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Author: Prof. Joseph Homer Saleh
Georgia Institute of Technology, United States

Mr. Yue Guan
Georgia Institute of Technology, United States
Mr. Fan Geng
United States

# AFFORDABILITY-PERFORMANCE MAP AND THE COST PER BIT/SECOND DECISION TREE FOR HIGH THROUGHPUT SATELLITES: ANALYSIS AND IMPLICATIONS

**Abstract**

High Throughput Satellites (HTS) are the proverbial wave of creative disruption, which will significantly reshape the satellite communication landscape in the next decade (markets, business models, operators, and end-users). Creative disruption refers to the process by which technology and system innovation makes strides and displaces older ones or pushes them to gradual, sometimes abrupt death by obsolescence. In this work, we first review the highly dynamic nature of the telecom landscape, in particular the changing mix in demand for connectivity from broadcast to broadband, and how HTS is uniquely positioned to take advantage of this emerging landscape. We briefly discuss the anchor tenant for HTS, namely broadband services to consumers, and the growth areas in mobile maritime and aeronautical services. Other markets for HTS are also examined, including data relay and cellular backhaul, enterprise data network, and support for military connectivity. Second, we examine the consequences of HTS for satellite operators and manufacturers, including higher customer churn, significant price erosion, and slower fill rates for the operators, and smaller volume, tougher procurement, and increased price pressure for the manufacturers. Having discussed the context and markets for HTS, we examine the affordability-performance map for telecommunication services. Affordability, as measured in dollar per Gbps, and performance or speed of upload/download (Mbps) are key metrics for satellite communication and broadband access. Our analysis shows a significant and widening gap in affordability-performance between HTS and the traditional Wide Beam satellites. As a result, the obsolescence of the latter, we argue, is likely to occur rather quickly in the next 3 to 5 years. We then introduce and develop the cost per bit/second decision tree for HTS. The tree provides an integrated perspective on multiple levers that drive this metric. For example, widening the satellite usable bandwidth will compress this metric, but regulatory constraints and congestion limit the usability of this lever unless communication is moved to higher frequency bands (e.g., Q/V). Similarly, increasing frequency reuse will compress this metric, but it requires larger antennas/reflectors and narrower beams; and increasing spectral efficiency will require higher order modulation schemes, which in turn require higher power amplifiers and higher power generated on board the spacecraft. The end-result is a decision analysis tool that examines the trade offs for HTS between frequency reuse, number of beams, spectral efficiency, antennae and feeds efficiency, and EIRP.