RTT TECHNOLOGY TOPIC
January 2022

Smart Science from Space

After 30 years of planning, twenty years of development and $20 billion dollars of government funding from the US, Canada and Europe, the James Webb Telescope is on its way to the second Lagrange Point (L2) a million miles away where it will orbit the sun, shaded by a sun shield which will allow it to peer back to the origins of the Universe.

The job of the sun shield it is keep the heat and light radiated by the sun, earth and moon away from the 'cold side' of the telescope operating at -233 degrees Celsius.

14 separate instruments spanning the lower infra-red band will see through the dust clouds that even Hubble could not penetrate capturing pictures of young warm exoplanets and the spectroscopy of their atmospheres, identifying and characterizing the first galaxies at long red shifts and analyzing the warm dust and molecular gas in young stars 13 billion years ago.

On the hot side of the telescope at 85 degrees Celsius, a K band all metal reflector antenna points back to one or more of the three 34 meter beam waveguide antennas located in Canberra (Australia), Goldstone (California) and Madrid (Spain), the backbone of the Deep Space communications Network (DSN).

28.6 Gbytes of recorded science data will be downloaded in two four hour sessions each day over the K band downlink between 25.5 and 27 GHz together with an S Band uplink and downlink for telemetry and telecontrol. This requires the ground based telescopes to track the James Webb from horizon to horizon from relatively low elevation (10 or 20 degrees). The ten degree ground elevation start point takes 1.2 dB off the link budget but means one ground station can serve the telescope across a four hour download. The telescope antennas on the satellite also require precision pointing to compensate for relative orbital movement.

Assuming it all goes to plan, The James Webb will produce pictures from the past which should radically improve our understanding across all space science domains including astro physics, astro chemistry and astro biology.

In the grand scale of telecommunications, a 26 Gigabyte four hour download does not represent a massive amount of bandwidth but James Webb is just one of dozens of scientific experiments presently heading into near space and deep space.

These can be single payloads on single satellites or a single payload on several satellites flying in formation. The science payloads can be looking out into near space, deep space or back to earth and can span the whole electromagnetic spectrum from VHF via X band though to infra-red to ultra violet and beyond.

It is possible, possibly likely, that space from space and earth from space imaging bandwidth will scale faster than the RF bandwidth available for space to earth links which is why the ESA and NASA and other regional and national space agencies are helping to support and develop a new generation of optical downlinks and optical cross connect technology.

Earth imaging from space already includes RF imaging from VHF to 15 GHz, synthetic aperture radar at X band and sub metre infra-red and optical imaging.

Adding space from space to earth from space creates almost infinite radio frequency (RF) and optical bandwidth value.

This is opening up a wide range of new income and funding opportunities both from scientific projects and other groups with close interest in scientific research including defence agencies and has coined a new term of 'Science as a Service' based on third party providers supplying space access on demand.

Science payloads have adding value to commercial satellites for at least thirty years so this is not a new trend. The business model will however be fueled by the latest generation of massive methane rocket engines which promise to bring fuel costs for a launch down to $150,000 for a 150 metric tonne payload. That is $10 dollars per kilogram, and the rocket could potentially be reused hundreds of times.

The Hubble Telescope has spent the last twenty five years proving that it is possible to deliver spectacular scientific value from space. James Webb will literally take us further. Both Hubble and James Webb were planned before the cost of getting to space started rocketing downwards.

To quote from that well known space scientist Buzz Light Year, *Smart Science from Space* promises to take us to Infinity and Beyond, now where did I put that box of AAA batteries?

The mechanics of Smart Science from Space are addressed in technical detail in our next book, *5G and Satellite RF and Optical Integration* which if all goes to plan should be available from Artech House at the end of the year.

You cannot pre order it yet as I have only written two chapters but you can read the last two books which have lots of useful stuff in them.

The two books are

5G and Satellite Spectrum, Standards and Scale

You can order a copy on line using the code VAR25 to give you a 25% discount.

http://uk.artechhouse.com/5G-and-Satellite-Spectrum-Standards-and-Scale-P1935.aspx

5G Spectrum and Standards
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00 44 7710 020 040