

QUESTION ITU-R 111-1/7*

Signal delays in antennas and other circuits and their calibration for high-accuracy time transfer

(1990-1997)

The ITU Radiocommunication Assembly,

considering

- a) that there is a need for accuracy in precision time transfer exceeding that currently available;
- b) that the antenna and other electrical circuits are critical elements in the radio signal path at the transmitting, relaying and receiving sites for the accuracies desired;
- c) that there is a need to account for antenna and other circuits delay in radio paths for precision time signal transfer;
- d) that it is desirable to have standard antenna designs of known delay characteristics;
- e) that it is desirable to have international agreement on the measurement technology;
- f) that extensive efforts have been made on the calibration of two-way satellite and GPS time transfer,

decides that the following Question should be studied

- 1** What methods can be recommended to determine and characterize the delay introduced by the antennas and associated circuits for accurate time transfer over a radio signal path?
- 2** What are the antenna parameters to quantify the characteristics influencing delay in the passage of time signals, such as wavelength, aperture, bandwidth, impedance, polarization, directivity, dielectric effects, array factors, travelling wave effects, lens effects?
- 3** What is the delay in standard type dipoles and horns suitable for covering the radio spectrum?
- 4** What are the environmental effects which could affect delay such as temperature, pressure, humidity and magnetic field?
- 5** What influence have supporting electrical circuits on signal delay?
- 6** What is the measurement technology required to address accuracies in the nanosecond and picosecond ranges?
- 7** What level of agreement exists between calibrated two-way satellite and GPS time transfers?
- 8** What are the sources for disagreement between calibrated two-way satellite and GPS time transfers?
- 9** What standardization of calibration methods is possible?

* In the year 2009, Radiocommunication Study Group 7 extended the completion date of studies for this Question.

10 What standard reference systems would be useful for calibration purposes?

further decides

1 that the results of the above studies should be included in (a) Recommendation(s);

2 that the above studies should be completed by 2011.

11-17 1997