RTT TECHNOLOGY TOPIC
August 2023

Low Altitude Platforms

Over the course of this year (January to November 2023) we have been making our way through the eleven chapters of our new book, 5G and Satellite RF and Optical Integration, highlighting industry announcements that hopefully help to consolidate the underlying narrative of an emerging market for 5G services from space coupled to increasing use of optical free space technology for inter satellite, inter constellation and earth to space/ space to earth links.
As a reminder,
Chapter 1 covers 5G radio spectrum including RF C Band, RF link budgets and active and passive device efficiency.
Topics addressed in the rest of the book include
Chapter 2 Optical C Band link budgets and active and passive device efficiency
Chapter 3 RF over Fiber- link budgets and network architectures
Chapter 4 Space RF Link Budgets
Chapter 5 Optical Inter Satellite Links (OISL)
Chapter 6 Deep Space and Near Space technologies
Chapter 7 Ground Station and Earth Station Hardware and Software
Chapter 8 Low Altitude Platforms
Chapter 9 High Altitude Platforms
Chapter 10 RF and Optical Technology Enablers
Chapter 11 Technology Economics of RF and Fiber for terrestrial and space networks.

For more information and to order go to
https://uk.artechhouse.com/5G-and-Satellite-RF-and-Optical-Integration-P2194.aspx
Hard and soft copies of the two previous books in the Series can be ordered here
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If you are interested in writing a book for Artech House or have research work you would like included in future 5G and 6G satellite RF and optical titles then email geoff@rttonline.com who will put you in touch with the Artech commissioning team.

Low Altitude Platforms (Chapter 8)

Last month's (July) Technology Topic looked at the technologies used in Ground Stations and Earth Stations. This month (August) we look at the specific communication needs of Low Altitude platforms including drones.

Low Altitude Platforms (Chapter 8) covers how we connect and communicate with anything that floats or flies in the sky between the ground and 12 kilometers. The September Technology Topic, High Altitude Platforms,(Chapter 9), looks at how we connect and communicate with anything that floats or flies in the sky between 12 kilometers and the Karman limit (or Karman line) at 100 kilometers, the point at which the atmosphere becomes thin enough to allow spacecraft and satellites to stay in orbit without consuming an inefficient amount of power and or the point at which the atmosphere becomes too thin to provide sufficient lift from an aircraft wing to maintain efficient flight.

The two topics therefore provide a high level summary, addressing sub orbital wireless systems including RF and optical link budgets.

Sub orbital can be subdivided into the troposphere from ground level to 12 kilometers, the stratosphere from 12 kilometers to 45 kilometers, the mesosphere between 45 and 50 kilometers, and the thermosphere above 80 kilometers. High altitude platforms (HAPS) are normally deployed in the stratosphere between 17 and 22 kilometers. This is above the height at which civil aircraft fly and generally above cloud level though night/noctilucent clouds can occasionally be found as high as 85 kilometers.

The choice of 12 kilometers might seem arbitrary but that is generally the altitude above which rain fade margins disappear from the link budget, link budgets become more predictable and stable and free space atmospheric propagation loss approaches 0.2 dB per kilometer which is equivalent to the loss in terrestrial fibre. High Altitude Platforms (Chapter 9) is therefore largely about how we build free space wireless networks in the sky that can support cross link rates that are close to terrestrial fiber but faster (300 million meters per second rather than 270 million meters per second).

Chapter 8 by contrast looks at how we work around the weather, tropical storms, typhoons and hurricanes, the winter, spring, summer, autumn weather cycle of the temperate zones, the snow and ice storms in the arctic and Antarctic and desert dust storms. On the ground, wind makes masts sway and introduces pointing loss into millimeter band RF and optical systems. As engineers we find ways around this by either adding additional bracing to the mast or by using flat panel arrays that can correct for movement induced aberrations. In the air, turbulence will cause pointing loss. In both cases, pointing loss will increase as beamwidth reduces. Generally this means that as we move up in frequency either in the RF domain (the millimeter and sub millimeter bands) or to optical frequencies, pointing loss becomes increasingly important. Vibration, or the need to dampen and/or correct for vibration becomes important as well.

At 12 kilometers these links can be from the ground or from space or typically both and are generally at the moment RF rather than optical. Modern aircraft, just like modern cars are however transitioning to fiber in order to move bits around the air frame more efficiently so providing optical connections from space to interconnect with all this ‘flying fiber’ begins to make commercial and technical sense. The move from copper to fiber inside an aircraft saves weight so reduces fuel cost but the dollar cost is also less than copper and fiber supports terabits of bandwidth assuming that is what planes need and passengers expect in the future.

Other topics covered in the Chapter include military drone connectivity. Military drones divide roughly into long range and short range tactical drones. Long range devices tend to be supported by dedicated radio systems including satellite radio systems such as Iridium. Short range drones can either be proprietary or use comms systems borrowed from consumer drones which generally use the 2.4 GHz Wi-Fi band for uplink telemetry and control and the 5 GHz Wi-Fi band for imaging and video.

5G is also being actively promoted for Low Altitude Platforms and is a potentially effective way to address the presently unresolved air traffic control issues. Chapter 8 includes two intriguing case studies of 5G enabled air traffic management, one from China (EHang Corporation) and one from the UK (Altitude Angel). In Flight Connectivity is also addressed tough present multiple options make it hard to see what will emerge as the dominant connectivity model

Last but not least, we cover optical links to and from Low Altitude Platforms though with the proviso that safety critical systems must deliver ‘all weather wireless.’ It is hard to beat a VHF AM or FM radio for resilience!

The drone market has been revolutionised by a combination of improved battery technology and stability control with a market that continues to expand at exponential speed. Wireless connectivity is an essential enabler in that market expansion process and we can expect many more innovations over the next few years.

Ends

RTT Technology Topics reflect areas of research that we are presently working on. We aim to introduce new terminology and new ideas to help inform present and future technology, engineering, market and business decisions.

The first technology topic (on GPRS design) was produced in August 1998. 25 years on there are over 270 technology topics **archived on the RTT web site**.

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RTT, and **Niche Markets Asia** are presently working on research and forecasting projects in the mobile broadband, public safety radio, satellite and broadcasting industry and related copper, cable and fibre delivery options.

If you would like more information on this work then please contact **geoff@rttonline.com**
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