intercom

SERVITIO ★ special heritage edition ★ DEDICATI

APRIL 2019

intercom ✪ CONTENTS

Stories & Photos courtesy of the AFNIC History Office unless otherwise noted. Designed by Karen Petitt, 375th Air Mobility Wing Public Affairs

LUDWIG HALL

Ludwig Hall in Bldg. 1700 on Scott Air Force Base holds the largest collection of communications and cyberspace artifacts in the Air Force. The fundamental mission of the collection is to present the communications and cyberspace history of the United States Air Force. Artifacts span from the 19th Century including telegraph and Signal Corps equipment, through WWII with the switchboard used during the Pearl Harbor attack and a German Enigma machine, to the modern era including Hammer ACE equipment and cell phones. The location also hosts the Cyber-space Operations and Support Hall of Fame. The collection is open Monday through Friday to all with base access.

Airmen are the heart of AFNIC's successes

The Air Force Network Integration Center and its predecessor organizations can be proud of 75 years of "historical firsts" that have allowed our Air Force to lead the way in military communications and cyber capabilities.

Although there are plenty of software and hardware accomplishments to be proud of, our competitive advantage was built by Airmen—Airmen employing these tools to fly, fight and win in cyberspace.

Our Airmen are the heart of AFNIC's historical successes. The human element can't be enhanced with new acquisition strategies or outsourced to our commercial partners. Our Airmen will continue to provide our advantage in a fast-paced, contested environment shaped by continuous engagement in competition with global powers.

Our reliance on our Cyber Airmen and technology has never been more important than it is today. Advances in our adversary's technology and cyber capabilities demand innovative approaches and weapons systems. We are not entitled to success in this competition. We'll have to earn it. The men and women of AFNIC will play key roles in all of our efforts, and I look forward to seeing what they come up with.

Gen. James M. Holmes
Commander,
Air Combat Command

AFNIC celebrates heritage, anticipates future

The Air Force Network Integration Center and its predecessors have a rich heritage of providing communications, air traffic control, and cyberspace support to our nation's warfighters.

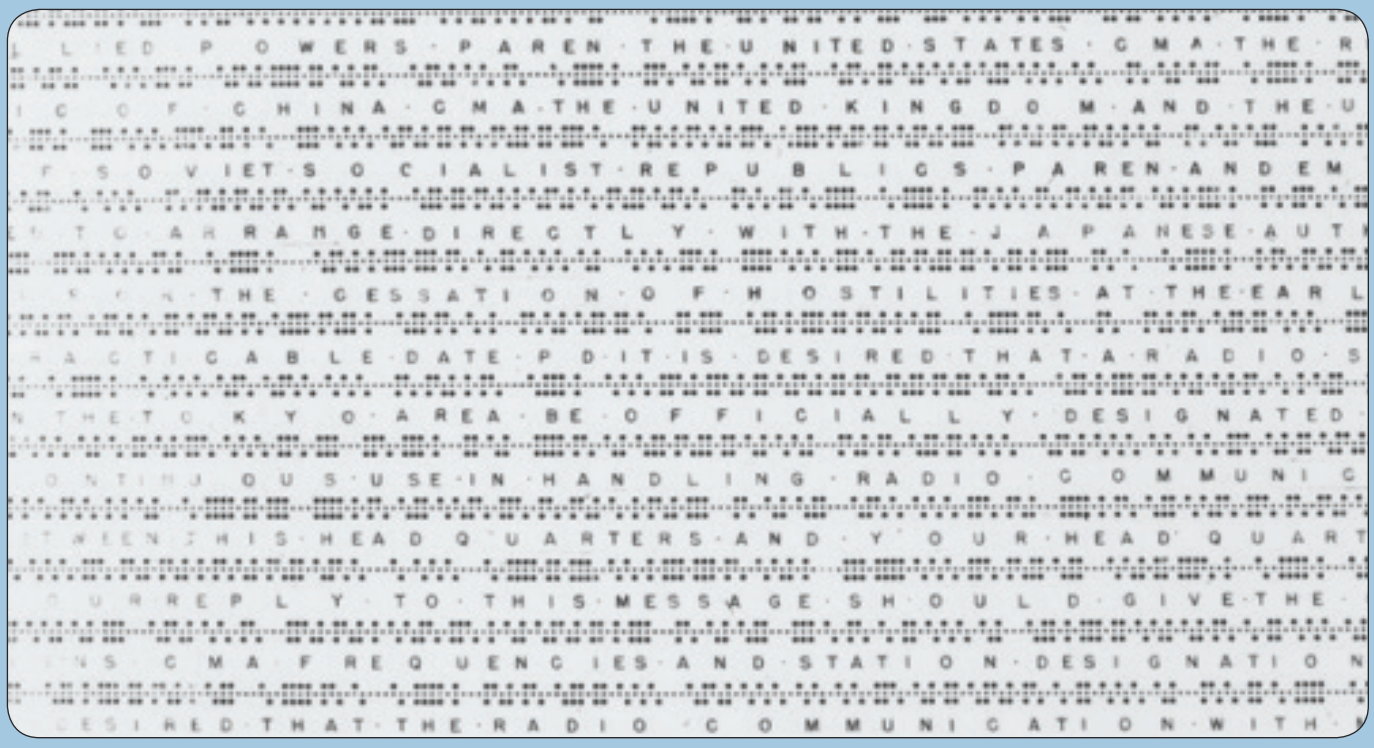
Over the past year, in celebration of our 75th anniversary, the men and women of AFNIC have penned the articles found in this Special Heritage Edition of the INTERCOM highlighting key events throughout that history.

We published these articles virtually on our public web site over the past 12 months, but I felt it appropriate to bring them to you in one document to honor a snapshot of the achievements of those who came before us.

And while we spent time in retrospect to produce these articles, we also spent considerable time looking forward to determine how AFNIC needs to transition to meet the needs of future warfighters. As we close out this anniversary year, I anticipate great things in AFNIC's future and am excited to see what the future holds.

AFNIC… Servitio Dedicati for 75 years and counting!

Col. Douglas S. Dudley
Commander, Air Force
Network Integration Center



MACARTHUR MESSAGE TO JAPAN: The first direct communications between Allied powers and Japan sent from Army Airways Communications System station WXXU Manila, Philippines, at 5:08 p.m., Aug. 15, 1945.

a legacy of DEDICATED SERVICE

By Col. Douglas S. Dudley
AFNIC commander

For more than 75 years, the men and women of the Air Force Network Integration Center and its predecessors have played a vital role in providing communications, information technology, and cyberspace systems operations and sustainment for Air Force missions.

While our roots go back to the Army Airways Communications System mission established in 1938, our lineage as an organization began April 26, 1943, when the Army Airway Communications System Wing was activated. Over the years, the missions and organization of AFNIC and its antecedents have changed significantly.

The original mission of the Army Airway Communications System Wing and the subsequent Airways and Air Communications Service was to operate all fixed Air Corps radio facilities, providing ground-to-ground and ground-to-air communications, dissemination of weather data, and control of air traffic by means of radar and navigational aids. In 1961, advances in communication systems and the need for better management of these services in order to keep pace with technological advances led to the organization's elevation to major command status under the Air Force Communications Service.

The consolidation of communications and data processing functions, incorporation of the engineering and installation mission, and the added responsibility for communications system acquisition in the 70s led to AFCS's redesignation as Air Force Communications Command in 1979. In addition to the above mentioned functions, AFCC was responsible for communications and air traffic control operations at all Air Force installations and, over the years, operated 20 different models of aircraft in order to perform its worldwide mission to inspect airfield navigational aids.

One of these aircraft, a C-140A painted in its Vietnam-era camouflage, can be seen today in the Scott Air Force Base Airpark.

Following the end of the Cold War, Air Force organizational realignments led to divestiture of AFCC's acquisition responsibilities and the transfer of its operational units to their host wings and parent major air commands. AFCC lost its major

command status and became the Air Force Command, Control, Communications, and Computer Agency in 1993. AFC4A was a Field Operating Agency reporting directly to Headquarters Air Force responsible for providing the Air Force's primary source of technical expertise for command, control, communications and computer system standards, integration and interoperability.

In 1996, AFC4A was renamed the Air Force Communications Agency and assumed a larger role in Air Force Chief Information Officer responsibilities such as architectures, policy and governance. Today, AFNIC is a center-level organization under the Air Force lead for cyberspace, Air Force Space Command, and reports directly to the AFSPC Commander.

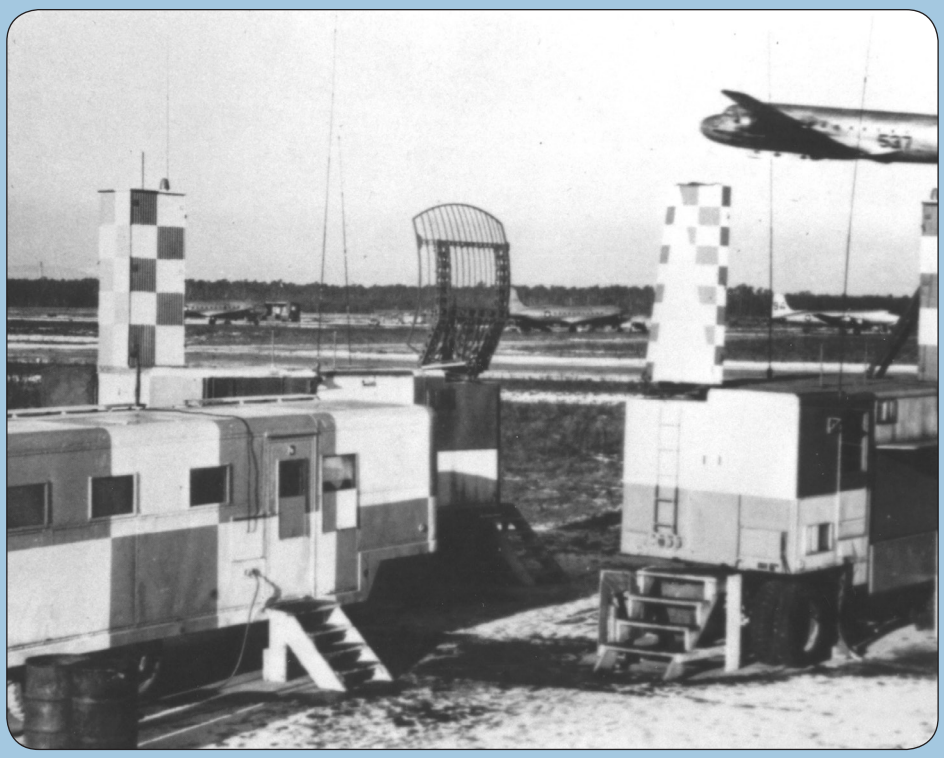
Over the years, AFNIC and its preceding designations have participated in a number of significant events throughout history.

Some of these include transmitting the first message from Gen. Douglas MacArthur to the Japanese outlining surrender instructions at the end of World War II, handling nearly 28,000 airlift flights during the Berlin Airlift, bringing into operations the Apollo Launch Control Center at Patrick AFB, Florida, which was used to support the Apollo space missions, and providing air traffic control, navigation and communications support to NASA's space shuttle program.

The organization has also supported a number of global contingencies over the years such as Operation Just Cause in Panama, Operation Eldorado Canyon in Libya, and Operations Desert Shield and Desert Storm in Iraq.

As a major command, the institution remained key to fielding and integrating state of the art technology into Air Force systems. The first fully automated switching center for the USAF Strategic Communications System was installed in 1957 at Andrews AFB, Maryland, tripling message handling capability.

In 1961, AFCS activated the first Central Notice to Airmen Facility at Tinker AFB, Oklahoma, and used it to transmit weather and critical flight data to aircrews and command posts across the continental U.S. The Air Force Data Communications System became operational in 1962 at Norton AFB, California.



BERLIN AIRLIFT: A C-54 "Sky Master" aircraft passes over the mobile ground control radar as the aircraft takes off from Rhein-Main Air Base, Germany, on its way to Berlin.

It was the first automated, fully electronic, high-speed data communications network in the Air Force and was the first component of the future Automatic Digital Network.

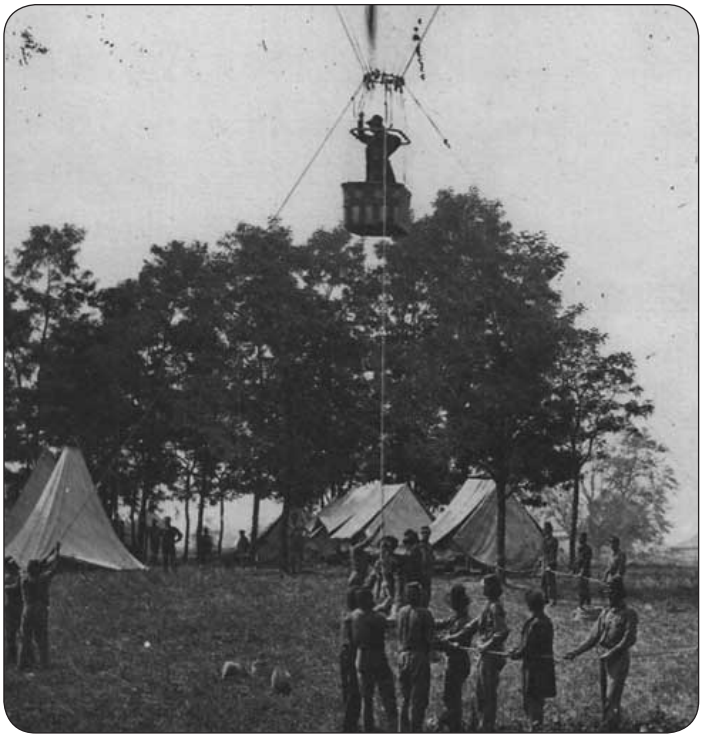
Other significant technological advances in AFNIC's lineage include the first Air Force Satellite Communications installation, development of the Defense Switched Network, fielding of the STU III secure telephone, the MILSTAR Satellite Communications System, the Red Switch Network and the Defense Messaging System. "Without communications, all I'd command is my desk," said Gen. Thomas S. Power, former Commander of Strategic Air Command, in 1959.

While the organization and the systems and services provided by it have changed over the years, Power's comment remains valid today.

