Air Traffic Control Project
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, May 13, 1949

1.0 GENERAL

(W. G. Welchman)

At this early stage in our work on air traffic control our main objectives are to begin to acquire background knowledge and to begin writing down computer codes for parts of the problem. As a result of a discussion with Mr. Gabelman of Watson Laboratories, Red Bank, New Jersey, we have begun to study reports of navigational equipment and we have also agreed to consider three problems: the maintenance of automatic private line communication with a number of aircraft, the correlation of information about aircraft that is derived from different sources, and the conversion of information between the binary digital form and any form into which it may be put for transmission. These three initial probl[illegible] re concerned with the information-handling system that must be s[illegible] n order to perform control functions, not directly with the contr[illegible] ctions themselves.

At [illegible]nt the main value of any work on coding that we may do is likely t[illegible] that it will make it easier for us to discuss problems of air traf[illegible]ntrol with people who know a lot about air traffic and about navigatio[illegible]uipment but little about computers. We want to be able to show th[illegible] of thing that a computer could do and we also hope that by giv[illegible]ome preliminary consideration to the coding of these problems we [illegible] begin to discover what information we are particularly anxious to ob[illegible] from the experts.

So far we [illegible]e only tackled the private line problem and, in order to obtain a def[illegible]te coding problem, we have made certain assumptions. These assumptio[illegible] however, are purely tentative and we shall expect to change most of t[illegible]m later on.

As a start we assumed that the private line communication is to be achieved by a beam rotating at a constant rate. The beam width is at present taken to be about 3 degrees and the rate of rotation 2 or 3 seconds per revolution. It is assumed that positional information about an aircraft is available in the aircraft and can be obtained automatically by interrogation. It is further assumed for the present that the azimuth obtained by the computer is that of the aircraft with respect to an origin at the antenna of the beam. Each aircraft is supposed to have a coded address and all control computations are supposed to be done and the necessary instructions transmitted while the aircraft is in the beam.

1.0 GENERAL

(W. G. Welchman) - continued

The problem is to ensure that once an aircraft is in the system it will always be dealt with by the computer at a time when it is in the beam. It is assumed that there may be as many as 100 aircraft in the system at distances between 10 and 100 miles, flying at speeds between 100 and 500 miles per hour and having a maximum rate of turn of 5 degrees per second.

Provisional codes were prepared for discussion (M-2000, M-2001). These first codes made the further assumption that there is a "blind sector" which will never be traversed by aircraft in the system. The codes separate into three parts. First, a test program to find out whether it is time to interrogate an aircraft. Secondly, a prediction program carried out during contact with an aircraft to determine when the next contact will be made. Thirdly, a shuffling program performed during the blind sector to determine the order in which aircraft will be picked up on the next sweep.

We are now investigating how to get rid of the blind sector and what advantages would be gained by controlling the speed of the beam in various ways.

(P. Franklin)

A study of private line communication was started, with emphasis on the evaluation of different methods of establishing a variable speed of rotation of the beam.

(T. W. Hildebrandt)

I have finished writing the resume on several suggested systems of air navigation, and it should be issued as Memorandum M-2003 early next week.

(P. Rabinowitz)

A simplified prediction code based on first order approximation was prepared.

The problem of programming a code based on non-constant angular velocity of the antenna is receiving serious consideration.

(E. Reich)

Various methods of predicting positions of planes for establishing private line communication were considered with a view of obtaining an idea of the order of magnitude of the errors involved. With an assumed beam rotation speed of $\frac{1}{2}$ revolution/sec and reasonable maximum speeds and

1.0 GENERAL

(E. Reich) - continued

turning rates of planes an error not larger than $\frac{1}{4}^{\circ}$ is possible with simple first-order extrapolation of previous plane position data. This estimate does not include possible errors due to analog measuring equipment which may be of a higher magnitude. It thus seems fairly certain that no prediction method of order higher than the 1st order is needed.