

to or directly from a ground-based navigational facility. As the controller had no navigational display, he relied on position reports from pilots to issue clearances, monitor progress, and resolve potential conflict. This was known as a cooperative system as the factor which held it together was cooperation between the pilot and the controller.

It was readily agreed that the controller could do a better job of issuing clearances, monitoring progress, and resolving potential conflict if he had an independent means of observing the traffic flow and did not have to place complete reliance on position reports.

Ground-based radar did this job beautifully and still does. Automated radar will do it even better.

The problem is that the pilot's display was not improved even though the technology to do so was concurrently developed. As a result, the pilot had to go from point to point, but the controller could take him over an infinite number of routes due to the area navigational capability of radar.

As this area navigational capability of radar enabled an increase in system capacity, it was so used as it is now and as it will continue to be according to Federal plan. One result is that, particularly in the complexities of terminal area routings, the pilot is always slightly lost until the controller vectors him onto a route that his navigational display can identify and enable him to follow. We do not call this a cooperative system. We call it a ground-dominated system.

The ground-based portion of the ATC system is controlled by the Federal Government and operated by Federal employees. That this portion should dominate is the apparent preference of the Federal Government despite the colossal inefficiency of such an arrangement.

There are two reasons why this arrangement is inefficient:

First, to provide navigational guidance by radar vectors, the controller must concentrate intensely on each aircraft and should handle only about four at one time, whereas he can monitor the progress of a large number of aircraft.

Second, radar, a magnificent tool for monitoring traffic flow, is too inaccurate and too unreliable for precise navigational guidance. A reason for this is that the controller's display miniaturizes miles of airspace into a 36-inch circle so that aircraft a mile apart often appear to touch.

The safe resolution of these inefficiencies is to provide huge blocks of airspace around each aircraft enabling a relatively small number of aircraft to create a crowded sky.

Existing precise airborne navigational displays are so much more accurate than ground-based radar that the same terminal airspace would theoretically accommodate at least twice as many aircraft in greater safety. We will not know the exact number unless the Federal Government permits a broad scale operational evaluation.

Another advantage of the cooperative system is its lower total cost and the fact that most of the cost is placed directly on the user.

Another portion of the total problem is the airport. The cooperative system described previously would free reliever or satellite airports from their existing restrictions which is caused by the fact that the airspace over them is now used and dominated by operations to and from the primary, or major hub airport. At the present time, for