Whether conducting activities ranging from architecting the latest evolution in our cyberspace weapon systems to leading the Air Force's charge into cloud computing through initiatives such as Cloud Hosted Enterprise Services, AFNIC remains at the forefront of modernization of the Air Force's information technology and cyberspace systems. ✪

> ***"Without communications, all I'd command is my desk."***
>
> **Gen. Thomas S. Power**
> Former Commander of Strategic Air Command, 1959

Wireless transmissions: Guglielmo Marconi's experiments in wireless communication led to the first transatlantic wireless transmission from England to Newfoundland, Dec. 12, 1901.



Telegraph vital to Civil War military, political history: Thaddeus Lowe observes confederate positions at the Battle of Gaines' Mill, June 1862.

ELECTRONIC COMMUNICATIONS

HUMBLE BEGINNINGS

By Capt. Shane Crema
Air Force Network Integration Center

While communications dates back thousands of years, the effort toward electronic communications began in the mid-1800s.

It was over 180 years ago that Samuel F. B. Morse received a patent for his electromagnetic telegraph. He devised a cipher code where words were assigned three or four-digit numbers and entered them into a codebook.

Morse's now famous message from the Bible, "What hath God wrought?" was sent May 24, 1824, 41 miles from Washington to Baltimore on an experimental line.

Alfred Vail, Morse's assistant in Baltimore, received and returned the same message that day. Vail advanced Morse's original experiment and developed a more intricate numerical code using dots and dashes. Today, we are familiar with this as Morse code, which greatly increased the speed of deciphering messages and set the path for future electronic communications.

The military value of electronic communications was immediately evident. President Abraham Lincoln received his first telegraph message from Thaddeus S. C. Lowe's balloon named the Enterprise, June 17, 1861. The message was delivered through a cable from the balloon to the ground, which described the city view from 500 feet above Washington, D.C.

Lowe used this eye-catching feat to convince the president that balloons combined with electronic communications would be a valuable reconnaissance tool for the military. Later that year, he proved the merit of an emerging Balloon Corps by transmitting the location of the Confederate Army and heavy artillery positions over three miles away on Sept. 24, 1861.

The telegraph was a vital part of the Civil War's political and military history in two key ways. The telegraph proved to be a strategic, operational and tactical communication medium

Bringing the voice to wireless communications: Reginald Fessenden performed the first radio-voice transmission, Dec. 13, 1900.

that was an important contributor to the Union's victory, and it safeguarded civilian control over the military.

Union Army commanders executed real-time battlefield operations and coordinated strategy across great

distances. In all, the U.S. Military Telegraph Service handled 6.5 million messages and deployed 15,000 miles of line. Gen. Ulysses S. Grant, commander of all Union forces, wrote and transmitted many instructions regarding strategy across these miles of line, in many cases taking several hours to deliver.

Civilian control over the military was supported when the staff assigned to military telegraph operations had to report directly to President Lincoln and the Secretary of War Edwin Stanton. Stanton used the military telegraph system as a way to keep abreast of the generals' actions across the entire span of the conflict.

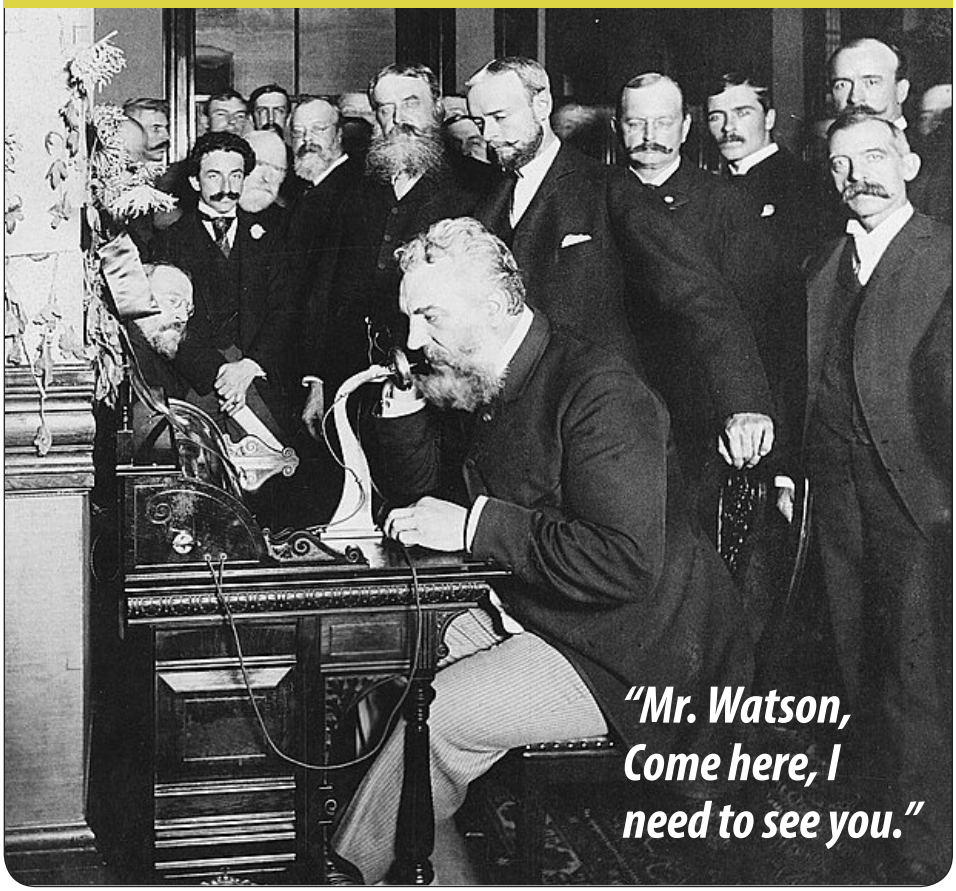
This groundwork in electronic communications laid the foundation of success for the first telephone call, the next major step in communications.

The United States Patent Office issued Alexander Graham Bell a patent, March 7, 1876, for the telephone, often called the most valuable single patent in history. Bell was fascinated with transferring speech across wires between two distant locations. At the time, a disadvantage with the telegraph was that only one message could be transmitted at a time. Bell wished to create a harmonic telegraph combining existing technologies from the original telegraph and a recording device to allow people to communicate to each other, in real time, between two points.

With his assistant, Thomas A. Watson, Bell's first prototype consisted of sound vibrations that were transferred magnetically and replicated to a receiving end. Three days later, the first intelligible message by telephone occurred between Bell and his assistant, when he shouted into the mouthpiece, "Mr. Watson, come here, I need to see you."

Guglielmo Marconi began wireless experiments in the late 1800s in an effort to free communications from wires. He was convinced that it was possible to transmit signals using electromagnetic waves to a receiving antenna wirelessly. At that time, scientists and other experts believed that these waves could only be transmitted in a straight line with no obstacle in the way. Marconi felt otherwise.

Telephone earns 'most valueable' patent: Alexander Graham Bell at the opening of the long-distance line from New York to Chicago, Oct. 18, 1892.



Marconi placed the transmitter near his house and a receiver, behind a hill, three kilometers away. He had an assistant on the other end who successfully received the Morse alphabet code of three dots, representing the letter S. Marconi experimented at greater distances until he reached a distance of 100 kilometers.

These early experiments led to the first transatlantic wireless transmission 2,200 miles from Cornwall, England to St. John's, Newfoundland, Dec. 12, 1901.

Radiotelegraphy had now become a reality. The transition from dots and dashes to voice communications began in the early 1900s.

On Dec. 23, 1900, the first radio-voice transmission was demonstrated by American physicist Reginald Fessenden. Fessenden went on to work for the United States Weather Bureau with the goal of using coastal radio station towers to transmit weather information without the use of telegraph lines.

With advances in receiver design, he worked to develop the audio reception of signals.

Afterwards, Fessenden's future success consisted of barretter and electrolytic detectors that set the standard in radio reception sensitivity. This effort finally brought voice to wireless communications and could not have come at a better time as the monumental event of the world's first powered flight on Dec. 17, 1903 would prove the need for more advanced communication.

In 2019, AFNIC continues to develop communications capabilities that science fiction writers only dreamed of decades ago.

Government email migrating to the cloud, global mobile communications, tablet computing, and advance satellite communications are today's version of advancements like Morse code and radio telegraphy. The men and women of AFNIC are now writing their own chapter in the advancement of communications and continue this storied past moving forward to be the Air Force Engineering and Integration Center of Excellence. ✪

Air-directed bombing demo: An air-directed bombing demonstration at Fort Riley, Kansas, Nov. 5, 1912. Pictured are Lt. Follett Bradley, observer and radio Operator, and Lt. Henry H. Arnold, pilot.

THE BIRTH OF POWERED FLIGHT &

AIR-TO-GROUND COMMUNICATIONS

By Chief Master Sgt. William M. Higginbotham
Air Force Network Integration Center

The year 1903 was monumental for heavier-than-air flight and communications expansion.

Just as a fledgling Signals Corps Lieutenant, William "Billy" Mitchell, was finishing his assignment to place 500 miles of telegraph wire in the Alaskan territory, Orville and Wilber Wright were preparing to launch the first airplane into flight.

The Wright brothers' ambitious achievement Dec. 17, 1903, heralded the beginning of capabilities that would eventually lead to an independent United States Air Force. The following 40 years would prove to be the pioneering era for both powered flight and electronic communications.

Communications through wired telegraph from balloons had already been demonstrated during the Civil War. The next evolution was to show that airplanes of the day could send, and also receive, radio telegraphic messages in flight.

After first demonstrating the transmission of messages from an airplane in flight to a grandstand at a race track in New York, young lieutenants began demonstrating the military application of communications technology. In 1911, Lt. Benjamin D. Foulois made reconnaissance reports to Signal Corps stations along the Mexican border while in flight.

Additionally, in November 1912, Lts. Henry H. Arnold, J.O. Mauborgne, and Follett Bradley used radio telegraphy from a Wright Model C Flyer to adjust artillery fires during an air-directed bombing demonstration.

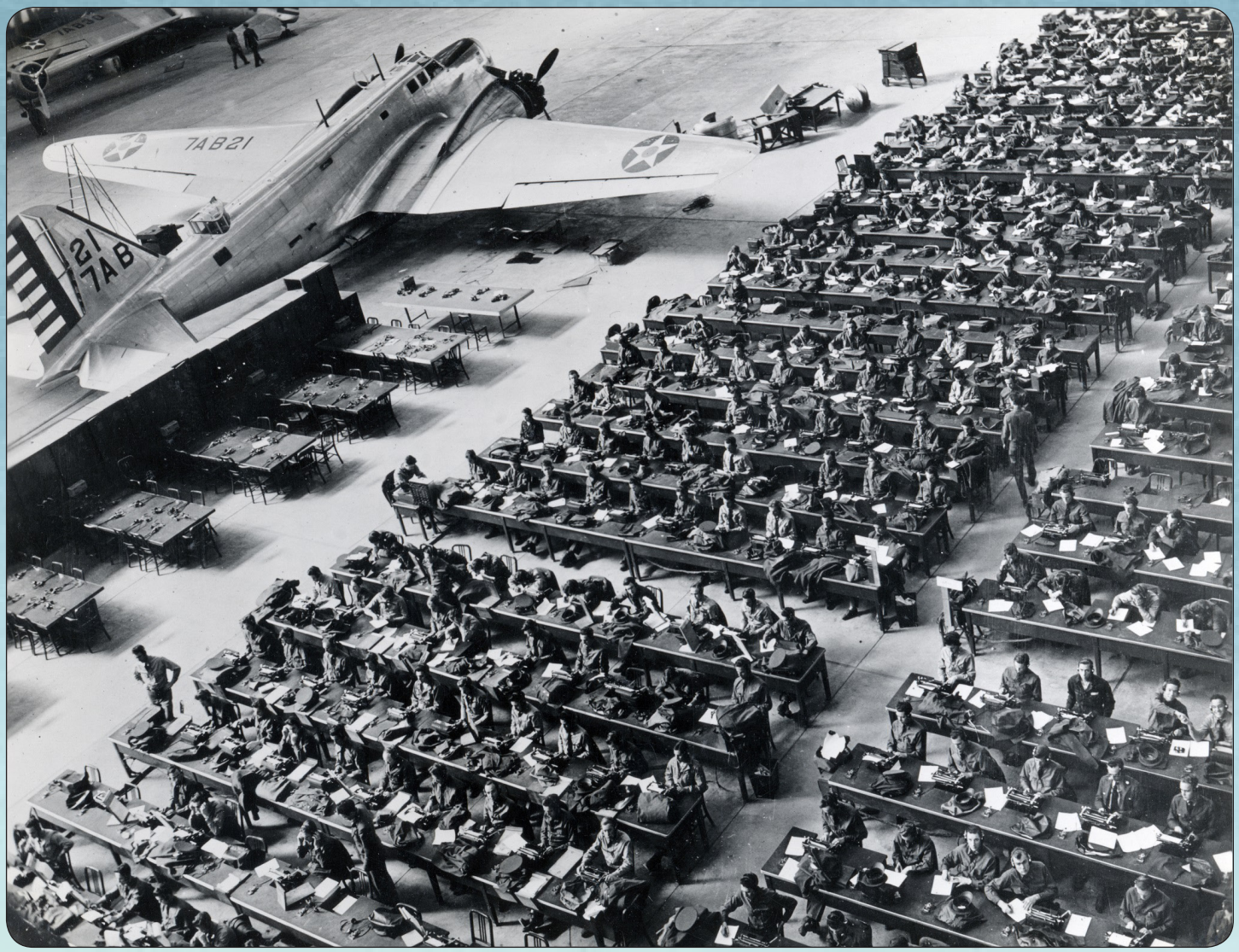
Dots and dashes were replaced by human voice in February 1917. By the end of 1917, air-to-ground radiotelephone sets were in full production and were being placed in aircraft and ground stations alike.

Communications distances were also increasing. In 1915, the range of radios was only two miles. In 1917, radiotelephone sets were reaching other aircraft at 25 miles away and ground stations at 45 miles away.

As the Aviation Section of the U.S. Army Signal Corps gained more knowledge in shielding ignition systems, bonding, and metallizing their aircraft and radio sets, the clarity of voice communications improved. Long range communications began to enable long distance flying, creating new challenges for aviation pioneers to overcome.

In 1922, the Air Corps established the Model Airways to promote long distance flying, and to provide aerial transportation of government officials and express cargo on regularly scheduled time tables.

The established route included stops at Bolling, Langley,



Radio school: Radio school training in Hanger 1 at Scott Field, Illinois, Mar 1, 1941.

