intended to be temporary, funded by the congress as a stopgap measure until a more complete system could be

designed. Over the next two years, 44 radar stations were built focused around certain strategically important areas. Lashup provided nothing near nationwide coverage, but was expected to detect bombing runs directed towards the most important military targets. Lashup included three stations surrounding my own Albuquerque, due to the importance of the Sandia and Manzano Amy Bases and the Z Division of Los Alamos.

Lashup sites used sophisticated radar sets for the time, but perhaps the most important innovation of Lashup was the command and control infrastructure built around it. Lashup stations were connected to the air defense command by dedicated telephone lines, the air defense command was connected to the continental air command by another dedicated telephone line, and ultimately dedicated lines were connected all the way to the White House. This was the first system built to allow a prompt nuclear response by informing the commander in chief of an impending nuclear attack as quickly as possible.

If you've read any of my other material on the cold war, you might understand that this is the core of my fascination with cold war defense history: the threat of nuclear attack was, for the large part, the first thing to motivate the development of a nationwide rapid communications system. For the first half of the 20th century there simply wasn't a need to deliver a message from the west coast to the President in minutes, but in the second half of the 20th century there most definitely was.

The fear of a Soviet nuclear strike, and the resulting government funding, was perhaps the largest single motivator of progress in communications and computing technology from the 1940s to the 1980s. Most of the communications technology we now rely on was originally built to meet the threat of a first strike.

We see this clearly in the case of air defense radar. While Lashup nominally had the capability to deliver a prompt warning of nuclear attack, the entire process was rather manual and thus not very reliable. Fortunately, lashup was temporary, and just as construction of the Lashup sites was complete work started on its replacement: the Permanent System.

The Permanent System consisted of a large number of radar stations, ultimately over 100. More importantly, though, it consisted of a system of communications and coordination centers intended to quickly confirm and communicate a nuclear threat.

It will help in understanding this system to understand the strategic principal involved. The primary defense against a nuclear attack by bombers was a process called ground-controlled intercept, or GCI. The basic concept of GCI was that radar stations would provide up-to-date position and track information on inbound enemy aircraft, which would be used to vector interceptor aircraft directly towards the threat. The aid of ground equipment was critical to an effective response, as fighter aircraft of the time lacked sophisticated targeting radar and had no good way to search for bombers.

To this end, the Permanent System included Manual Air Defense Control Centers (ADCC) (the "manual" was used to differentiate from automatic centers in the later SAGE system). The ADCCs received information on radar targets from the individual radar sites via telephone, and plotted them with wet erase marker on clear plexiglass maps (perhaps the source of the clear whiteboard trope now ubiquitous in films) in order to correlate multiple tracks. They then reported these summarized formations and tracks to the Air Defense Command, at Ent AFB in Colorado, for use in directing interceptors.

The Permanent System was extended beyond CONUS, although Alaska continued to have a distinct air defense program. The biggest OCONUS extension of the Permanent System was into Canada, with the Pinetree Line (the first of the cross-Canadian early warning radar networks) roughly integrated into the Permanent System. Perhaps most interestingly, the Permanent System also saw an early effort at extension of early warning radar into the ocean. This took the form of the Texas Towers, a set of three awkward offshore radar stations that were later abandoned due to their poor durability against rough seas [1].

Technology was advancing extremely rapidly in the mid-20th century, and by the time the Permanent System reached nearly 200 radar stations it had also become nearly obsolete. For its vast scale, the capabilities of the Permanent System were decidedly limited: it could only detect large aircraft, it performed poorly at low altitudes (often requiring mitigation through "gap filler" stations), and interpretation and correlation of radar data was a manual process, costing precious minutes in the timeline of a nuclear reprisal.

Here in Albuquerque, Kirtland Air Force Base was host to the Kirtland Manual ADCC, activated in 1951. 13 radar stations around New Mexico, eastern Arizona, and western Texas reported to Kirtland AFB. Each of these 13 radar stations was itself a manned Air Force Station including housing and cantonment. The Continental Divide Air Force Station, for example, consisted of some fifty people in remote McKinley County. The station included amenities like a library and gym, housing and a trailer park, and two radars: an early warning radar and a height-finding radar. Finally, a ground-air transmit-receive (GATR) radio site provided a route for communications with interceptors.

Continental Divide AFS was deactivated in 1960. You can still see the remains today, although there is little left other than roads and some foundations.

Like Continental Divide AFS, the Permanent System as a whole failed to make it even a decade. In 1960, it was as obsolete as Lashup, having been replaced not only by improved radar equipment but, more importantly, by a vastly improved communications and correlation system: the Semi-Automatic Ground Environment, or SAGE--by most measures, the first practical networked computer system.

We'll talk about SAGE later, but for now, check out a list of Permanent System sites. There might be one in your area. Pay it a visit some time; in many ways it's the beginning of the computer revolution: a manual data collection network obsoleted in just a few years by the development of the first nationwide computer network.

[1] The Texas Towers were connected to shore via troposcatter radio links, one of my favorite communications technologies and something that will surely get a full post in the future.