DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
# AIR TRAFFIC BULLETIN
SOUTHWEST REGION

Ramon A Alvarez
CHIEF, AIR TRAFFIC DIVISION

ISSUANCE 80-4

SPECIAL AIR TRAFFIC BULLETIN

EN ROUTE

AUTOMATION PROGRAM UPDATE

HISTORY AND BACKGROUND

The Federal Government first became involved in civilian air traffic control in 1936 when the Bureau of Air Commerce took over the airway traffic control centers at Newark, Chicago, and Cleveland. These centers had been established and operated by private airline companies, such as American Airlines, etc. The air traffic control system of that era can best be described as very basic and crude; for that matter, until the end of World War II, the civilian air traffic control system consisted solely of radio communications between pilots and controllers, with controllers noting on paper strips (flight strips) the latest time and altitude data for aircraft. For several years, these communications were relayed to the pilot through flight service stations or air carrier companies. The controller's basic function was to remain aware of the information contained on the flight strips to assure that no two aircraft were at the same altitude/place at the same time. This very basic system of manual control is considered today as the first generation of air traffic control. Today this system of control is the first one taught to our developmental controllers. These basic manual separation standards are used frequently at locations outside of and below our radar coverage; i.e., Brownwood, Texas; Paris, Texas, etc.

In the mid-1950's, the long-range radar for en route air traffic control was added to the system, with installations at the New York, Chicago, and Norfolk Centers. This equipment, provided to the Civil Aeronautics Administration by the military (ADC sites), had a number of limitations and some were replaced by more sophisticated ARSR-1 radars beginning in 1958. Positive air traffic control was initiated for the first time in 1958,

Distribution: A-X (AT)-3; A-FAT-0 (Max.); AAC-930 (10 cys); Ea. Regional Air Traffic Division; ASW 1; ASW-2; ASW-4; ASW-5; ASW-8 (1 cy each); A-FFS-1/7 (1 cy); ASW-252 (3 cys)

Initiated by: ASW-540

with selected positive control airways running primarily between the east and west coasts, with some supplemental and interconnected routes at altitudes of 17,000 and 22,000 feet inclusive.

The first computers in the system were Univac file computers commissioned for use at the New York and Washington Centers in 1959. These general purpose electronic computers were designed for use in preparing flight progress strips and in assisting controllers with bookkeeping tasks.

In late 1960, our nation's long-range radar network consisted of only 40 locations; this number has progressed to more than 100. In that same time frame, secondary radar, which receives target information from beacons, was introduced into the system, providing improved target identification.

The advent of jets in the late 1950s and increasing traffic prompted a hard look at that second generation of air traffic control which employed broadband radar. In 1961, Project Beacon recommended that the Federal Aviation Agency make a broad-gauged use of automation in air traffic control. That report formed the catalyst for the development of today's automated system. After an intensive research and development effort, FAA had completed, by 1966, field appraisals of two prototype automated air traffic control systems--one for en route use and one for terminal use. By the end of 1970, limited capability automated terminal systems had been installed at Atlanta and New York; the computer component of the en route automated system was installed at the majority of centers in the contiguous United States; and a complete en route system, which was not operational, was installed in the Jacksonville Center.

Between March of 1974 and August 1975, full flight data and radar data processing systems were commissioned at all 20 centers in the contiguous United States. In contrast with the broadband system which provides two-dimensional data (range and bearing) requiring voice communications to obtain altitude data and the use of shrimp boats for tagging and tracking targets; today's system has many automated features resulting in more efficient use of a controller's time, and with its computer capabilities, has enabled us to progressively add additional safety functions such as conflict alert. All along the way, we have continued to expand the capability and coverage of our radar, to improve the antennas used in the system, to refine our air traffic control procedures, and to develop feasible collision avoidance devices--all with the intent of improving the safety of our air transportation system.

As is readily apparent, the air traffic control system has evolved significantly since its inception, with many of the significant strides forward having occurred in the very recent past.

## COMPUTER AVAILABILITY/RELIABILITY

Our air traffic control system is the best, safest, and most efficient in the world. But at the same time, because of its complexity, we experience and will continue to experience system interruptions.