McCook, Mitchell, Chanute, Selfridge, and Wilbur Wright Fields. Each of these flying fields established radio stations to support flight operations, but each station operated independently and not as a "system." Airfield operations and communications fell under the responsibility of the local commander, and each commander's efforts were not coordinated with the others. This caused weather and flight messages to be treated as routine, often resulting in aircraft arriving at the next stop before the message of their departure was sent from the previous location.

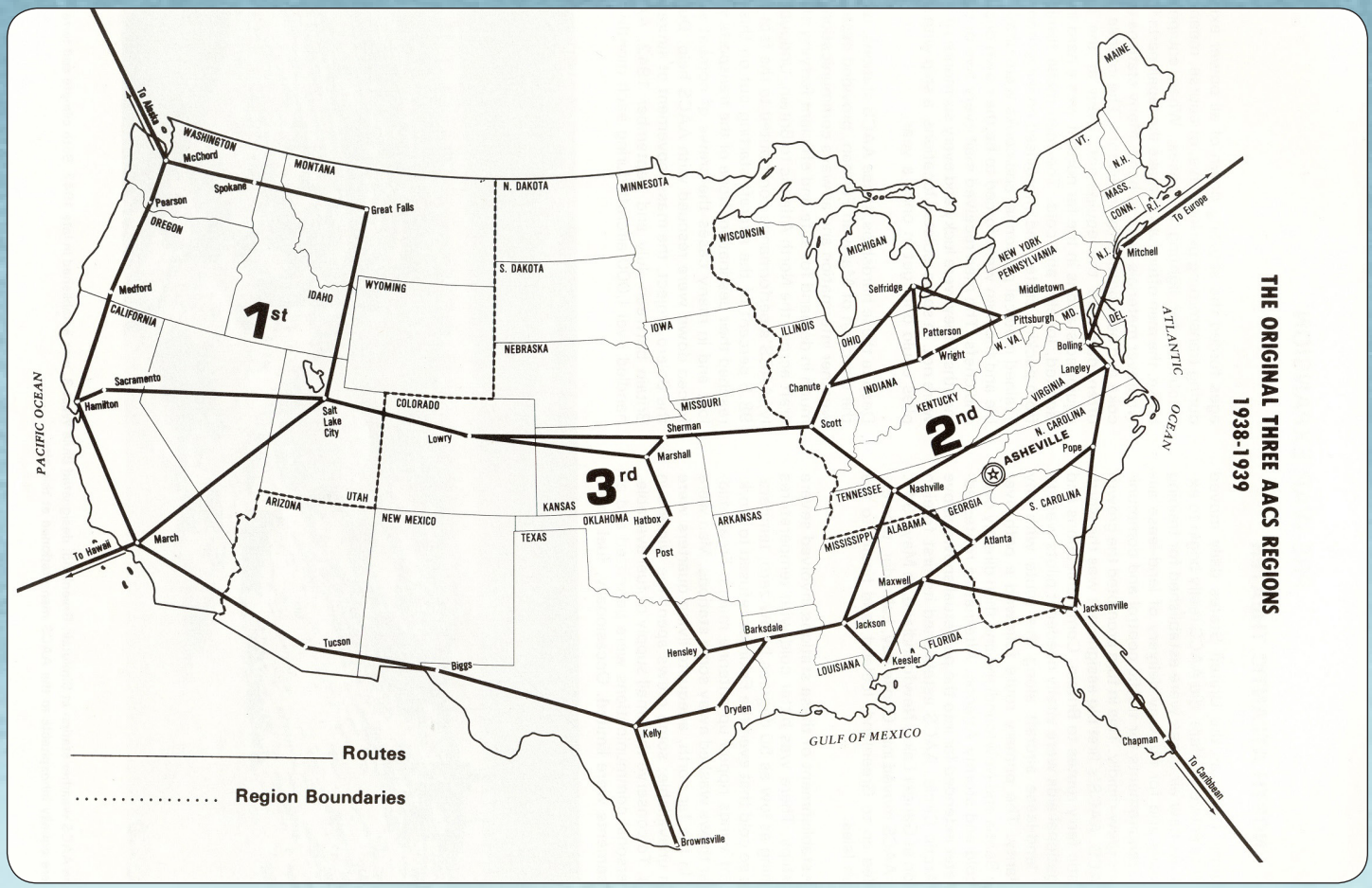
As long distance flight became more prevalent, the need for navigational capabilities grew. Instruments were added to aircraft to provide information that pilots would not normally have. In September 1929, radio signals and an altimeter provided the means for Lt. James H. Doolittle to make the very first instrument landing. Procedures were developed in 1933 for instrument flight over land and water in order to improve aerial frontier defense.

In the following year, President Roosevelt cancelled commercial air carrier contracts in order to renegotiate them. The Air Corps was asked to pick up the slack and carry the mail on commercial routes for the next three months. These three months saw 10 fatalities on the commercial routes, calling into question the capabilities of military fliers. This prompted the addition of two-way radios and blind flying instruments for every plane in the force.

> ***Notable graduates of what was to become known as the "Communications University of the Army Air Corps" were Medal of Honor recipient Tech. Sgt. Forrest L. Vosler and the eventual first Chief Master Sergeant of the Air Force, Paul W. Airey.***

In an attempt to recover some of the prestige the Air Corps had lost, as well as validate long range frontier defense, Lt. Col. Henry H. "Hap" Arnold coordinated a long distance flight of 8,290 miles between Bolling Field, Washington D.C., and Alaska.

Signal ground stations were alerted to give the flight of 10 Martin B-10 bombers high priority as they traversed the route. Equipped with a new interphone capability and a



crude radio compass, the formation of B-10 bombers was able to remain in constant contact with ground stations and the mission was completed without mishap.

Arnold was awarded the Mackay Trophy and a Distinguished Flying Cross. The success garnered some much needed positive publicity. More importantly, the outcome of this flight clearly demonstrated the need for an integrated air communications system to ensure the safety of travel in the air. However, it would be another four years before our peacetime nation grew concerned enough to grant the resources necessary to enact the plan Arnold built as a result of his long distance flight. By direction of the War Department, 1938 saw the establishment of the Army Airways Communications System. Its primary purpose was to provide ground-air and air-ground communications between AACS stations within the continental United States, in order to promote safety of flight and the facilitation of flying operations.

In all, the continental United States had 33 stations divided into three communications control regions. HQ Army Air Corps, Directorate of Communications authorized 300 enlisted men to carry out the mission of this new system. A new radio school was stood up at Scott Field, providing support to the increasing need for radio operators. Notable graduates of what was to become known as the "Communications University of the Army Air Corps" were Medal of Honor recipient Tech. Sgt. Forrest L. Vosler and the eventual first Chief Master Sergeant of the Air Force, Paul W. Airey. New overseas stations such as Alaska, Hawaii and Newfoundland started to fold into the AACS. Other new locations would continue to grow the network of ground stations in support of air travel around the globe.

> ***The attack on Pearl Harbor turned the deliberate plans for expansion of air navigation routes into an immediate wartime necessity.***

The attack on Pearl Harbor turned the deliberate plans for expansion of air navigation routes into an immediate wartime necessity. The AACS expanded rapidly to support both the Pacific and European war theatres. Just after WWII started rolling, the AACS was threatened with disintegration. Since the AACS was just a system and not an organization, there was no authority to continue to develop a centrally controlled and unified communications system. Since communications was not yet fully understood, the AACS had less consideration in terms of importance. Due to continuing wartime operations overseas, five of the newly established regions were made AACS headquarters for their areas. This, along with Army Air Forces HQ's decision to move all operations to the field, contributed to the creation of the AACS as an official organization.

The first AACS Wing under the newly established Flight Control Command was born April 26, 1943. Thus began the proud forerunner of today's Air Force Network Integration Center. ✪

AACS emblem: The Army Airways Communications System Wing emblem shows the early start to the Air Force Network Integration Center.

Anniversary emblem: The Air Force Network Integration Center created this design to showcase its heritage for its 75th anniversary.

HOW WE GOT HERE

AFNIC at 75 years & counting

By Daniel P. Williams
AFNIC History Office

When the United States Air Force celebrated its birth as an independent service Sept. 18, 1947, what would eventually be designated the Air Force Network Integration Center was already four years old.

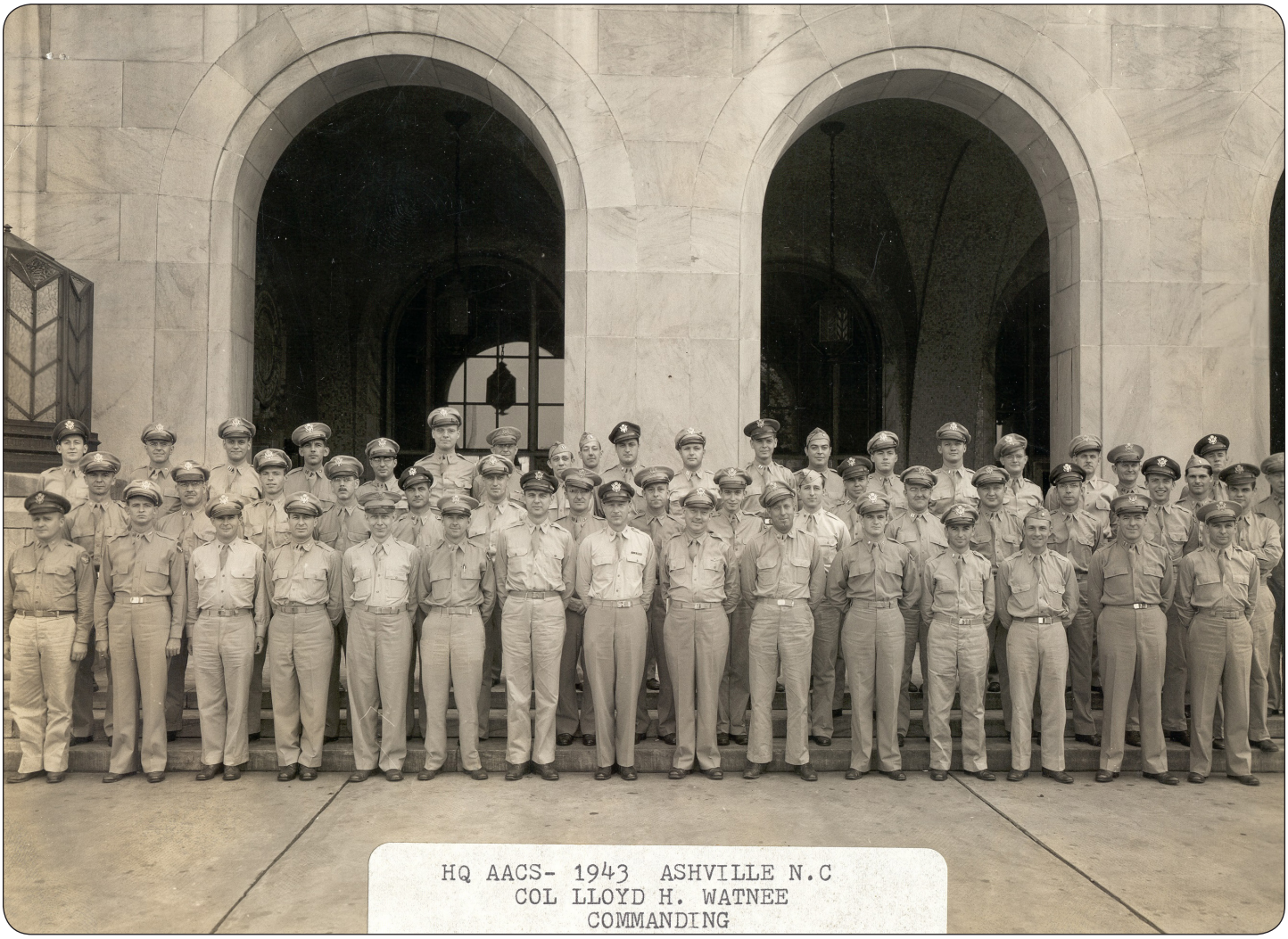
On April 26, 1943, the Army Airways Communications System Wing was activated in the midst of a globe engulfing conflict recognized as World War II.

It was well before America's involvement in the Second World War that the destinies of aircraft and communications would be closely linked. On Nov. 15, 1938, the United States Army Air Corps established the Army Airways Communications System to operate all fixed Air Corps radio facilities in the continental United States. Placed as a staff function of Headquarters Army Air Corps Directorate of Communications, within the Training and Operations Division, this was a system and not an established organization. Because of this, the system has no "official" lineage and honors dating from 1938 despite the significant accomplishments of the organization before and into World War II.

When the official lineage begins in 1943, AACS would find itself assigned to the newly created Flight Control Command with its first station in Ashville, North Carolina, where it would remain until the end of the war. Like most military organizations, post war demobilization brought significant reorganization. With its wartime strength seeing a high of nearly 50,000 personnel dedicated to communications and air traffic control, post war demobilization brought AACS down to just 8,635 by June 1946, and with it more change.

Today's cyberspace professionals are well acquainted with frequent and fast moving change, this was just as true over 70 years ago. AACS would see a series of redesignations, or name changes, from Army Airways Communications System, April 26, 1944, Air Communications Service, March 13, 1946, and Airways and Air Communications Service, Sept. 11, 1946 to preserve the familiar AACS acronym. In addition to names, assignments would change as well from Air Transport Command, March 13, 1946, to Military Air Transport Service, Aug. 16, 1948, both of which trace their lineage to today's Air Mobility Command. The stations AACS was assigned to after the war were varied as well and included Langley Field, Virginia, Dec. 29, 1945, Gravelly Point, Virginia, Dec. 12, 1946, ending for a time at Andrews AFB, Maryland, Nov. 22, 1948.

After its decade's long assignment at Andrews, and continuing to follow the Military Air Transport Service, AACS relocated to Scott AFB, Illinois, Jan. 15, 1958. By the end of the 1950s, communications, computers, air traffic services, and many other missions fell under various authorities. At the direction of Headquarters USAF, a special study of Air Force communications recommended a single manager for most communications efforts Air Force-wide. This study led to the



HEADQUARTERS STAFF 1943: The Headquarters Staff of the Army Airways Communications System Wing stand on the steps of the Municipal Building in Ashville, N.C., in 1943. This wing eventually led to the creation of the Air Force Network Integration Center.

redesignation of AACS as the Air Force Communications Service, July 1, 1961, becoming the Air Force's 16th major command.

