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# Trends In Development Of Broad- Band Phased Arrays In Commercial Satellite Systems And The Potential Applications For Tracking High Earth Orbit Satellites, Deep Space Vehicles, And Mobile Robotic Networks

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Occasionally, it is argued that the cost and size of the phased array antennas are prohibitive for space applications. It should be noted however, that combining the communication, imaging, and multi-target tracking capabilities of a broad-band phased array antenna has made it an attractive solution for high speed mobile ATM networks, air traffic control, collision avoidance systems, wireless local area networks (WLAN), and radar imaging. The new era of Internet satellite networks on the other hand, has started to use Ka-band broad-band phased arrays for earth orbits. Miniature phased arrays for smart sensor probes, and robotic networks seem yet other domains of new phased array applications, which could as well be utilized for inter-planetary applications. The increasing usage of the phased array antennas is playing a key role in lowering the cost and size of T/R modules, packaging, cooling, and integration at an amazingly fast pace. One of the beauties of phased array antennas, which is occasionally overlooked, is its modular nature, i.e., if the first module prototype is successful, one can add more modules, with minimum down time. Reflector antennas don't have this scalable feature without much more complexity, or down time. While there are several programs, that are employing phased array antennas for earth orbits, there has not been sufficient effort in the development of phased array antennas for applications from high earth orbits to deep space vehicles and robotic networks.

In this paper we will discuss and analyze various methods that phased array technology can be utilized to provide multifunction capabilities for planetary space applications. It will also be shown how phased array antennas add much flexibility to deep space applications, e.g., ground support systems, Mars networks, and monitoring high-speed robotic missions. Various beam-forming network architectures including power dividing/combining and phase-shifting techniques will be outlined and ways to reduce cost, weight and complexity of T/R modules and beam-formers will be discussed.