



G. MARCOZZI 2007

Guglielmo Marconi Orbiter – The First Interplanetary Communications Satellite

Gary Noreen, Tom Komarek, Roger Diehl, Gene
Brower, Phil Varghese, JPL; M. Marcozzi, C.
Dionisio, Alenia Spazio

October 10, 2002

GKN-1



Overview



RS 2007

- ▶ Mars Relay Network
- ▶ Relay Users
- ▶ Guglielmo Marconi Orbiter (GMO) Mission Design
- ▶ End-to-End Information System Design
- ▶ Mission Operations

G. MARCO

October 10, 2002

GKN-2



Mars Relay Network



G. MARCO MARS 2007

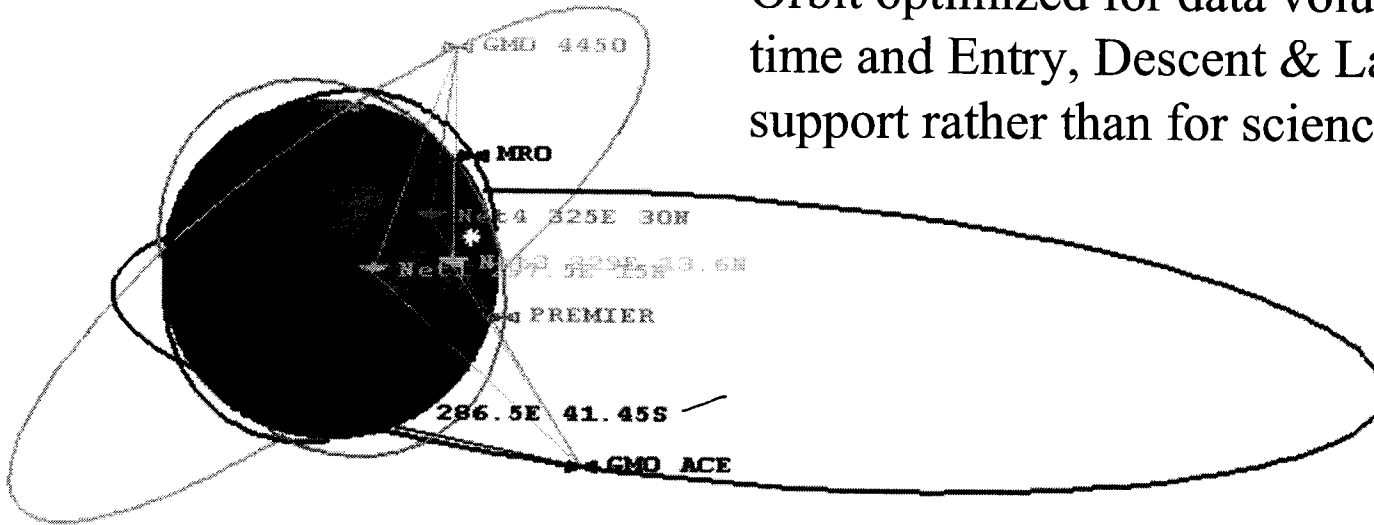
- ▶ Relay communications
 - Range² reduced by a factor of up to 6.4×10^{21} (218 dB)
 - Gigantic improvement in ability to communicate with in-situ elements
- ▶ UHF relay radios added to most Mars science orbiters
 - Now orbiting Mars: NASA Mars Global Surveyor & Mars Odyssey
 - 2003 ESA Mars Express, 2005 NASA Mars Reconnaissance Orbiter, 2007 CNES Premier Orbiter
 - Relay performance limited by primary science mission
 - Low orbit optimized for science, not relay
 - Omnidirectional relay antenna on shared platform
- ▶ Guglielmo Marconi Orbiter
 - High orbit optimized for relay service
 - High performance steered relay antennas



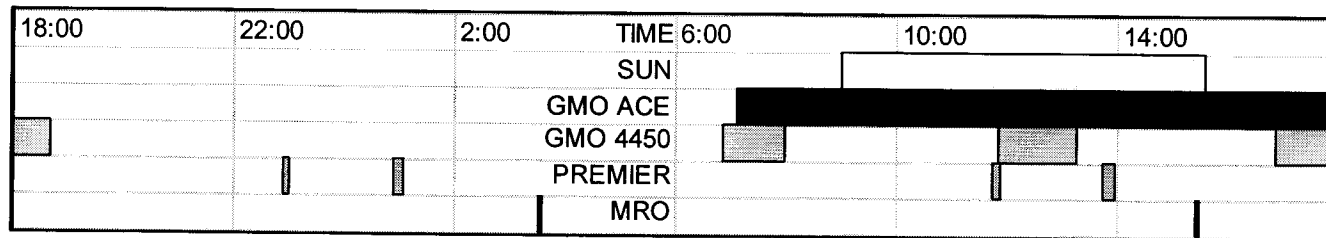
High Relay Orbit Increases Contact Time



Orbit optimized for data volume, contact time and Entry, Descent & Landing (EDL) support rather than for science observations