In this new role, AFCS executed its mission to provide air traffic control and telecommunications services with all communications organizations Air Force wide falling under the command. AFCS would remain at Scott until July 16, 1970, when the command was reassigned to Richards-Gebaur Air Force Base, Missouri. This would be a relatively short stay, and on Sept. 30, 1977, AFCS returned to Scott, a place it has called home ever since.

Over the next decade the command grew in its responsibilities beyond being the single manager for communications and air traffic control. On Nov. 15, 1979, AFCS was redesignated as Air Force Communications Command with responsibilities focused on engineering, programming, installing, operating and maintaining telecommunications, electronics, and air traffic control facilities.

The latter of which included an assigned fleet of aircraft to perform worldwide inspections of airfield navigational aids. These efforts would require significant numbers of personnel and AFCC reached its high water mark having over 58,000 personnel assigned in 1987.

It would be two years later that AFCC would move into its current home on Scott AFB, Bldg. 1700, which was named for the first major command commander, Lt. Gen. Harold W. Grant. As the United States emerged victorious from the Cold War with the Berlin Wall down and the Soviet Union no more, significant change for AFCC was on the immediate horizon.

On July 1, 1991, the status of AFCC changed from a major command to a field operating agency of the USAF. Service-wide communications units were now assigned locally at the wing and group level under their respective major commands and significant numbers of AFCC's assigned personnel went to these units.

The flight check mission and aircraft had already transferred to Military Airlift Command by 1987, and by 1992, the Air Traffic Control mission that the organization had been responsible for since its first days was transferred to the Air Force Flight Standards Agency. This marked a significant change given the close relationship held between the organization and the flight control mission it had always known.

The mid-to-late 1990s saw substantial change in the way organizations responsible for computers and information systems were organized. AFCC

BLDG. 1700 DEDICATION: Maj. Gen. Robert H. Ludwig, Air Force Communications Command commander, delivers a speech during the formal dedication of the Lt. Gen. Harold W. Grant Building at Scott Air Force Base, Ill., Oct. 16, 1989.

FLIGHT CHECK AIRCRAFT: A C-140A "Jet Star" aircraft is painted in the bright orange and white scheme of an Air Force Communications Service flight check aircraft.

SATELLITE UPLINK: A U.S. satellite uplink station is deployed in the desert during Operation Desert Shield.

would be redesignated the Air Force Command, Control, Communications, and Computers Agency May 28, 1993, and would change names yet again three years later to the Air Force Communications Agency, June 13, 1996. It was the following year, April 1, 1997, that AFCA went from being assigned as a field operating agency of the USAF to a subordinate unit of the newly created Air Force Communications and Information Center.

This would not last long as AFCA would be reassigned back as a field operating agency of the USAF, Oct. 1, 2000. If you're keeping track, that's three names and four assignments in a decade. As any "old timer" from the 1990s will remember, that was a period of significant organizational change in the Air Force.

The current status of the organization today began May 4, 2009, when AFCA was no longer a field operating agency of the USAF and became a direct reporting unit of Air Force Space Command, the lead command for all Air Force cyberspace operations. Two months later, July 15, 2009, AFCA was redesignated as the Air Force Network Integration Center.

It comes as no surprise to the cyberspace professionals of the United States Air Force that, yet again, change is in the air.

In the Air Force today are cyber professionals who are just beginning their careers and it is likely that some will be in this organization for AFNIC's centennial celebration.

For today, and as this organization's long-storied past proves, the men and women of the AFNIC stand ready to be the engineering and integration center of excellence for decades to come. ✪

WORK IN CHINA: Majs. Gleason and Mandle work at the Army Airways communication System headquarters in Kunming, China, in the mid 1940s.

TELETYPE COMMUNICATIONS: Perforated tapes for transmission hang on the left side of the teletype room as members of the 19th Army Airways Communications System Squadron use model 30 and 36 teletypes to send communications out.

MOMENTOUS BEGINNINGS: COMMUNICATIONS ENCIRCLE THE GLOBE

By Capt. JD Helm
Air Force Network Integration Center

The Air Force Network Integration Center is a leader in military communications with a long history starting with the Army Airways Communications System and leading up to today.

The AACS began as just a system of Airmen and technology performing a combination of communications and air traffic control functions. In January 1943, the War Department established a special communications board headed by Col. Ivan L. Farman.

Farman's team moved AACS from being just a peacetime system into large world war operations and gave the AACS a wartime mission of using radio to watch aircraft in flight, signaling the beginning of global communications.

Before this, communication was happening on the regional scale. Communications would leap frog from relay point to relay point.

For example, a radio operator in Miami would send a message to Puerto Rico, relayed to British Guiana, relayed again to Brazil, and once more transmitted through Ascension Island to end up in the Gold Coast. A plane would have to navigate across these routes using each relay point to travel across the ocean. There was no internet, no World Wide Web and no global communications.

World War II, however, was being fought on a global scale.

On Feb. 28, 1943, only two months before the AACS Wing activated, the AACS station in Kunming, China, contacted their sister station in Brisbane, Australia. This seemingly small act completed a communication chain that encircled the globe. The United States and its allies now had the ability to relay messages to ground stations and aircraft around the globe, marking the beginning of a connected global communications network, the foundation of today's Air Force capability of global reach.

During October 1943, the North Atlantic region of the AACS network began upgrading to radio-teletype systems. At the time, Morse code was the standard for long distance communications, where a trained operator could tap out five words per minute. The operator would have to master the code, and translate the verbal, written or perhaps typed message into Morse code to be sent out manually via the iconic dots and dashes.

The advancement of the radio-teletype made things easier and faster. The operator simply typed the message into a teletype, similar to a typewriter, which would print out the message on paper tape. The tape is then fed into an automatic head that encoded and transmitted via radio out to the recipient radio-teletype which decodes and delivers a clear text message, not unlike today's email and fax machines.

In the years following, AACS continued to spread across the globe, putting up stations throughout Europe, Africa and the Pacific Islands. Aircraft would be safely guided through inclement weather, or even enemy fire. AACS Airmen fought, and some died defending these stations as World War II continued. Where the soldiers went, so followed AACS. Only 19 days after the

WORK IN THE PHILIPPINES: Members of the Army Airways Communication System Detachment 60 gather in Manila, Philippines, April 1954.

10th United States Army stormed the Okinawa beaches, AACS had a radio installation operational there.

Gen. Douglas MacArthur, Supreme Commander of the Southwest Pacific Area, was authorized to arrange the end of the war, Aug. 15, 1945, and used the AACS Manila station to transmit the first direct communication between the Allies and the Japanese government.

Nine days later, AACS members led by Col. Gordon Blake, Army Airways Communications System commander, were among the first Americans to reach the main islands of Japan. Colonel Blake brought with him another first: the first airborne radio station in Air Force history. These Airmen safely guided allied occupation troops to the island.

With the war over, the military began to draw down its massive wartime numbers. This communications beginning almost came to an early end. In 1946, AACS was renamed the Airways Communication Service. The restructure also meant losing over 40,000 military personnel to only having 8,635 members to man 249 stations around the globe.

On Sept. 11, 1946, it was renamed to the Airways and Air Communications Service, going back to the original AACS acronym. Shortly following this, many calls were made to abolish the AACS, but the creation of the United States Air Force gave the AACS a new home. During this tumultuous time, the AACS continued to shine. AACS Airmen guided 276,926 airlift flights carrying over 2.3 million tons of relief supplies as part of the Berlin Airlift. They expanded the radio-teletype network worldwide, providing point-to-point weather data. Soon, AACS would be instrumental during the Korean War.

Even with less manpower today, AFNIC still provides essential communication capabilities to the warfighter. Today's teams continue where AACS started: bringing global communication to U.S. and allied military members in need anywhere, anytime across the globe. ✪

WORK IN JAPAN: Col. Gordon Blake stops in front of base operations at Atsugi Airport, Japan, in the Army Airways Communications Squadron jeep, August 1945.

Truck-mounted emergency Military Affiliate (Auxiliary) Radio System station.

MOBILE COMM

By Master Sgt. Justin A. Schoenthal
Air Force Network Integration Center

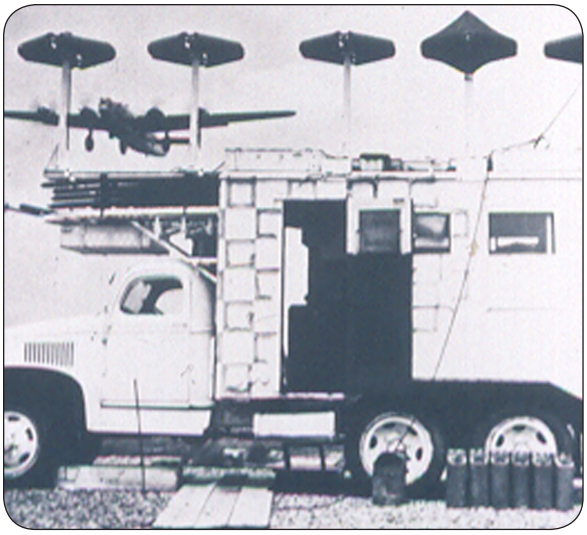
Looking back through the Air Force Network Integration Center's rich history, the 1950s showed exponential growth in the mobile communication sector.

Mobile communications for the AFNIC are currently focused around smart devices and how we, as a center, can provide enterprise mobility management allowing for worldwide communication over these mobile technologies. During the 1950s, AFNIC's predecessor, the Airways and Air Communications Service, was more focused on regional mobile communication support.

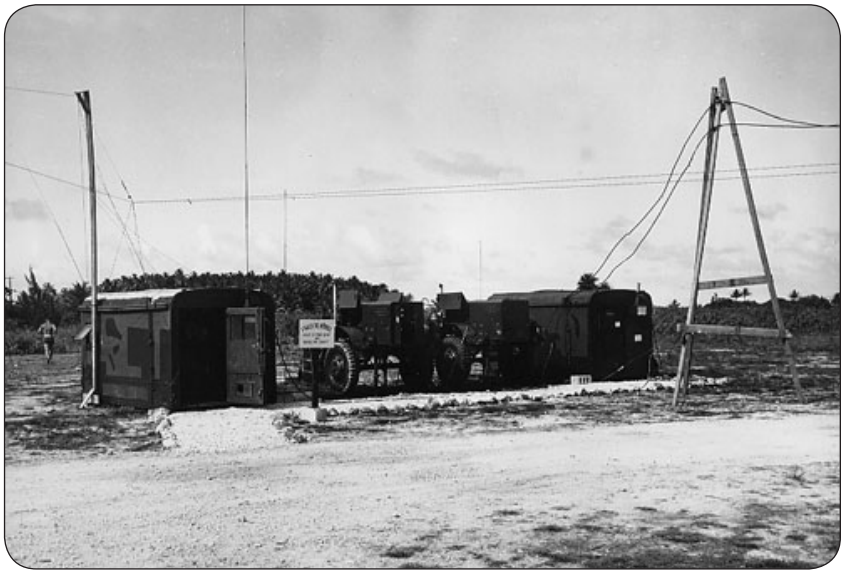
On May 1, 1951, the 1860th AACS Mobile Communications Squadron, the first mobile communications squadron in Europe, was activated at Munich-Riem Airport, Germany, with an authorized strength of 20 officers and 427 Airmen. AACS had been operating elsewhere as a system since 1938, providing air-ground and ground-air communications, but the use of mobile units and detachments had only been used since the mid-1940s.

The 1950s in Europe, when an AACS member was operating a mobile system, they would have been referring to something such as a Military Auxiliary Radio System mobile van which could provide mobile, or moving, communication during operations and emergencies. While nowhere near as portable, tiny or powerful as a cell phone fitting in one's pocket today, these vans could travel across the country providing communication to remotely located military members. These rugged beefed-up combat styled trucks ensured mission essential information continually and securely flowed giving the military member the same sense of connectivity that all desire and are accustomed to today.

Nothing beats being able to receive a response in a "Can you hear me now?" type of situation when the status quo of the day would often be "No. I can't hear you." In addition to voice transmissions, other mobile communica-



B-17 "Flying Fortress" passing over an SCS-51 instrument landing system.



AN/MSQ-1 Close Support Control Set.

tion tools in use by AACS during the 1950s included the AN/MSQ-2 Close Support Control sets which were used for command and control over various missile and bombing systems. This helped the Air Force continue their "warheads on foreheads" in any environment with the most precise tools of the time.

Much like today, mobile communications in the 1950s were not always everyone's priority. In 1952, Headquarters Tactical Air Command requested that AACS create a mobile unit dedicated solely to the support of TAC operations. However, U.S. Air Force headquarters rejected the request as not being justified. Regardless, this did not slow down the spread of mobile communications nor the creation of new units within AACS dedicated to this effort.

This can be seen mirrored in today's environment with the different attempts to implement mobile technologies such as tablets across the Air Force with varying levels of success. Currently, as in the past, AFNIC leads the Air Force with the most widely used mobile technology solution that encompasses the best communication features available for the warfighter.

In 1952, it wasn't a tablet that the warfighter was interested in, but aircraft low approach guidance. What got these 1950s communicators excited was the completely revised Instrument Low Approach System program, which saw the installation of the older SCS-51 mobile and newer AN/MRN-7 and 8 systems to be installed. This change was prompted by requirements during the Korean War.

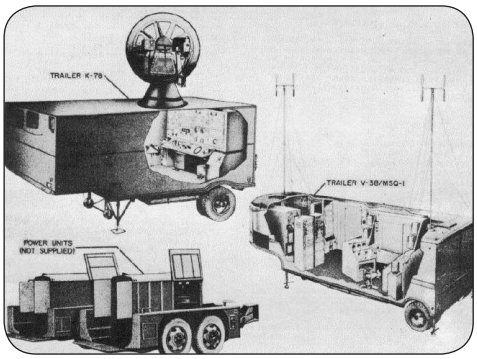
More commonly known as the Instrument Landing System (similar systems still in use today), this system was operated by AACS at several locations and consisted of a mobile, self-contained unit in a truck and trailer but could also be permanently deployed.

This equipment consisted of three independently operated components: runway localizer transmitter, glidepath transmitter and three 75 MHz marker beacon transmitters. The system provided the pilot with a straight-line glidepath beam and a runway localizer beam.

September 1954, Headquarters AACS established Detachment 1, 3d AACS Squadron at Langley Air Force Base, Virginia, and attached it to Headquarters Tactical Air Command for operational control.

This detachment was the first AACS mobile combat unit to be dedicated solely to TAC use, something the community continued to feel was necessary since it was first rejected in 1952. The detachment supported TAC until September 1959.