We are doing all we can to aggressively seek out the causes of system interruptions and to cure them. In recognition of the fact, however, that system interruptions will occur, we continue working to assure that the high level of controller skill and training is maintained in order to safely deal with any unexpected difficulty in a professional manner.

The computer system used today is called a TRIPLEX because it consists of three completely reconfigurable systems. Two of these systems are required to operate the NAS operational program, while the third system is maintained in a standby mode. When a system configured in the operational system malfunctions, that element is automatically replaced by a standby element. The software (program) developed and used for this integrated system comprises the most complicated "real time" system in the world.

Though the reliability of the electronic devices is very high, they can and do fail. The same applies to the physical connectors used for cables and printer circuit boards. Modifications to the software program are thoroughly tested before implementation, but situations can arise which are not contemplated, resulting in a program software abort. The cause of the abort is then investigated and a solution coded. I think it is also significant to note that the computers in a typical center receive, analyze, and process 180,000,000 bits of data each hour from the radars alone.

During 1978, our three centers' computers were available and operationally reliable more than 99 percent for the scheduled periods of operational use. In 1979, that operational reliability increased about one-tenth of one percent for the scheduled periods of operational use.

## SYSTEM IMPROVEMENT PROJECT (SIP) GROUP

In late 1978, rising concern over 9020 system capacity prompted the formation of a group of field automation specialists to investigate the causes of capacity problems and make recommendations for their solution. This group was composed of one Data Systems Specialist from each of the three possible equipment configurations in use in the field. The task was named the System Improvement Project. The group met for the first time on January 22, 1979, and completed the project on June 22, 1979.

The project focused primarily on the NAS Stage A software; however, hardware and procedural options were also investigated. The recommendations were divided into two categories; Lockouts and Efficient Resource Utilizaton.

There are 10 lockout, 29 efficient resource utilization, and 7 hardware recommendations. Most of them will not be directly visible to you as a controller; however, the improvements will provide you with a better and more efficient system. Detailed discussion is available from your data systems staff through your FATTAC committee and should be requested, if interested. The recommendations are scheduled for implementation in the next three systems; i.e., A3D2.10 (April-May 1980), A3D2.11 (October-November 1980), A3D2.12 (April-May 1981).

## UP AND COMING IMPROVEMENTS BOTH HARDWARE AND SOFTWARE

### En Route Minimum Safe Altitude Warning System (E-MSAW)

The E-MSAW system, currently in the A3D2.9 operational program, is still being tested at Albuquerque Center. E-MSAW is scheduled to receive additional testing at Cleveland Center this month (March 1980). The data being analyzed will be the basis for recommendations to headquarters, which will lead to national implementation.

### Houston 9020A Capacity (CPU Load)

In October 1979, ASW-550 briefed AAT-500 and the other region automation chiefs on additional 9020A interfaces. The intent of the briefing was to show that there should be a "step-up" in the process; i.e., provide the means which would allow the 9020A (and even the 9020D) to continue being efficient and effective to our requirements until the replacement system is a reality.

We are currently gathering data at several centers, primarily graphing CPU and track data. This statistical approach will provide the most valid means for intelligent recommendations and solutions to the problems we face.

We anticipate these recommendations will be forwarded to headquarters sometime late this summer (1980).

### Metering

The present method of providing controllers with data for metering arrival traffic is accomplished manually. Calculations at the common reference point, the estimated time of arrival (ETA) at the airport, must be calculated manually. Control times for aircraft to depart or cross outer and/or metering fixes are verbally relayed from the metering position to the arrival sector. The manual process in this area is cumbersome, time-consuming, less than timely, has a lack of a fine degree of accuracy, and can result in inequitable distribution of ATC imposed delays caused by demands beyond the acceptance rate for aircraft arriving at the airport. New control techniques for arrival metering require automated assistance for the controller to insure that aircraft will cross metering fixes at precise times.

Therefore, metering software automating the above items has been developed and is in the process of being "handed-off" to AAT-500 for implementation into the A3D2.11 NAS system due in the field in the spring of 1981.

