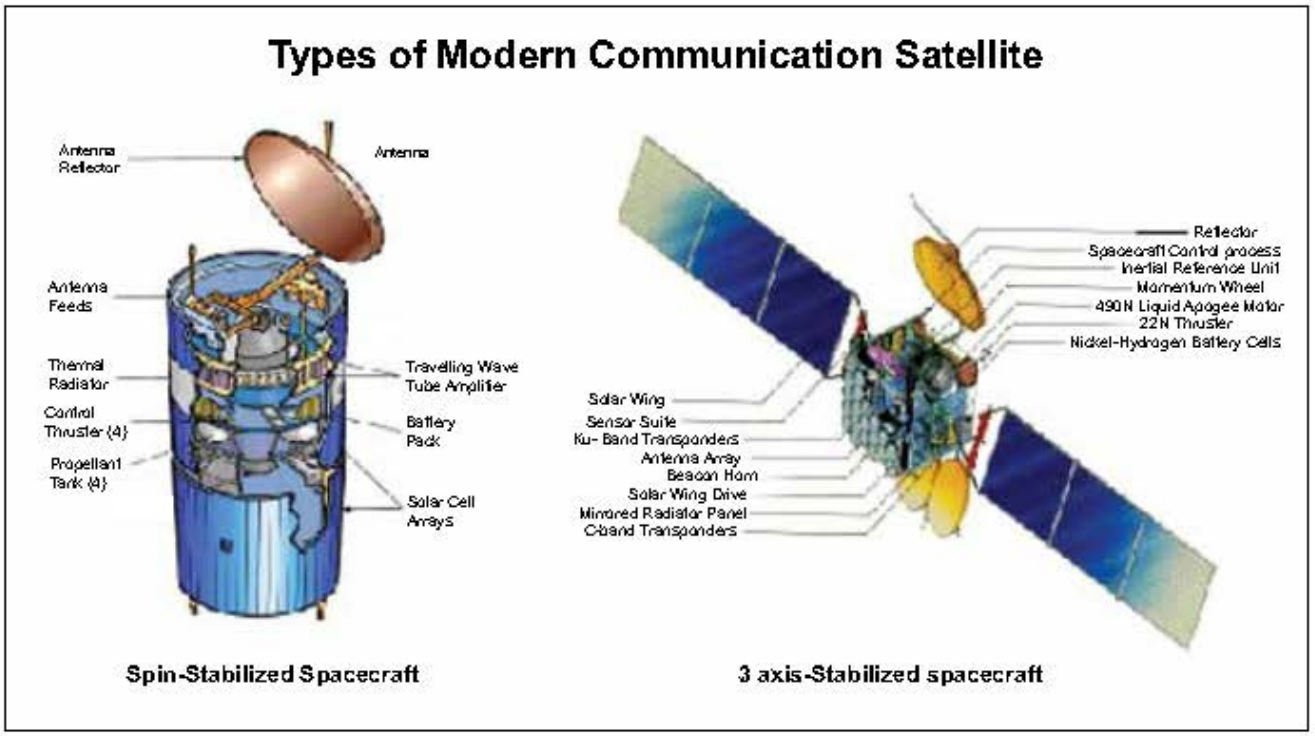
Satellite Failures, Anomalies and Space Environment

ENGINEERING EDUCATION TECHNICAL DIVISION

by Ir. Chew Weng Yuen



THE Engineering Education Technical Division organised a talk titled Satellite Failures, Anomalies And Space Environment, together with the Engineers Australia Malaysia Chapter and the Institution of Mechanical Engineers Malaysia Branch, on 1st October 2013, at the Auditorium Tan Sri Prof. Chin Fung Kee, 3rd Floor, Wisma IEM. The talk was delivered by En. Azih M Zin, Senior Advisor at Measat.

There were 70 participants. The talk commenced at 5. 30 p.m. with En. Azih showing pictures of the various types of modern communication satellites.

He then elaborated on the geosynchronous orbit, geosynchronous satellite, geostationary orbit, and geostationary satellite. He said that most commercial and communications satellites including Measat's two (2) satellites operate in geostationary orbit which has an altitude of approximately 35,786 km directly above the Equator and that satellites here have a velocity of 3.00 km/s.

As the number of satellites in the geostationary orbit is very high, operators are allocated orbital slots to locate their respective satellites. This is to limit and manage the number of satellites in the geostationary orbit. Each orbital slot is able to stack (co-locate) up to a maximum of 8 satellites.

En. Azih described space as a dynamic place filled with energetic particles, radiation, and trillions of objects, both very large and very small, ranging from micrometeoroid showers to orbital debris. The velocity of these particles ranges from zero to the speed of light. Temperatures vary from being extremely high to being extremely cold. Charge particles continually bombard exposed surfaces. Magnetic field can be intense and the environment in space is constantly changing. All these factors influence the design and operation of space system.

He explained in length with regards the negative effects of surface charging, photoelectron current, difference of floating potential on dielectric surface material that causes arc-discharging, and deep dielectric or bulk charging (IESD) on spacecrafts. He said spacecraft charging is responsible for a number of operating anomalies such as telemetry glitches, logic upsets and component failures and spurious.

He continued with the space weather outlook for the years beyond. He said that designers will normally look at past events to forecast future occurrence. He then told the participants that the sun glows its brightest every 11 years.

The cycle whereby the sun is at its minimum to its maximum is known as a solar cycle (SC) and space scientists will benchmark these solar cycles for the future 15 years space flights.

En. Azih also talked about proton event which relates to energies released by the sun and which ionises heavy iron. He said proton and ionised irons are hazardous to spacecraft and are primarily responsible for anomalies. As such, designers will design spacecrafts based on the solar maximum to mitigate the effect of these solar energetic particles.

He further mentioned the radiation effect caused by Galactic Cosmic Ray, Solar Flare, Solar Proton Event and Coronal Mass Ejection. Passive electronics such as cable, wiring, solar array and sensors can be seriously affected by radiation. As such, space components have to be radiation hardened (RAD HARD), with shielding and grounding in order to mitigate the above threats.

Next, En. Azih moved on to the threats caused by space debris. It was shown that space debris had increased by a thousand-fold since 1960. This debris was generated by spacecraft explosion, collision, etc and the size of the debris varies from less than 0.01cm to those greater than 10cm. Damage caused by space debris, even small ones, can be relatively significant, because of the extremely high orbital velocity which varies from 8 to 10 km/sec.

To observe and track space debris, various ground-based radars or telescopes, detectors aboard satellites or orbiting equipment recovered on the ground (i.e. Hubble telescope panels) are available.

En. Azih then discussed mitigation methods carried out by operators to lessen damage to their spacecraft caused by space debris and the current regulations imposed on spacecrafts operators by international space regulators.

Active discussions followed with questions raised by the participants after the talk. En. Azih answered all the questions and the talk ended with the presentation of a memento to En. Azih and a round of applause from the participants. ■

Deputy Chairman of IEM Engineering Education Technical Divison, Ir. Mathew Thomas presenting a memento Encik Aziz M. Zin

---

Ir. Chew Weng Yuen is a committee member of the Engineering Education Technical Division of IEM. He is currently the Deputy General Manager of Forefront Tiara Sdn. Bhd., a property development company.