Another large AACS mobile achievement occurred in 1957 with the 1st AACS Squadron supporting Project DOVECOT, the atomic weapons testing effort by the British government at Christmas Island, today called Kiritimati. Located in the central Pacific Ocean, Kiritimati is hundreds of miles away from any form of civilization, a perfect location for AACS mobile abilities to shine.



Truck-mounted emergency Military Affiliate (Auxiliary) Radio System station.

Initially a classified project codenamed Operation GRAPPLE by the British, AACS provided weather observation, communications and associated administrative support for the effort. Twenty-four hour radiotelegraph support was provided to all of the locations to include Hawaii, Palmyra and Penrhyn Atolls, as well as 24 hour air and ground radio service between Palmyra and Penrhyn.

In the 1950s, AACS paved the way for mobile solutions to continue their valuable contribution to the military and solidified the need for communication anywhere and everywhere on the planet. The men and women of the AFNIC continue their legacy of integrating mobile communications services for today's warfighter. ✪

Interior view of the McClellan AFB, California, AUTODIN Switching Center.

AUTODIN

The first high speed data communications network

By Maj. Jennifer M. Sibit
Air Force Network Integration Center

In the mid '50s, the Department of the Air Force had a manual data communications system for punched card traffic and a separate system for teletype communications.

These manual data systems had inherent limitations in speed and capacity as well as being susceptible to human error. These limitations, combined with the success of the automatic teletype communication system, motivated planning for the purpose of automating the data network.

The proposed automated data communication system, known as the "Combat Logistics Network," or COMLOGNET, would provide computer controlled data switching centers and automatic data terminals on a nationwide basis.

Initially, this network was planned as a data-oriented system to replace the manual data relay centers that were in existence. However, very early in the design phase, it was proposed that the system concept be modified so that both narrative and data traffic could be processed in the network.

Combat Logistics Network was replaced and renamed to a system known as the Automatic Digital Network, or AUTODIN, in 1962. The AUTODIN system, originally designed by Western Union and then leased to the Air Force for use, was installed, operated and maintained by the Air Force Communication Service, the agency today known as the Air Force Network Integration Center.

AUTODIN was the Air Force's first automatic, fully electronic, transistorized, high speed data communications network. This network was a common system that linked more than 300 Air Force, Department of Defense and defense industry users for the purpose of rapidly exchanging information.

The need for such an increased data network originally was the solution to the logistics challenges of the time. In 1963, the Air Force was handing over 19 million supply

Pre AUTODIN view of a data communications manual relay facility, late 1950s early 1960s.

Two computer operators preparing messages for transmission in an AUTODIN terminal.

Interior view of an AUTODIN automatic switching center.

Lt. Gen. Alfred D. Starbird, US Army, Director of the Defense Communications Agency, and Brig. Gen. J. Francis Taylor, USAF Director of Command Control Communications, HQ USAF during the Andrews AFB Air Force Data Communications and Automatic Digital Information Network activation ceremony, Feb. 27, 1963.

requisitions annually and required a system that could help in expediting those requests to meet the needs of the Air Force's global mission. While born from a need to meet the service's growing logistics requirements, when AUTODIN was completed and fully implemented, its communications capabilities would see significant growth.

The basic function of AUTODIN was to accept, process, store and deliver digital message traffic to and from subscribers located around the world. Between November 1962 and February 1963, AUTODIN was fielded in five locations across the country and was declared fully operational on Feb. 27, 1963.

The first five sites that fielded the AUTODIN Switching Centers, or ASCs, were Norton AFB, California; McClellan AFB, California; Tinker AFB, Oklahoma; Gentile AFB, Ohio; and Andrews AFB, Maryland.

But the growth did not end there. In fact, this was just the beginning for AUTODIN.

Beginning in October 1967, ASCs were fielded overseas and the first of eleven locations became operational at Clark AB, Philippines. In the months following, more ASCs would be added and accepted. Centers in counties like Thailand and Germany added to the operational capability of this now global network.

Each ASC was designed to operate 24 hours a day, seven days a week, 365 days a year. The centers were maintained at a high state of readiness and no single points of failure could affect the operational capability of the centers. This design ensured the highest degree of reliability, message security and integrity.

While the '50s and '60s saw the achievement of rapid, reliable and efficient narrative and data communications through AUTODIN, the future decades would present an even bigger need for other modes of communications for which AUTODIN was not designed handle.

In 2001, the Defense Message System was fielded in an effort to enable any user within the Department of Defense to exchange both classified and unclassified messages with anyone else in the DoD all while reducing the costs and manpower demands of AUTODIN. ✪

THE MISSION
& my time with
AFCS

By Lawrence "Rock" Verrochi
Air Force Network Integration Center

Capt. Lawrence "Rock" Verrochi in the cockpit of an OV-10, Nakhon Phanom Air Base, Thailand, 1973. *(Courtesy of Mr. Lawrence "Rock" Verrochi)*

Flight inspection of procedures, navigational aids and ground-air communications to ensure flying safety began in the United States in the early 1920s when the airway system was created at the behest of the U.S. Airmail Service.

Prior to World War II, the Civil Aeronautics Administration inspected Army Air Corps navigation systems, but in 1942, this mission was given to the Army Airways Communications System. Between October 1942 and October 1987, AACS and its successor organizations, Air Force Communications Service and Air Force Communications Command, performed this mission for the Air Force.

In 1962, AFCS transferred part of the mission to the Federal Aviation Administration, but the command retained 16 aircraft to perform flight inspection in support of emergency mission support requirements and to continue the service evaluation function.

To manage this mission, the command established three geographic areas of responsibility and three new units, the 1866th, 1867th and the 1868th Facility Checking Squadrons for the U.S., Pacific and European theaters respectively.

The war in Southeast Asia expanded the command's wartime flight inspection mission because FAA policy precluded deployment of FAA crews into hostile areas. Consequently, the command deployed all but one of its flight inspection aircraft to the Pacific. During the course of the war, these aircraft were damaged by enemy fire 26 times.

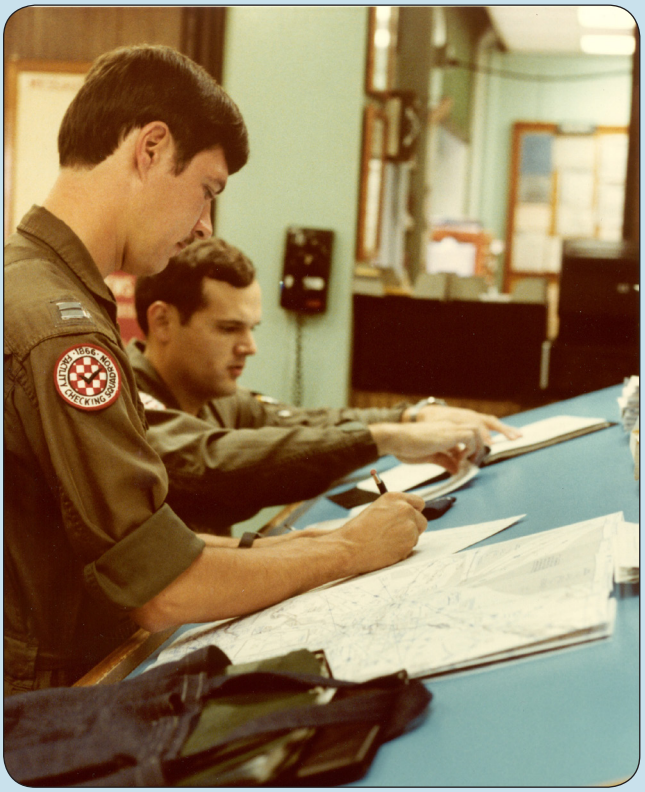
In July 1971, the command assumed all flight check responsibility in the Philippines and all maintenance assistance inspections in the U.S .and Europe from the FAA. The phase down of military operations in Southeast Asia enabled the command to reduce the size of its overseas squadrons.

Upon graduation from pilot training in July 1971, my first assignment in AFCS was in a C-47A with the 1867th FCS at Clark Air Base, Philippines. After the normal

EC-47 serial number 43-48902 known as "Old Patches" pictured in flight. Old Patches was the last C-47 assigned to Air Force Communications Service, being stricken from the rolls in 1972.

Survival Evasion Resistance Escape and Sea Survival training courses, I proceeded to the FAA Flight Inspection certification training, lasting four weeks, and soon after to the Air Traffic Control Officers Course. This was another eight weeks. Arriving at Clark AB in early January 1972, I was quickly immersed in my C-47 aircraft training, Flight Inspection mission and my ATC facility training at the Clark AB Radar Approach Control.

The regular schedule had us in country (i.e. South Vietnam, Thailand, sometimes Laos and Cambodia) every other week performing a multitude of navigational aid inspections and ATC evaluations. When we were at home base, our days were usually occupied with



Capts. Steve Gaertner (background) and Marty Pruden (foreground) from Air Force Communications Service's 1866th Facility Checking Squadron complete their flight planning prior to a flight inspection mission.

Inside view of one of Air Force Communications Command's C-140 "Jet Star" with Chief Master Sgt. Tony Haus working the flight inspection equipment console.

training and a few local missions.

One of my more memorable missions was as a part of the first "all-LT" crew responsible for commissioning a TACAN near Da Nang AB, Vietnam. Flying southwest on a coverage check, we observed several explosions in the jungle a couple miles in front of us. Then we noticed the actual naval artillery shells flying into the target. Recognizing we should not have been in the area, we quickly exited and had a rather heated discussion as to who should have been monitoring the HF radio. Due to the transfer of all C-47 aircraft to our Asian allies, my tour was cut to 10 months, and I became on OV-10 Forward Air Controller.

In 1974, I was again assigned to the AFCS with the 1866th Facility Checking Squadron at Richards-Gebaur AFB, Missouri. At that time, AFCS was an Air Force Major Command headquartered at Richards-Gebaur. At that point, the 1866th FCS had several aircraft types, 1 C-135A , 4 C-130As, 4 C-140As and 2 T-39As performing the Flight Inspection and Air Traffic Control Evaluation missions worldwide.

I was checked out and certified in both the C-135A as a co-pilot and the C-140A as an aircraft commander and flight examiner. In addition, I was honored to be a selected as the mission commander for several high priority programs which included evaluations of classified airfields, Joint Tactical Information Distribution System testing, and various evaluations at locations including Camp David, Soto Cano AB, Sondrestrom AB and Thule AB to name a few. The phase down of military operations in Southeast Asia enabled the command to reduce the size of its overseas operations. Changes to stateside operations continued as well, and starting in 1975, the 1866th divested most its flight inspection aircraft fleet, leaving only four C-140A Jetstar aircraft assigned.

By 1977, the Air Force relocated AFCS from Missouri back to Scott AFB, where the organization has been ever since. We located our fleet of aircraft to Scott and AFCS was redesignated Air Force Communications Command. By 1980, I completed my time with the command transferring to Laughlin AFB, Texas, as a T-38 Talon Instructor Pilot and Flight Commander. Though I left the command, the flight inspection mission would remain with AFCC for another seven years.

On October 1, 1987, the Air Staff transferred AFCC's last six aircraft and the associated flight inspection mission to Military Airlift Command and placed it under the 375th Airlift Wing at Scott AFB. After 45 years, the flight inspection mission would no longer reside in AFCC. For better than half of this time, the flight inspection mission was an integral part of its proud past. In my opinion, flight inspection is the by far the best peacetime flying mission with regards to piloting skills and sense of mission accomplishment.

Performing the required aerial maneuvers at low altitude in the airport traffic area, while simultaneously coordinating airspace separation with air traffic control authorities and other disparate aircraft was both physically and mentally challenging. Doing it right and doing it well ... provided me with some of my greatest moments of job satisfaction and self-actualization. ✪

A1C Mark Williams checks the status of Digital European Backbone remote unmanned sites using transmission monitoring and control equipment, Europe.

ANALOG-TO-DIGITAL
EFFORTS IN THE LATE 70S & 80S

By Gregg E. Noud
Air Force Network Integration Center

During the late 1970s and 80s, three initiatives illustrate Air Force success in leading a change in culture by using the industry to advance technology, reduce cost, and increase speed and quality of implementation.

These were the transition from analog to digital technologies, use of equipment based on commercial standards vs. military standards, and the application of industry-provided engineering and installation capabilities allowing the Air Force to increase focus on warfighting capabilities. These opportunities presented themselves due to the emergence of commercially available hardware and software marketed as commodities.

The Air Force embarked on the journey to convert its telephone systems from analog to digital technology with the goals of improving quality of service, enabling better security and increasing physical media capacity.

During this period, the Defense Communications Agency, today known as the Defense Information Systems Agency, implemented a series of efforts to upgrade theatre communications for the Department of Defense.

DCA chartered the Air Force to take the lead for three programs that illustrate this progression of technology: Digital European Backbone, Japan Reconfiguration and Digitization and the Philippine Digitization Upgrade.

In the late 1970s, the 1842nd Electronics Engineering Group, a subordinate unit to AFCC, provided the lead engineering services for the DEB to convert signals from analog to digi-

tal. The lesson learned from the DEB led to more advancements in the Pacific Theater including Army initiatives in Korea and the U.S. Navy in Guam synchronizing with the JRD and PDU.

The 1842nd EEG partnered with other AFCC units to implement microwave and tropospheric scatter digital radio links, digital telephone switches, as well as underground copper and undersea fiber.

These successful efforts provided connectivity to all U.S. military installations in and around the European Command and Pacific Command regions.

The 1980s also saw Satellite Communication become increasingly important. AFCC, working with Air Force Space Command and the Space Missile Center, provided the engineering and implementation groups responsible for the ground segments of the communication system.

These groups were responsible to ensure the ground terminals and the rest of the segment design met the jam-resistant and High Altitude Electromagnetic Pulse MILSATCOM link requirements around the world. These projects replaced analog radio, multiplexors and voice switches thereby giving the Air Force a distinctive advantage in long distance digital communications.

