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Section**



Joint Seminar of the IEEE Ottawa ComSoc/BTS, AP/MTT, CPMT, and CAS Chapters and
Department of Electronics, Carleton University

Title: **Impacts of the Sun on Satellite Communications Systems**

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Location: 4124 Mackenzie Engineering Building, Carleton University

Abstract

For over 60 years, artificial man-made satellites have been providing diverse, highly available services, worldwide. The Sun is the lifeline of majority of satellite space segments, providing to satellites a thermal equilibrium, and, via solar cells, the electric energy. When the Sun becomes obscured by the Earth or by the Moon, a solar eclipse occurs. A satellite's lifeline becomes vitally reduced or cut and its thermal equilibrium disrupted. Different measures have to be taken to reduce and/or avoid potential degradations and/or disruptions of services. The worst case scenario, an unavailability of service, is also called an outage.

Direct exposure to the Sun by a receiver's antenna main beam would cause an increase in the receiver's system noise temperature, which, consequentially, may cause a degradation of service and even an outage.

We focus on satellites in the GeoStationary Orbit (GSO). A simplified link budget calculation for a hypothetical GSO satellite is presented, and a component in this budget, which is impacted by the Sun, is pin-pointed. Geometrical aspects of satellite earth station antennas, satellite space segments, the Sun, the Earth, the Moon and related natural phenomena, including equinoxes in particular, are described and illustrated with a number of examples. Three major alignment scenarios are analyzed and illustrated: Earth Station-GSO-Sun alignment also known as the Sun transit of the antenna main beam, GSO-Earth-Sun alignment and GSO-Moon-Sun alignment. The last two scenarios are solar eclipses.

The Moon caused solar eclipses (partial, total, annular) are the least frequent of the three; the total eclipse could last minutes, an annular eclipse lasts approximately 10 minutes and a partial one still longer. The Earth caused solar eclipses (partial, total) occur regularly around equinoxes; at equinoxes, they last approximately up to 72 minutes around midnight of the local time, and repeat every day with shorter and shorter durations for approximately up to +/-23 days. The timing of the Sun transit of the antenna main beam depends on the geographic location of a particular earth station antenna. It occurs on equinoxes for stations at equator and shifts away from equinoxes for stations at higher latitudes. The exposure lasts for approximately 10 minutes for an average size antenna at its peak worst time instant. It is gradually reduced within a number of days. Higher gain antennas are exposed over shorter periods of time but with higher intensity, and vice versa.

Speaker's Biography

Dr Andy D Kucar P2EE4 has >30 years of industrial experience, worldwide, working on: top-of-the-line special projects and design of advanced terrestrial and satellite wireless radio equipment for oil/nafta/gas, aviation, transportation, TV, PTT, Baby Bells, dispatch and delivery, service industries, governments, etc.

His affiliations include(d): Zagreb University, Radioindustrija Zagreb, Iskra/ITT, Ottawa University, BCE: Telesat, BCE: Bell Northern Research (now Nortel), KFUPM, and since 1990 4U Comm > www.radio4u.com, where he serves as a co-founder and senior manager.