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SYNCHRONIZATION OF TIME STANDARDS FOR SATELLITE TRACKING

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One of the two questions which Commission I has been asked to consider by the URSI-COSPAR committee is the question of synchronization of time standards at various locations on the earth for purposes of satellite tracking. I understand that synchronization to about 10 microseconds is desired within a few years. Presumably launching ranges where still finer synchronization is needed would be handled separately by locally operated systems.

There are at least three systems which may be feasible for achieving the desired time synchronization for satellite tracking. One is a system similar to Loran C where the ground wave or selected hop sky wave two-way transmission of pulses at roughly 100 kc/s is used. The usable range is of the order of 2000 km, and a chain of transmitters would be needed. A second and more esthetically pleasing possibility is the use of time signals in some form, such as frequency switching or on-off pulsing on world-wide VLF or LF transmissions. The third scheme is to use the locally received phase of world-wide VLF or LF transmissions to maintain time synchronization, but to provide the initial synchronization by transporting a time standard from one location to another.

The first method appears feasible if sufficiently world wide coverage can be obtained, but the cost would probably be high because of the number of stations needed. Some experiments which will help to determine the accuracy achievable with VLF transmissions are under way, but more effort in this direction is needed. It therefore appears undesirable at this time to recommend to the URSI-COSPAR committee what type of signal should be used for high-precision world-wide time synchronization. Instead, it seems desirable that the URSI encourage international cooperation and coordination in the monitoring of VLF and LF transmissions so that limitations due to changes in the transmission paths from day to day become known as soon as possible.

At present the transmissions which appear most suitable for widespread measurements are GBR (16 kc/s), NBA (18 kc/s), MSF (60 kc/s) and DCF (77.5 kc/s). Measurements of the received phase of these transmissions are needed in as many countries as possible, as well as measurements on other transmissions, such as OMA and WWVB, where feasible. It is suggested that condensed results should be given in terms of the phase difference in microseconds at a given time each day between each of the received carriers and a common locally generated time scale. The locally generated scale need not be uniform for the measurements to be valuable, since much of the desired propagation information is contained in the phase differences of the received carriers with each other. Where the locally generated time scale is believed to be uniform with respect to local atomic standards it is desirable for the uncertainty of the uniformity to be given in microseconds for each day.