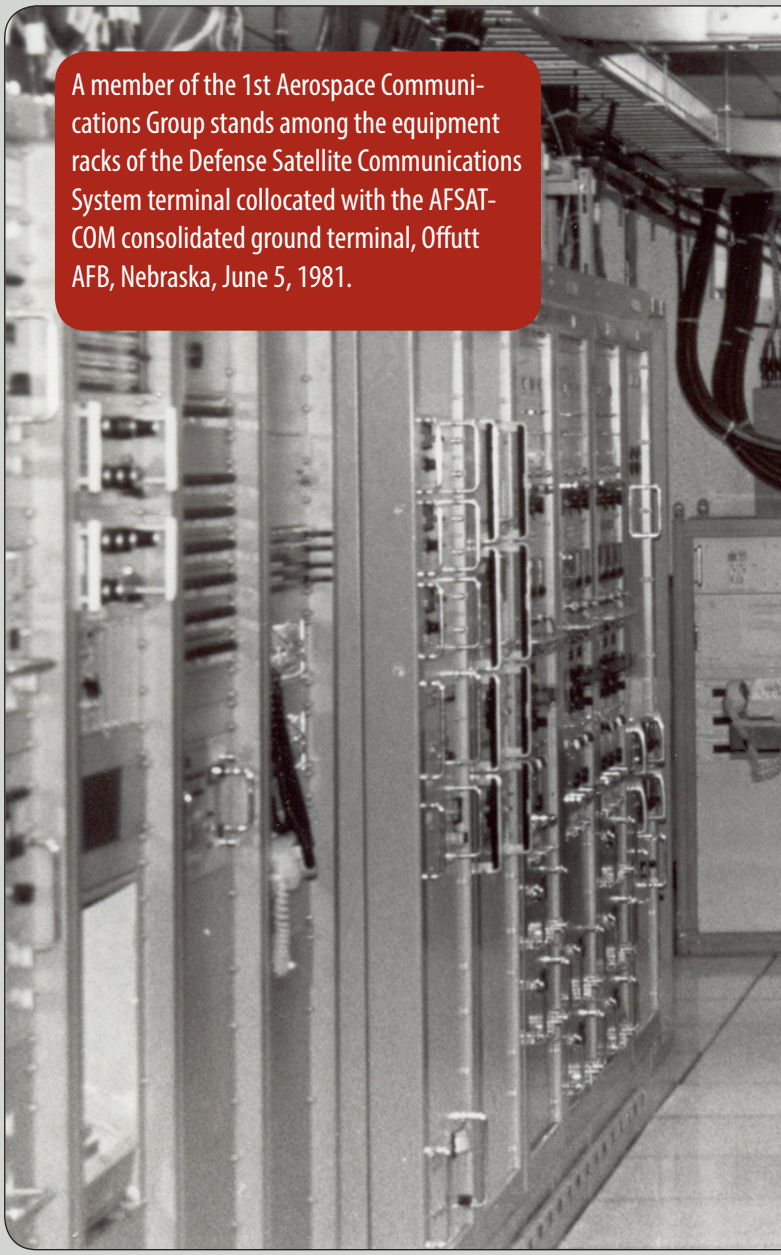
Digital systems proved to be much more reliant and not as sensitive to interference in the radio frequency spectrum. With error correction, bits lost in transmission could be calculated and corrected increasing survivability of the data through adverse radio reception periods caused by anomalies such as electrical interference or changes in the weather. Digital systems also made communications easier to protect in enemy jamming scenarios using capabilities like spread spectrum, frequency hopping and interleaving technologies, hence providing better communications capability for the warfighter.

The newly implemented digital environment offered key advantage for information protection. Encryption was much easier using simple binary math as compared to the complex phase shifting algorithms required for encryption of analog signals. The same binary math could be used to decrypt the data.

Implementation of the PDU project marked the beginning of a new acquisition and implementation procedure. The AF opted to not only utilize the equipment supplied by commercial companies, but

Second Lt. Norman Howard,1842d Electronics Engineering Group, verifies automated procedures on the prototype digital microwave radio system supporting the Japan Reconfiguration and Digitization program, Japan.

Sharnee Riley, 1837th Engineering Installation Squadron, uses an Amphanol "Amp-Champ" crimper to terminate a connector on one of the multitude of 25-pair cables installed at the control site as part of the Scope Signal III installation to modernize Giant Talk, the Strategic Air Command's world-wide command and controls network, Clark AB, Philippines.



A member of the 1st Aerospace Communications Group stands among the equipment racks of the Defense Satellite Communications System terminal collocated with the AFSATCOM consolidated ground terminal, Offutt AFB, Nebraska, June 5, 1981.

also contracted for installation and implementation. This was known as a "turnkey" solution, and in terms of AF evolution, marked the beginning of employing industry to provide the cyberspace domain.

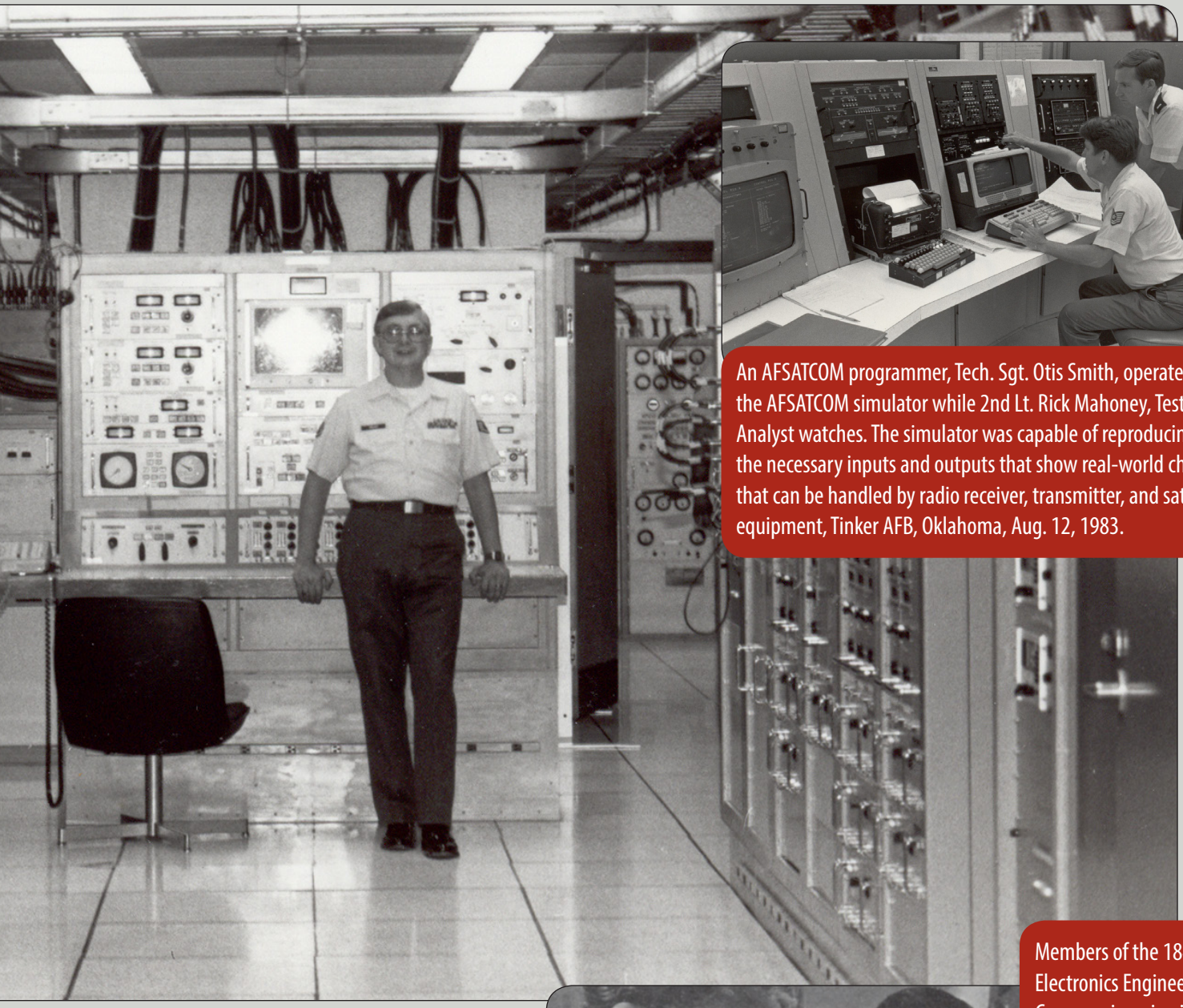
The evolution from DEB, provisioned with Military Standards based equipment, to JRD and PDU provisioned with commercial equipment reflected a first step in conforming to industry standards to meet Air Force communications requirements.

The DEB's Mil-Std equipment required development of special interfaces with the commercial capabilities. With the wide spread use of commercially supplied equipment, the Air Force eliminated the need for special interfaces between the civilian sector and the Air Force environments.

As we continue to evolve, the Air Force is changing its cyberspace strategy to becoming a service consumer instead of a service supplier. Analogous to the operational domains of land, sea, air and space, the goal is to leverage a cyberspace domain provided by industry.

The Air Force has set a long-term goal in its strategy to operate in cyberspace in a similar way.

Today, an integral aspect of this culture change is the adoption of a "cloud com-

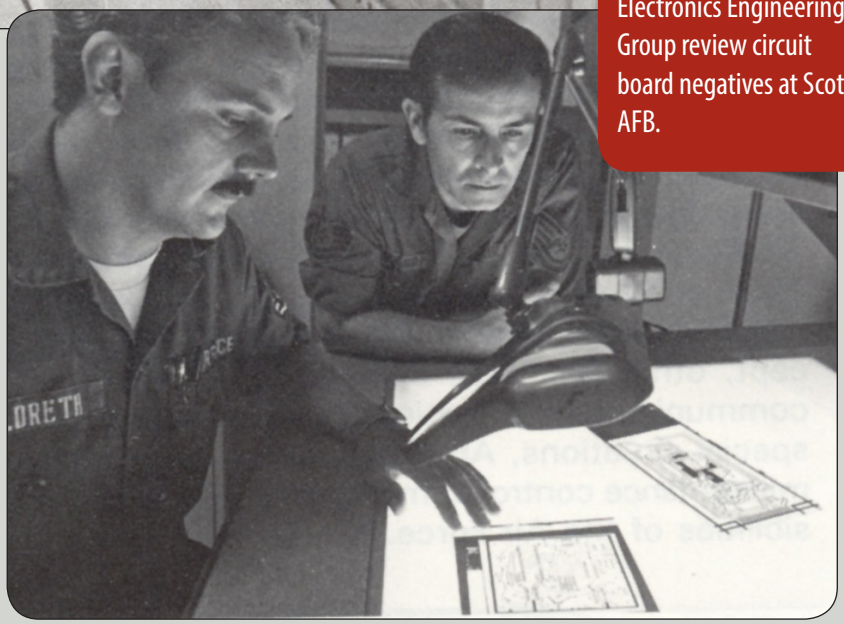


An AFSATCOM programmer, Tech. Sgt. Otis Smith, operates the AFSATCOM simulator while 2nd Lt. Rick Mahoney, Test Analyst watches. The simulator was capable of reproducing the necessary inputs and outputs that show real-world choices that can be handled by radio receiver, transmitter, and satellite equipment, Tinker AFB, Oklahoma, Aug. 12, 1983.

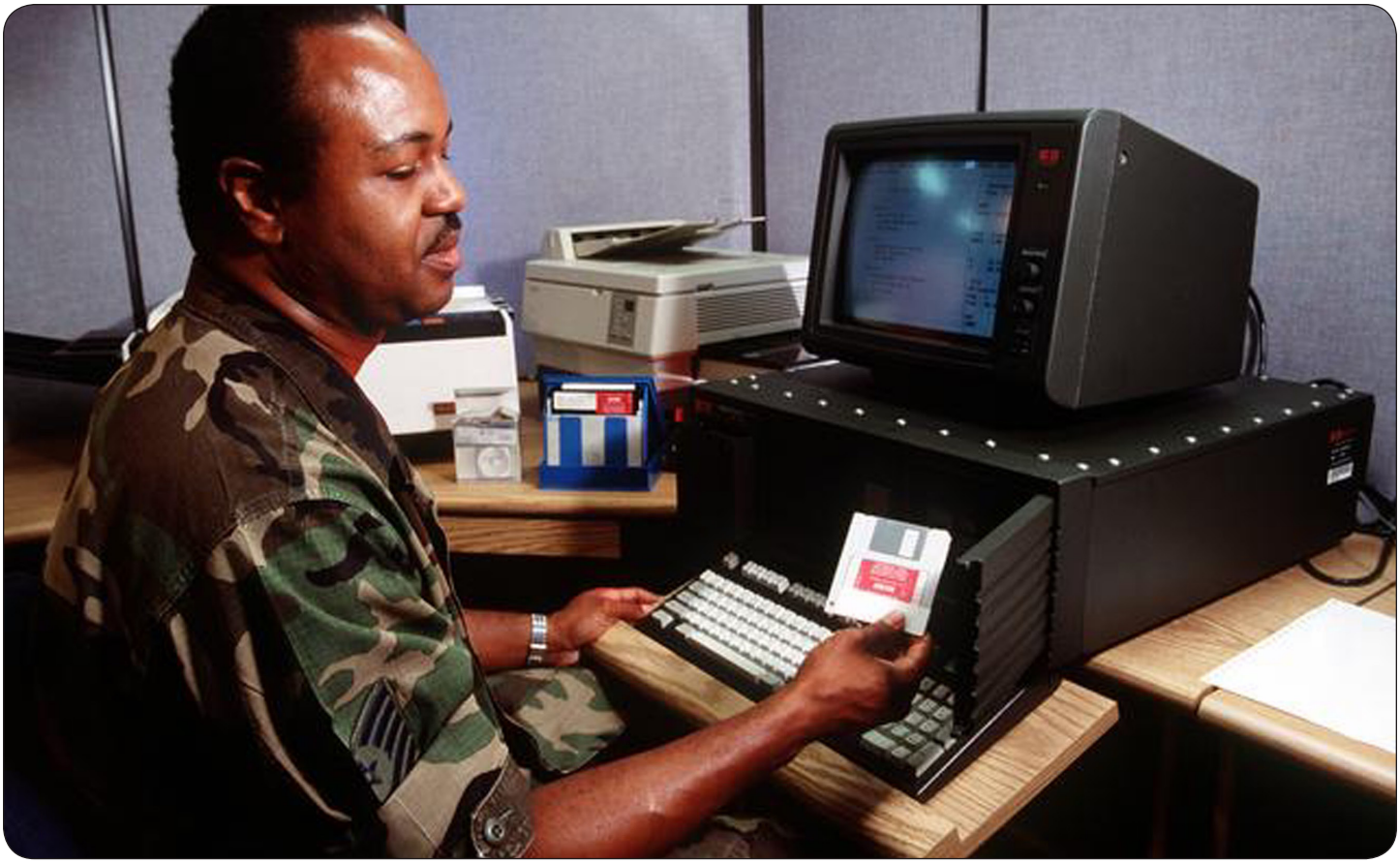
puting" and enterprise information technology "as a service."