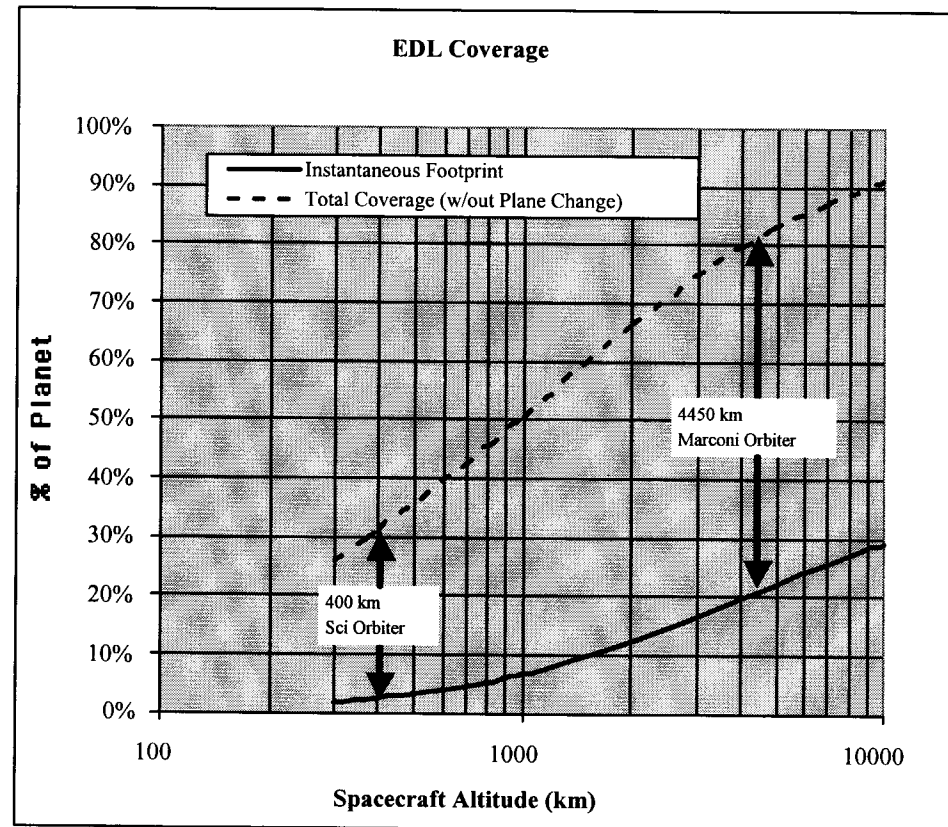
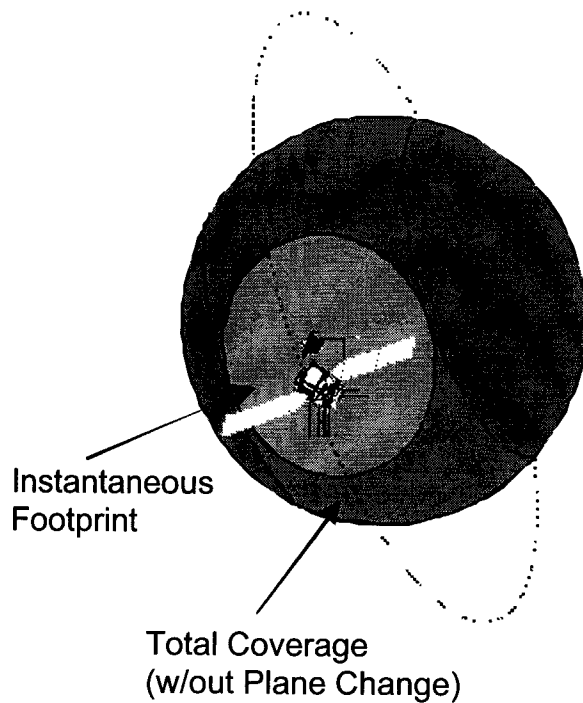


High orbit → EDL tracking for wide range of landing sites, long contact times
Long contact times → operational flexibility, traverse monitoring



G. MARCO RS 2007

- ▶ High orbit maximizes area of Mars in view, maximizing possible landing site locations
- ▶ GMO orbit node can be selected to facilitate EDL tracking