This contribution by the Air Traffic Service toward fuel economy and energy conservation is significant to our industry.

Direct Access Radar Channel (DARC)

The DARC system which will replace the broadband system is currently being installed at all of the en route centers around the country. The DARC software is currently undergoing an operational evaluation at the Salt Lake City ARTCC, which began March 7, 1980, and will last 60 days.

There have been major operational problems identified in the DARC system, and they will be looked at closely during this evaluation. These operational problems are:

a. There are no altitude amendments sent from NAS to DARC if an altitude amendment is entered into the NAS system.

b. DARC has no capability to automatically assign discrete beacon codes per the National Beacon Code Allocation Plan.

c. DARC does not automatically delete the full data block information from the system when no longer necessary for control purposes.

d. DARC allows full data blocks on discrete beacon replys only; which would cause a mixed control environment with shrimp boats for nondiscrete and primary targets.

The operational problems defined are serious to us and we intend to receive resolution prior to operational implementation. Therefore, we are currently coordinating with the Airway Facilities Service to correct them. This review and operational evaluation will provide us with input that will guide the implementation dates of the DARC system.

Direct Access Beacon System (DABS)

The DABS system is a high performance radar surveillance system designed to handle the projected 200 percent growth in U.S. air traffic over the next 20 years.

At the heart of the DABS is a new aircraft transponder that will have the same individual discrete code for as long as it is installed in a specific airplane. Like the present air traffic control radar system, DABS will pinpoint an aircraft in space, elicit its identity, and provide general monitoring service. Because of its discrete transponder code feature and sequencing capabilty, however, DABS will elicit individual aircraft responses when it interrogates aircraft within its coverage area. It will not be saturated by garbled replies as sometimes happens with the present ATC system, when closely spaced transponder-equipped aircraft in the radars line-of-sight reply simultaneously.

Another unique and important feature of DABS is its digital data-link capability. This can be used to transmit automatically all sorts of information such as weather and wind shear advisories to a cockpit display. The types of information that could best be transmitted over this DABS data-link is currently under study. Considered one of the leading contenders at this time is collision advisory and resolution information that would be transmitted automatically.

Moreover, DABS is designed to be completely compatible with the present air traffic control radar beacon system (ATCRBS). This will make possible a gradual, minimum cost, transition from ATCRBS to DABS over an extended period of time.

DABS testing is progressing quite satisfactorily at this writing. There is a snag in the system and that is the replies that are elicited from individual aircraft beyond 60 miles have proved to be unsatisfactory. Design changes are being provided that will resolve this problem.

We look forward to the DABS system, knowing it will make our job easier in providing a quality service.

<u>En Route Tabular System (ETABS)</u>

The prototype ETABS system has been delivered to NAFEC. It will replace the flight strip printers and the computer readout devices currently in the center. An operational evaluation by radar and manual controllers will be conducted either this fall 1980 or next spring 1981. From that evaluation, changes will occur that will make ETABS totally compatible to the air traffic controllers' needs. Shortly thereafter within a 2- or 3-year time period, the ETABS system should become operational in the en route facilities.

There is a possibility that would not happen; i.e., contract slippage based on design requirements. If this is the case, the ETABS system would probably be associated with the implementation of the 9020 replacement system; which leads us to our next subject.

Replace the IBM 9020 Computer

This project is currently under way and the study is extensive. Plans call for the replacement system to be operational sometime between 1987 and 1992. Some questions under consideration concerning the replacement system we know you will find interesting are: Should we replace the 9020 and use the same buildings by adding another wing? Should we build new buildings? These are serious considerations as we must remember that the ongoing system provides us with a service now and cannot be interrupted for the installation of a new system. Who can provide the FAA (what company) with the hardware and software needed for quality service and enhancements for the next 15 or 20 years? Many companies are interested. The decision must be sound and cannot be hurried; we will have to "live" with it. What steps do we take, once the above questions are answered, to implement the most complex "real time" systems in the world? It is easy to see, if the 9020 replacement project were accomplished in a hurried manner, it would cause an impact to the Air Traffic System we would not want to happen.

ASW-550