

**Mars Telecommunications Orbiter
K_a-Band System Design and Operations**

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NASA's Mars Telecommunications Orbiter (MTO) will relay high bandwidth communications from landers, rovers and spacecraft in the vicinity of Mars to Earth. MTO features the most advanced communications system ever launched on an interplanetary mission, with high performance X-, K_a-band and optical Direct-To-Earth links as well as high performance X-band and UHF relays. The MTO K_a-band downlink will be the first operational K_a-band system at Mars.

This paper reviews the history of K_a-band deep space communications development. It then describes the MTO communications system, focusing on K_a-band elements, and characterizes MTO K_a-band performance.

The paper also describes how the K_a-band system will be used operationally. The severe effects of adverse weather on K_a-band links raise unique link management issues for deep space communications. The long two-way light time to Mars precludes feedback control of the K_a-band link, necessitating the use of predictive weather models to estimate link performance and adjust link parameters in advance. Given our limited ability to predict weather outages, and the severity of such outages at K_a-band, there will be large outages. It will thus be necessary to use an automatic repeat request system with long latency capability to ensure reliability. This drives memory requirements on the spacecraft.

The paper reviews spacecraft, ground system and operational trade-offs made in the design of the MTO K_a-band communications system and operating procedures.