This continued evolution will enable a new approach to delivering IT services that promises to be highly agile and operate at potentially lower costs for consumers.

We want to continue to leverage industry to develop, deploy and operate the cyberspace domain, allowing the Air Force to concentrate on building weapon system capabilities that operate in, on and through the domain in support of Air Force core missions. ✪



Members of the 1842nd Electronics Engineering Group review circuit board negatives at Scott AFB.



Master Sgt. Gregory E. Settles uses a UKY-83 desktop computer in the combat communications center to convey information to the United States Central Command Area of Operation from Langley AFB, Virginia, Jan. 8, 1992.

1990s

COMPUTING TECHNOLOGY, ADVANCEMENTS

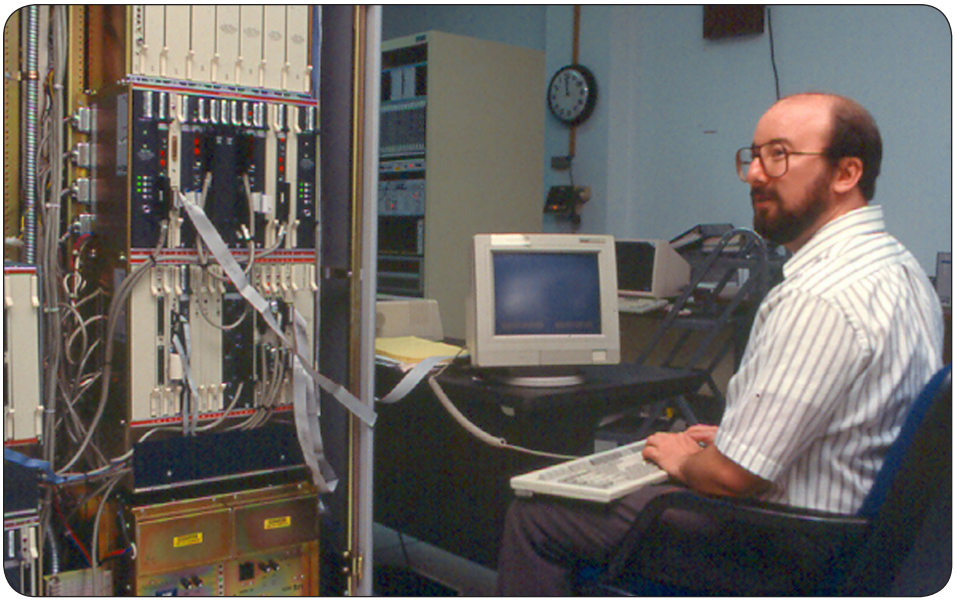
By Thomas P. Korte
Air Force Network Integration Center

Each decade brings its own innovations, but through the wealth of advancements in computing and networking technologies, the 1990s were truly a revolutionary time in the history of the Air Force.

Associated organizational changes also foundationally re-shaped the way the Air Force managed communications and further transformed the military's approach to traditional warfare. The predecessor organizations to today's Air Force Network Integration Center were instrumental in leading many initiatives through this period of change.

At the beginning of this era, a typical office in the Air Force may have had a few first-generation personal computers with 5 ¼ inch floppy disk drives, a monochrome screen and maybe a 20-kilobyte hard drive. Some were connected through a local-area network allowing building-level email, while the introduction of office productivity applications, the graphical user interface, and the computer mouse were on the cutting edge.

Organizationally, the Air Force was also assessing how it managed communications and information services. The newly-redesignated Air Force Communications Command stood up in 1979, emphasized centralized control of Air Force communications services. However,



Bradley Piotrowski, an AFC4A engineer, performs equipment tests in the lab of Bldg. 3190 at Scott AFB, Illinois, Aug. 30, 1993.

Despite frequent restructures of the early 90s, Air Force leaders still valued the need for accountability and responsibility with respect to weapons system management.

in the early 1990s, top leadership valued local flexibility over centralized control. On July 1, 1991, AFCC was once again redesignated, this time to the Air Force Communication Agency and control was delegated to the bases where innovation thrived, albeit at local levels.

From Aug. 2, 1990, to Feb. 28, 1991 the country was engaged in Operation Desert Shield/Storm. When operation Desert Shield began, AFCC was already planning the transfer of its units to the supported major commands; however, the command still provided technical support to U.S. Central Command including communications and computer planning, installing satellite communications and computer terminals, and developing communications support equipment and computer software.

About 100 members of AFCC were deployed to the theater of operations at the end of 1990.

Shortly thereafter in 1991, AFCC personnel formed a new Technology Integration Center under HQ AF/SC, today's equivalent to the Air Force Chief Information Officer.

However, the TIC as an independent unit was short-lived, inactivating in 1992, yet its functions carried on within AFCC headquarters.

The next year, AFCC was redesignated the Air Force Command, Control, Communications, and Computer Agency as a Field Operating Agency under Headquarters Air Force at the Pentagon.

Despite these frequent restructures of the early 90s, Air Force leaders still valued the need for accountability and responsibility with respect to weapons system management.

When more than one command possessed the same type of weapon system, the "Lead Command" concept allowed for a single advocate to ensure all requirements associated with every system receive comprehensive and equitable consideration. Throughout the decade, AFNIC's predecessors gained Lead Command responsibility for several types of command, control, communication, computers, and intelligence systems used both on and outside the base.

Internal systems included telephone switches, electronic messaging, Public Key Infrastructure, and base information transport. External systems included long-haul communications, the Defense Information System Network, Defense Message System, and the Defense Red Switch Network. Major commands were still responsible for the "last 400 feet" including desktop computers and telephones. Overall, the Lead Command concept ensured some top-level communications oversight remained throughout the 90s.

Another key initiative in the first third of the decade were Air Force Major Command Templates. These were long-term strategic studies that assessed MAJCOMs' information pro-

Two AFC4A Hammer ACE team members setting up the LSSC-300 terminal and portable satellite antenna during a training exercise at Scott AFB during the 1990s.

cessing and transmission needs while emphasizing compliance with Air Force communications and computer system architectures.

In total, the TIC and AFC4A published 11 template documents for various MAJCOMs and each one took an average of six months and 11,000 work hours to complete. Templates provided a roadmap for many MAJCOM systems, and the missions they supported for years to come. Closing out the first half of the decade, in 1995 AFC4A opened its new Technology and Interoperability Facility, which still operates today as a pre-fielding proving ground for new capabilities.

AFC4A also provided support to many high profile events. In April 1995, two of its members were dispatched to Oklahoma City less than 24 hours after the bombing of the Alfred B. Murrah Federal Building to restore communications for the local Secret Service office.

This is one example of the critical support the team provided to the nation along with Presidential Inaugurations, Foreign Dignitary visits, the Olympics, and much more that continue today under the 5th Combat Communications Group.

Furthermore AFC4A managed HAMMER ACE (Adaptive Communication Element) deployments to provide communications support for several aircraft crashes; most newsworthy was Secretary of Commerce Ron Brown and 34 others who crashed into mountainside near Dubrovnik, Croatia in 1996. Hammer ACE also provided airborne communications support for Operation KEIKO LIFT, relocating the whale from Oregon to Iceland as captured in the movie Free Willy. Today, Hammer ACE continues its mission under the 5th Combat Communications Group.

More organizational change came in 1996 when AFC4A was renamed the Air Force Communications Agency, working under the Air Force Chief Information Officer. In 1997, AFCA initiated "Scope Network" to create an Air-Force-level emergency response team for base networks.

The Air Staff expanded the concept to include periodic preventive visits for network optimization. Scope Network's mission gave AFCA technical

Viewing one of the 3-D displays during JWID97 execution is Gen. Malchase D. Shalikashvili, Chairman of the Joint Chiefs of Staff and General John J. Sheehan, Supreme Allied Command Atlantic, NATO, 1997. (Photo courtesy of Thomas P. Korte)

notoriety across the Air Force.

Through the late 1990s, AFCA focused on "last-meter" communications, that is, from the system to the user's senses. AFCA partnered with the prestigious David Sarnoff Research Center to investigate stereoscopic 3-D battlespace display technology. This technology, termed the Joint Operations Visualization Environment, used liquid crystal display glasses to provide an "out-of-the-screen" 3D experience using our natural sense of sight.

At the time, AFCA served as the Air Force Executive Agent for Joint Warrior Interoperability Demonstrations, and members demonstrated JOVE to the Chairman of the Joint Chiefs of Staff during JWID '97. The system ultimately achieved its foothold in the Air Force's Human Computer Interface Laboratory and for exercise and war gaming use. The decade ended with the Y2K issue, but AFCA began serving as the Air Force's Y2K Executive Agent in December 1995, and significantly ramped up activity as the year 2000 approached. In addition to executing an Air Force-wide awareness campaign, AFCA created a Certification Checklist, tested software products for compliance, and tracked readiness through an online database. History will recall Y2K as a non-event, but the hard work of AFCA and the greater Air Force were the key to making it so.

...one of the first mentions of "cyber" in the Air Force was 1999 when the AF/SC declared, "We saw real cyberwarfare activity by a designated opponent for the first time in Kosovo."

In the 90s, the Air Force was not yet able to leverage the power of cyberspace as we know it today, but one of the first mentions of "cyber" in the Air Force was 1999 when the AF/SC declared, "We saw real cyberwarfare activity by a designated opponent for the first time in Kosovo."

Communications capabilities and the introduction of cyber warfare have only continued to grow exponentially as time marches on, and the services today's AFNIC provides help assure every member and mission in the Air Force on a daily basis. ✪

The Combined Air and Space Operations Center at Al Udeid Air Base, Qatar, built in 2002 and declared operational in March 2003.

Air Force Command and Control at the start of the new Millennium

Daniel F. Flores
Air Force Network Integration Center

The new millennium began with advances brought about by the technological boom of the 1990s, and the Air Force now faced the challenge of how to maximize operations using these new technologies.

The primary focus was to integrate new technology into command and control, or C2, while the Air and Space Operations Center fulfilled this C2 role for an air campaign.

In September of 2000, then Air Force Chief of Staff Gen. Michael Ryan declared the AOC a weapon system. This article recounts my personal experience as a young Air Force officer from early 2000 to the end of 2002 working with the Air Force Communications Agency to test and integrate these new technologies into the AOC.

In 2000, the Air Force began its third iteration of its C2 exercise, Joint Expeditionary Forces Experiment 2000, or JEFX, designed to exercise new technologies in the AOC, and I was assigned to the IC2S program office, part of the Electronic Systems Center at Hanscom Air Force Base, Massachusetts.

We were charged with JEFX planning and execution while the AFCA provided a new network design for the AOC. This new design departed from the multiple Fiber Distributed Data Interface rings to physically separate network traffic to a new Ethernet design using virtual local area networks to logically separate network traffic.

Another new design for the AOC involved consolidating about 20 unique mid-level servers into three high-end servers. The team spent months designing and implementing these new designs in a simulated harsh environment with the goal of supporting the mission of the AOC.

This austere environment presented a unique challenge, because although these new technologies depended on a clean and stable power infra-

structure, JEFX was rife with simulated outages and electrical fires. Our success implementing these new technologies helped pave the way for the creation of the AOC Program Office and the designation of a new weapons system, the Falconer AOC. Our next challenge was to develop performance baselines for the Falconer.

My work developing baselines began while I was stationed with the 46th Test Squadron at Eglin Air Force Base, Florida. Although, JEFX 2000 successfully demonstrated a new AOC infrastructure design, no fielding had occurred because this new infrastructure had not yet undergone formal operational testing.

The Combined Air Operations Center during Operation Iraqi Freedom, Prince Sultan Air Base, Kingdom of Saudi Arabia, March 30, 2003. (Photo by Master Sgt. Michael E. Best)

AFCA and the 46th TS teamed to monitor and collect system performance metrics. Our new challenge dealt with relating these metrics to the AOC mission of planning and executing the Air Tasking Order. This required the engineering test team to obtain a basic understanding of the ATO planning and execution cycles. AFCA and the 46th TS efforts produced an initial performance baseline for planning and executing a 1,500 mission/3,000 sortie ATO.

Relating these network metrics to the ATO cycle proved to be a greater challenge. While the AFCA-provided network monitoring tool, Sniffer, was excellent for packet analysis and troubleshooting, it was less effective with correlating network traffic.

It was essential to link the AOC applications to the ATO cycle, and we needed to identify the ports and protocols of each application so the network monitoring tool could categorize network traffic.

Back then, documenting ports and protocols was not very common so we worked with the developer, Lockheed Martin, to accomplish this task. This provided us enough information to develop a network performance baseline that met AOC operational requirements.

AFCA provided engineering support for the first operational fielding of the new Falconer AOC network design (Ethernet vs FDDI) during Operation Desert Shift.

Operation Desert Shift involved relocating the Central Air Forces Coalition AOC from Eskan Village in Riyadh, Saudi Arabia, to Prince Sultan Air Base, Saudi Arabia.

Unfortunately, due to missing training requirements, the new server design was not part of the fielding plan. I was sent to PSAB as part of the 46th TS team responsible for the independent verification and validation.

Partnering with 9th Air Force and the Electronic Systems Center, AFCA provided in-theater engineering support from late 2000 to mid-2001. Their successful efforts led to the first operational

Their successful efforts led to the first operational Falconer CAOC which began planning and executing missions supporting Operations Northern and Southern Watch. This all soon changed on Sept. 11, 2001, when the CAOC we built began planning the Operation Enduring Freedom air campaign.

Col. Rob Kyrouac (center), 607th Air and Space Operations Center chief of combat operations division, leads members on the "pit floor" of the Korean Air Operations Center during Exercise Key Resolve. Osan Air Base, Republic of Korea, March 5, 2008. (Photo by Staff Sgt. Lakisha Croley)

Falconer CAOC which began planning and executing missions supporting Operations Northern and Southern Watch. This all soon changed on Sept. 11, 2001, when the CAOC we built began planning the Operation Enduring Freedom air campaign.

Fresh off the success of the PSAB CAOC, CENTAF developed plans for an alternate CAOC to be located at Al Udeid Air Base, Qatar, and I once again deployed as the lead test engineer. Although built by the same organizations, there were some key differences in each CAOC.