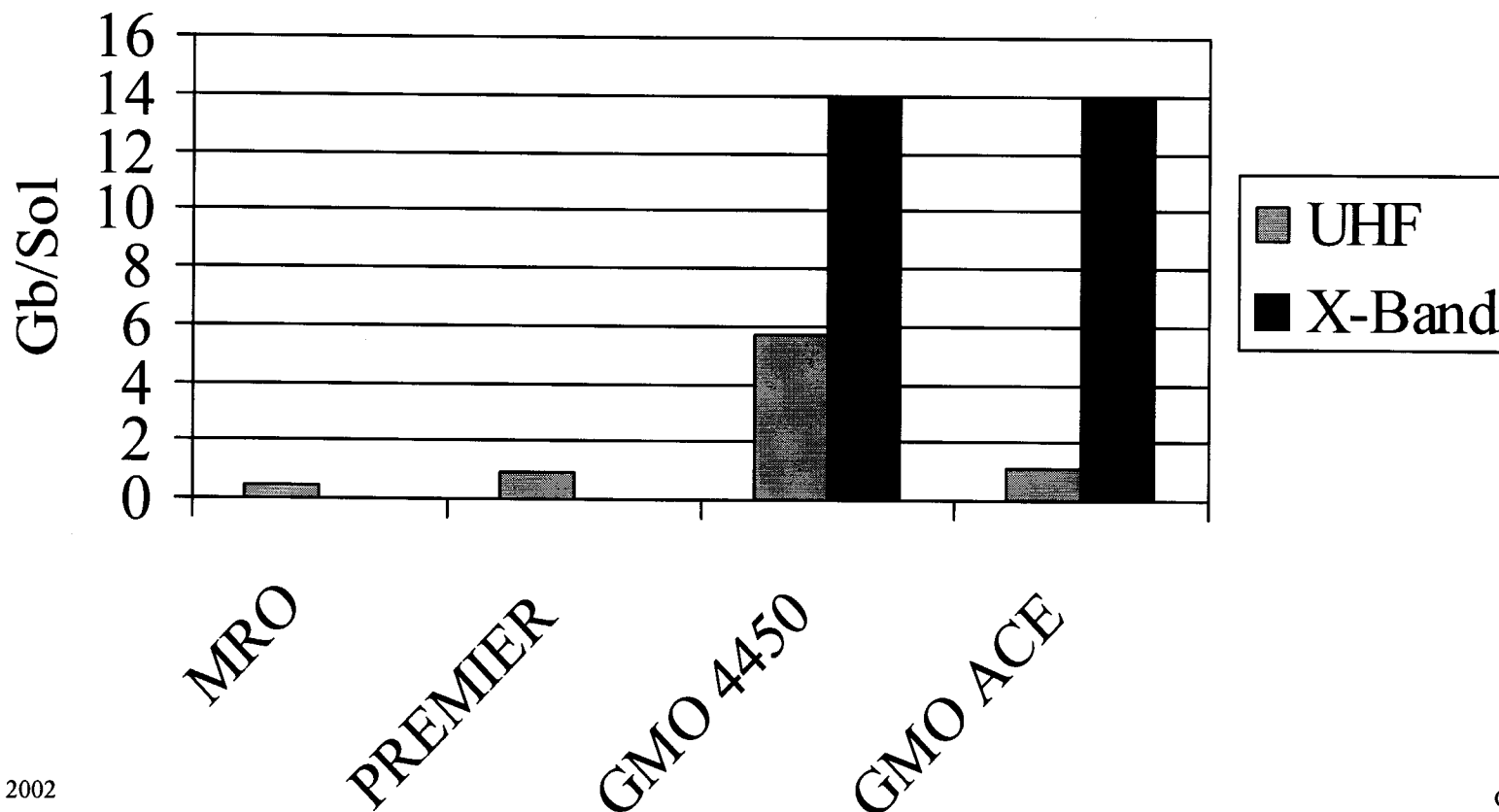
Increased Data Return



G. MARCO ... 2007

High orbit + X-band = huge increase in data return

Data Volume (Large Rover)





Relay Users



G. MARCO
MARS 2007

- ▶ 2003 (before GMO)
 - 2 NASA Mars Exploration Rovers
 - British Beagle II
- ▶ 2007
 - European (CNES) NetLanders
 - NASA Mars Scout
- ▶ 2009
 - NASA Mobile Science Laboratory (MSL)
- ▶ 2011 & Beyond
 - NASA Mars Scout
 - NASA Mars Sample Return



GMO Mission Design



G. MARCO
RS 2007

- ▶ Launch in 2007
- ▶ Type II trajectory to Mars
- ▶ Orbit Options
 - Circular sun synchronous
 - 4450 km
 - 1000 km
 - Elliptical
 - $\frac{1}{2}$ sol Apoapsis at Constant time-of-day Equatorial (ACE)
 - $\frac{1}{4}$ sol Apoapsis at Constant time-of-day Critically Inclined



