AIRPORT AND TERMINAL-AREA OPERATIONS: AIR TRAFFIC CONTROL PERSPECTIVE

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I have been asked to talk you today about terminal air traffic control.

The letter I received from Dave Sheftel back in August suggested that I might want to cover four specific areas. These are: the effects of increasing traffic on the controller; current and future requirements of airport and terminal area operations from a controller's perspective; and any ideas we might have on enhancing controller productivity, also automating specific functions of the controller. I'll address each area in my talk.

First, I would like to trace the terminal system's evolution before describing today's system. I will conclude my talk with some of our concerns regarding the research into, and the development of the future system.

TODAY'S TERMINAL ATC SYSTEM

The terminal ATC system began during the late 1920's when some municipal governments began to provide limited air traffic control at airports by using light signals, or light guns as they are called today. In late 1930, the city of Cleveland became the first to use radio communication to control airport traffic. Airport traffic control towers continued to be operated by the local agency having jurisdiction over the airport until November 1, 1941, when the Civil Aeronautics Administration began operating towers for the first time.

Today, terminal facilities are usually characterized by function, that is by levels of air traffic control responsibility. VFR Towers provide for the sequencing of aircraft in the traffic pattern and the separation of aircraft on the airport surface.

They also separate aircraft operating under instrument flight rules (IFR) by visual observation and relay IFR clearances from approach control facilities and centers.

NONRADAR APPROACH CONTROL TOWERS have the same base level responsibility as a VFR Tower, with the addition of approach control responsibilities. The approach controller is responsible for the separation of aircraft operating under IFR within the confines of airspace delegated to the facility. This is accomplished by the assignment various routes, altitudes, and time restrictions to the aircraft under his/her/control.

RADAR APPROACH CONTROL TOWERS consist of a tower cab of basically the same configuration as a VFR tower and a terminal radar approach control (TRACON), which is the room housing the radar approach control operation. These facilities are established in terminal areas with high traffic densities where the addition of the airport surveillance radar (ASR) can expedite the flow of traffic by reducing separation minima. Radar information is enhanced by the addition of alphanumeric data provided by an automated radar terminal system (ARTS).

A few radar approach control towers are TERMINAL RADAR APPROACH CONTROLS (TRACAB's); that is, the radar approach control function is performed from the tower cab using brite radar indicator terminal equipment (Brite) displays rather than from a separate room.

TRACON's consist of a combination of four types of operational positions; radar positions, handoff positions, data positions, and coordinator positions.

Radar facilities, in addition to separating IFR aircraft, often provide sequencing and separation to VFR aircraft as well.

RADAR APPROACH controls (RAPCONS), also termed radar air traffic control facility (RATCF) and TRACON, are facilities providing radar services without an associated tower. Though usually located on an airport, the tower is a separate facility from the approach control, both physically and administratively. Some radar approach controls are operated by the Department of Defense. These facilities serve both civilian and military traffic in the same manner as FAA operated facilities.

An approach control facility is in essence a small center that provides ATC and other radar services in the terminal airspace delegated to it by the center. This airspace is usually that airspace within 35 miles of the primary airport and below 7.000 feet agl. The exceptions to this rule are the larger facilities such as the New York and O'Hare TRACONS. Each of these larger TRACONS control traffic into and out of a number of primary and satellite airports.

Radar approach controllers provide essentially the same type of service as their controller counterparts at the center. The significant difference being that the service is provided within smaller portions of airspace using reduced aircraft separation minima and a high degree of vectoring.

Terminal automation, as we know it today, came into general use in the early 1970's. Computers have not only relieved the controller of routine tasks, but also give the controller information that assists in maintaining aircraft identification. Information such as altitude and aircraft speed, for which in a nonautomated environment the controller must ask the pilot, are displayed by means of alphanumeric symbology. There are several variations of automation hardware and associated software in use throughout the system.

In addition, Flight Data Entry Printout (FDEP) provides an automated means of printing terminal flight progress strips. FDEP equipment interfaces with the air route traffic center's computer and is used extensively throughout the system to automatically pass flight plan information from centers to terminal approach control facilities and associated control towers.

FORECAST

Marketing decisions by air carriers to use relatively low-activity airports as hubs will create record traffic levels at airports like Charlotte, Dulles Nashville, Baltimore and Raleigh-Durham in 1986 and 1987.

Several other major hubs such as Los Angeles, Washington National and La Guardia will experience less dramatic growth because of capacity limitations, environmental considerations, and policy constraints.

The recently published NAS plan forecasts an increase in towered airport operating from 50.6 million in 1982 to 88 million in the year 2000 (an increase of 73.9%).

THE NAS PLAN

Facilities and equipment, both federally and locally provided, will be needed in response to this forecasted demand.

The National Airspace System plan outlines several projects that will serve to upgrade ARTS systems. Flight data entry and printout devices (FDIO) will replace FDEP. In the 1990's, the Area Control Facility (ACF) program will consolidate FAA terminal radar control functions into the 20 contiguous centers, Honolulu ARTCC, Anchorage ARTCC, and the New York TRACON. These 23 ACF's will provide arrival, departure, and en-route control functions.

While the automated en-route air traffic control (AERA) project will introduce the new functionality to the en-route world, advanced terminal automation improvements are still the subject of discussion.

The statistics I cited earlier regarding forecasted traffic increases make it imperative that we vigorously pursue terminal automation. Continued growth without corresponding advances in terminal automation will only serve to increase delays.

From research and practical experience, we've learned much about what works and what won't work in the air traffic control system.

We have, however, much more to learn.

Air traffic control is a unique task, requiring a unique aptitude and the development of a unique sets of skills. If we assume that these controller skills are developed to perfection, unavoidable system inefficiencies will still exist. A controller must deal with many variables. Operations are enhanced, when, in the normal course of moving aircraft, the number of variables that a controller must deal with are reduced.

In the terminal area, variables such as traffic flow, aircraft mix (size and speed), availability and operation of transponders and Mode C readouts, pilot proficiency, the airport layout (runway and taxiway availability) and weather all contribute to system inefficiencies.

Inefficiencies also exist in the job task of the (terminal) controller. The dissemination and/or the validation of pilot receipt of critical data such as weather is a time consuming task. The existing man/machine interface and communications workload are other examples.

We are faced with a number of challenges. Eliminating system inefficiencies requires research into several different areas. Much of what needs to be done requires the breaking of new ground.

Work is being done in many areas to reduce the impact of these inefficiencies in the system.

I could cite specific suggestions where I feel there is room for improvement on controller productivity and recommend automating specific functions of the controller, but I won't.

In my opinion, a systems approach should be pursued. We should examine the mission and objectives, and define the role of man and machine with a top-down analysis.

The man/machine allocation is critical and should include an analysis of potential interim steps that are consistent with an agreed-upon end-state objective. The latter point is extremely important as our ability to operationally transition to higher levels of automation must be considered in every stage of the system design and development.

The man/machine functional allocation should take into consideration the man-machine interface of the advanced automation system, which is the basic foundation to which new functions will be added. Refinements to that foundation may be required.

Data link and its role needs to be examined and defined.

Avionics capabilities need to be used to best advantage.

On the human side we must gain a better understanding of the controllers ability to assimilate data and to interact with automated functions. Any new functions must fit a controller's job task flow without increasing either cognitive or manual workload or introducing distracting interruptions in the normal task flow.

We must examine and document how controllers think as we move into the area of rule-based decision making.

In conclusion, a systems approach with both pilot and controller input and interaction should enable us to define realistic goals, and, with the engineering community's help, attainable objectives.