First, unlike the PSAB CAOC, the AUAB CAOC would incorporate both the network and server design.

Another key difference from the two CAOCs was while the PSAB CAOC building was designed and built from the ground up, the AUAB CAOC was a converted warehouse.

The architecture closely resembled what we implemented during JEFX. Conex containers were retrofitted to support the AOC systems and were designed to connect together.

AFCA engineers supported the network build in the containers at Shaw Air Force Base, South Carolina, and then supported their setup in-theater.

The lessons learned during JEFX proved more valuable to the AUAB CAOC build than the PSAB CAOC build because we were adapting existing buildings to meet our requirements.

One unique challenge faced was maintaining data replication between PSAB and AUAB. AFCA assisted with the design and implementation of the network infrastructure between the two sites. Because of the capabilities of the AUAB CAOC, we knew our implemented design was not intended as an alternate site, and in March 2003, the AUAB CAOC began planning and executing the Operation Iraqi Freedom air campaign.

By 2010, I was stationed with the 607th AOC at Osan Air Base, South Korea, when I visited the experimental CAOC at Langley Air Force Base, Virginia.

I was pleased to learn that AFCA was still supporting the AOC. The new millennium presented us with new opportunities to improve C2 for the AOC and AFCA was a key player in integrating operations with new technologies. ✪

Capt. Jason Simmons and Staff Sgt. Clinton Tips update anti-virus software for Air Force units to assist in the prevention of cyberspace hackers July 12, 2007 at Barksdale Air Force Base, La. The Air Force had planned to set up an Air Force Cyberspace Command, but that was later changed. (Photo by Tech. Sgt. Cecilio Ricardo)

BACK TO THE FUTURE ... KIND OF

Markus Rogers
Air Force Network Integration Center

The 1990s and early 2000s saw the de-centralization of communications with the stand down of Air Force Communications Command as a major command and the responsibility for communications and networking realigning to local bases.

While this allowed individual MAJCOMs and local bases the leeway to acquire and implement technology to best meet their mission needs, it resulted in a patchwork of systems and networks with differing standards, operating processes and defensive postures.

However, by the mid-2000s we saw the Air Force look toward centralizing some of these functions as the importance of cyber was recognized.

On Dec. 7, 2005, then Secretary of the Air Force Michael W. Wynne and Chief Of Staff Gen. T. Michael Moseley unveiled a new mission statement for the U.S. Air Force. "The mission of the United States Air Force is to deliver sovereign options for the defense of the United States of America and its global interests — to fly and fight in air, space and cyberspace."

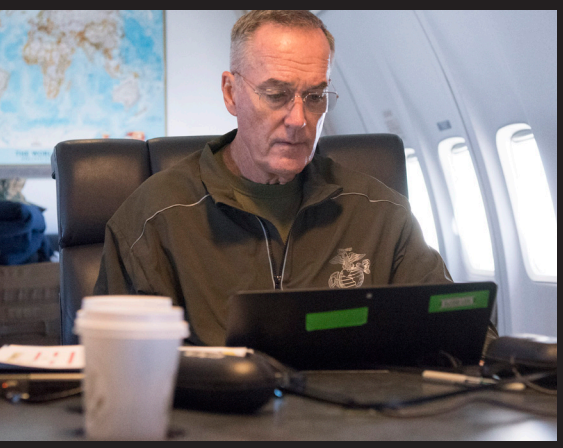
The unprecedented addition of cyberspace as an operational domain highlighted the increasing importance of cyber operations in the U.S. Air Force.

In July 2006, the Air Force Network Operations Command stood up, putting all Air Force

units charged with network operations under the authority of a single commander, Lt. Gen. Robert J. Elder Jr, 8th Air Force and AFNETOPS commander.

"The biggest benefit of standing up a command structure for Air Force Network Operations is that it unifies command of the Air Force computer network under one person, who serves as the Air Force component commander, and presents network operations forces to STRATCOM's Joint Task Force-Global Network Operations. Previously, we had commands focused on air and space forces, but no command focused on operations in cyberspace. That's what we're going to provide here."

Five months later, in further recognition of the importance of cyberspace as a warfighting domain, the Chief of Staff of the Air Force directed the 8th AF commander to create a new MAJCOM, Air Force Cyberspace Command, to "redefine air power by extending our global power into a new domain — the domain of electronics and the electromagnetic spectrum." On Sept. 18, 2007, HQ AF Cyber Command (Provisional) was activated, with Maj. Gen. William T. Lord taking command.



Marine Corps Gen. Joseph F. Dunford Jr., former Chairman of the Joint Chiefs of Staff, works in his cabin aboard a C-32 aircraft after departing Fort Greeley, Alaska, Aug. 19, 2017. (Photo by Navy Petty Officer 1st Class Dominique A. Pineiro)

AFCA personnel quickly became deeply involved in establishing the new command, providing 55 percent of the headquarters staff. In order to meet Lord's strategic vision, AFCA's Cyber Force Strategies division played a major role in establishing 17 new career fields and associated training and force development programs.

Then, the Air Force needed to focus on reinvigorating the nuclear enterprise, which paused the establishment of Air Force Cyber Command, ultimately deciding to establish a numbered Air Force for cyber instead.

In May 2009, the Air Force designated Air Force Space Command as the lead Air Force major command for cyberspace.

"The integration of these domains allows our service to capitalize on inherent synergies found in space and cyberspace architectures, processes, skill sets and training," said Gen C. Robert Kehler, AFSPC commander.

As part of this transition, AFCA would see a change in its mission responsibilities.

The organization would become the focal point for shaping, provisioning, sustaining and integrating the enterprise network, and enabling assured core cyberspace capabilities to achieve a warfighting advantage. This drove AFCA's redesignation as the Air Force Network Integration Center, and realigned AFNIC under AFSPC.

In August 2009, the 24th Air Force stood up under AFSPC to plan and conduct cyberspace operations in support of the nation's combatant commands and maintain and defend the Air Force Enterprise Network.

"For the first time in the history of the Air Force, we have consolidated cyber capabilities under an operational war fighter solely devoted to cyber operations," said Maj. Gen. Richard E. Webber, the first 24th AF commander, during the activation ceremony.

To simplify the operations and defense of the network for 24th AF, AFNIC executed the largest cyber network overhaul in Air Force history. The AFNET migration, a five year effort which began in 2009, collapsed the 13 MAJCOM networks on NIPR into a single, integrated network. It created a centrally managed, standardized structure under the operational control of the 24th Air Force commander. This $162 million effort migrated over 644,000 user accounts, integrated 275 bases and geographically separated units, and decommissioned 11,318 servers.

Until now, organizations across the Air Force have been operating what were essentially their own independent networks, consequently driving unique and unit specific requirements. The AFNET migration meant enterprise-class situational awareness, network scalability and an ability to command and control our network.

Along with the AFNET Migration, AFNIC was also engaged to provide education, training, crew certification, exercise and mission rehearsal capabilities to

cyber operators. AFNIC developed and deployed the Simulated Training Exercise range, a simulator that provided essential Computer Network Operations experience to improve Air Force and Joint Cyberspace Operations. SIMTEX simulated adversary network capability at the AETC schoolhouses and operational locations providing a full spectrum of computer network defense, exploitation and attack training. In 2011, AFNIC hosted the first "Cyber Nexus" competition, a force-on-force cyberspace operations competition which leveraged the SIMTEX range.

During this timeframe, AFNIC was also responsible for engineering and maintaining the ground entry points for the Executive Airlift Communications Network, which provides communications support to U.S. senior leaders giving them the ability to access multiple classification levels of voice, video and data services from select platforms while in flight.

AFNIC used the Airborne Laboratory Environment (Scope ABLE), a reconfigured DC-9 fuselage, for testing and advancing airborne networking and communications systems prior to flight testing and incorporation into EACN. New components or systems that proved promising for airborne networking were integrated into the equipment suite on Scope ABLE for a detailed aircraft ground assessment prior to flight tests. This significantly reduced the amount of testing that had to occur during flight, saving the Air Force thousands of dollars per hour in avoided flight costs.

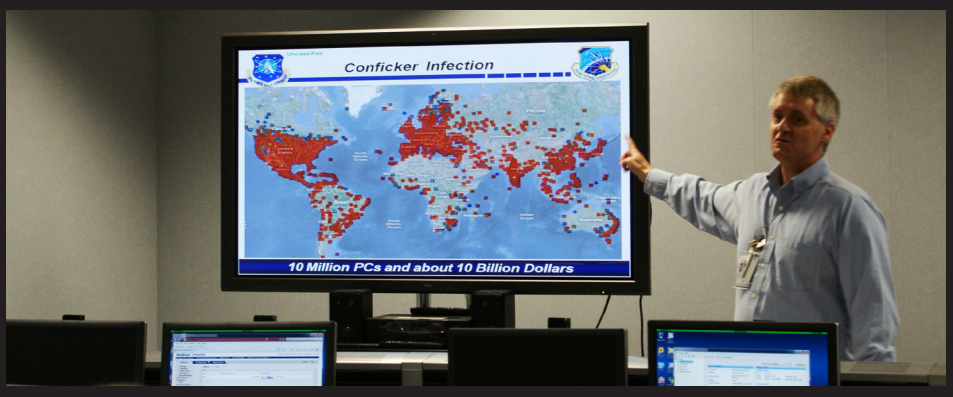
In 2011, as AFPSC was maturing its cyberspace capabilities, they conducted an organizational study on AFNIC. AFNIC didn't organizationally change when it transitioned from SAF to AFSPC, but at this time it became apparent that there was some duplication and mis-alignment with other cyber functions in AFSPC. As a result of this study, missions formerly assigned to AFNIC became a part of two new Air Force units.

The AFSPC Cyberspace Support Squadron, would provide the MAJCOM with the cyber expertise required to manage cyberspace-lead programs and activities. The 38th Cyberspace Readiness Squadron focused on delivering long-haul communications services and cyber systems management for the Air Force and joint warfighter. This left AFNIC to concentrate on its mission to be a technical center of excellence for AFNET integration, support HQ AFSPC in its role as the AF's lead command for cyber, and continue to execute network engineering integration responsibilities.

Gen. William L. Shelton meets members of AFNIC's migration project management team March 31, 2014, during his visit at Scott Air Force Base, Ill. (Photo by Shelly Petruska)

In July 2018, the AF realigned cyber responsibilities from AFSPC to Air Combat Command.

"Air Force cyber capabilities are intertwined with the intelligence, command and control, air superiority, personnel recovery, and precision attack missions that we are responsible for," said Gen. Mike Holmes, the commander of ACC. "This move streamlines how the Air Force presents forces to joint commanders, and it improves our ability to integrate cyber and air operations to improve our effectiveness in multiple domains." ✪



Tom May briefs a group about how the Simulator Training Exercise helps prepare Air Force's cyber warriors to respond to devastating cyber threats in AFNIC's Technology and Interoperability Facility August 3, 2011 at Scott. (Photo by Travis Nuckolls)

AFNIC COMMANDERS

Col. Lloyd H. Watnee
27 Mar 1943 – 11 Nov 1943
Brig. Gen. Ivan L. Farman
12 Nov 1943 – 23 Apr 1946
Maj. Gen. Harold M. McClelland
24 Apr 1946 - 9 Sep 1948
Brig. Gen. Wallace G. Smith
10 Sep 1948 - 27 Sep 1951
Maj. Gen. E. Blair Garland
28 Sep 1951 – 31 Aug 1954
Maj. Gen. Francis L. Ankenbrandt
1 Sep 1954 – 29 Jul 1955
Maj. Gen. Dudley D. Hale
29 Jul 1955 – 14 Jan 1958
Maj. Gen. Daniel C. Doubleday
14 Jan 1958 – 1 Jul 1961
Maj. Gen. Harold W. Grant***
1 Jul 1961 - 16 Feb 1962
Maj. Gen. Kenneth P. Bergquist
16 Feb 1962 – 1 Jul 1965
Maj. Gen. J. Francis Taylor, Jr.
1 Jul 1965 - 19 Oct 1965
Maj. Gen. Richard P. Klocko***
19 Oct 1965 - 15 Jul 1967
Maj. Gen. Robert W. Paulson
15 Jul 1967 - 31 Jul 1969
Maj. Gen. Paul R. Stoney
31 Jul 1969 – 31 Oct 1973

Maj. Gen. Donald L. Werbeck
1 Nov 1973 - 21 Aug 1975
Maj. Gen. Rupert H. Burris
22 Aug 1975 - 31 Oct 1977
Maj. Gen. Robert E. Sadler
31 Oct 1977 - 21 Jun 1979
Maj. Gen. Robert T. Herres***
21 Jun 1979 - 27 Jul 1981
Maj. Gen. Robert F. McCarthy
27 Jul 1981 - 31 May 1984
Maj. Gen. Gerald L. Prather
1 Jun 1984 - 28 Aug 1986
Maj. Gen. John T. Stihl
28 Aug 1986 – 29 Mar 1988
Maj. Gen. James S. Cassity, Jr.***
29 Mar 1988 - 16 May 1989
Maj. Gen. Robert H. Ludwig***
16 May 1989 - 9 Nov 1990
Maj. Gen. John S. Fairfield***
9 Nov 1990 – 21 May 1993
Col. George P. Lampe **
21 May 1993 – 1 Jul 1993
Col. Harry D. Raduege, Jr.***
1 Jul 1993 - 18 Jul 1995
Col. Patrick M. Ryan
18 Jul 1995 – 4 Apr 1997
Col. Gilbert R. Hawk*
4 Apr 1997 – 18 Jul 2000
Col. Thomas J. Verbeck*
18 Jul 2000 – 25 Apr 2002

Col. Jay R. Adsit
25 Apr 2002 – 3 Jun 2002
Col. David J. Kovach
3 Jun 2002 – 16 May 2005
Col. Robert J. Steele
16 May 2005 – 5 Jun 2007
Col. Carl Williamson
5 Jun 2007 – 15 Jul 2009
Col. John M. Odey
15 Jul 2009 – 26 Jan 2011
Col. Curtis O. Piontkowsky
26 Jan 2011 – 3 Aug 2011
Col. A. Rizwan Ali
3 Aug 2011 – 26 Jun 2013
Col. Amy V. Arwood
26 Jun 2013 – 1 Jul 2015
Col. John J. Dunks
1 Jul 2015 – 5 Dec 2016
Col. Douglas S. Dudley
2 Feb 2017 - Present

Later promoted to:
** Brigadier Gen*
*** Major General*
**** Lieutenant General*
***** General*