Mars Relay Network End-to-End Information System



G. MARCO
RS 2007

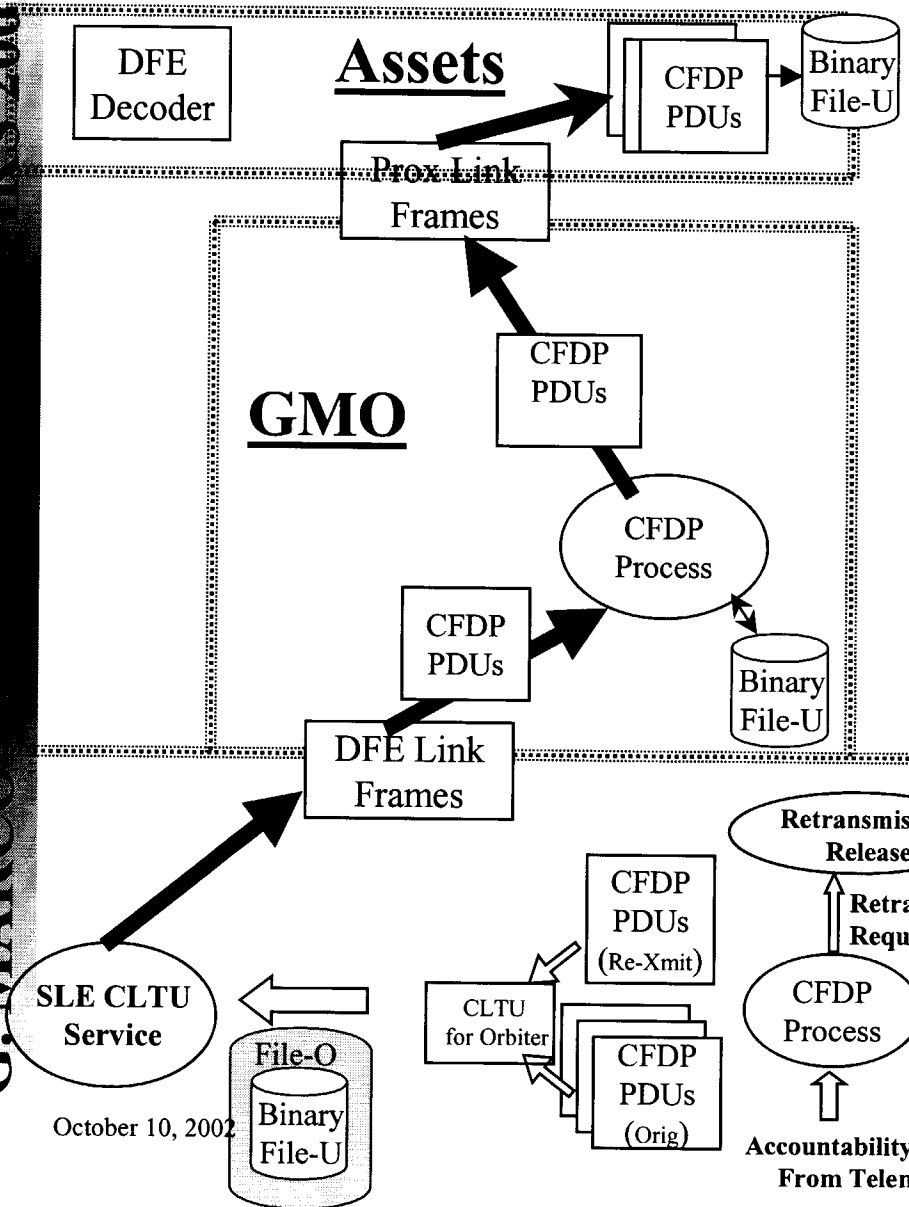
- ▶ Electra relay radio will be carried by all Mars orbiters beginning with NASA Mars Reconnaissance Orbiter in 2005
- ▶ Break between 2003 and 2007 landers being used to develop new end-to-end information system with greater commonality
- ▶ Objectives
 - Make orbiter & ground system transparent to relay user
 - Share development costs



Forward Link through GMO



G. MARCO RS.2007



- 1) GDS receives Binary File from Relay User Ops via FTP
- 2) GDS segments Binary File into CFDP PDUs optimized for the relay link
- 3) GDS encapsulates CFDP PDUs into Command Link Transmission Unit (CLTU)
- 4) Ground station transmits CLTU to GMO
- 5) GMO SFC extracts CFDP PDUs from CLTU
- 6) GMO SFC reconstructs Binary File from CFDP PDUs
- 7) GMO SFC segments Binary File into new CFDP PDUs optimized for the relay link & stores in memory
- 8) Electra relays CFDP PDUs to Asset using Proximity-1
 - Full duplex using Reliable Bit Stream
 - Half Duplex using Reliable CFDP
- 9) Asset assembles Binary File from CFDP PDUs

October 10, 2002



Mission Operations



G. MARCONI MARS 2007

