PHONING HOME FROM MARS IN 2025, J. Adams, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, (e-mail: jta@jpl.nasa.gov).

Introduction: It's spring at Martian Outpost 3, the year 2025. The Superbowl's on later today, and next week little Suzie celebrates her fourth birthday. Fortunately, this football fan and parent will be able to participate in both of these activities, albeit at a slight time delay, due completely to the sophisticated, high-speed quasi-real-time multimedia/navigation MarsNet surrounding Mars and tying it to Earth. Capable of moving gigabits a second in either direction, the network supports not only the multiple manned and robotic science needs of teams and devices encircling Mars, but also the very real human need for communication.

The Mars Network: This network has its heritage in the earth-encircling telecom/navigation networks first implemented at the beginning of the century: Iridium, Globalstar, Orbcomm, the GPS constellation, to name a few.

Tied with an inseparable link to Earth (except during the two weeks surrounding conjunction and they're working to fix that), the network handles quasi real-time multimedia communications to and from the Earth, and real-time multimedia communications and navigation between the various Martian outposts and robotic and manned exploration teams.

Back on Earth, what used to be the NASA Deep Space Network (DSN) has evolved into a public-utility dedicated Mars-Earth long-distance provider. The DSN pioneered the art of deep-space spacecraft-to-earth communication, and logically served as the basis for early interplanetary planetary and deep-space communications protocols. Protocols, hardware and operations concepts were created and honed in the 1950's, but always remained very single-user-centric. Now, with with multiple ground stations on six continents keeping a high-speed data, timing and nav link operating between the two planets, this new deep-space network provides tremendous connectivity. At any time, there are at least two of these ground stations linked to the areostationary MarsSat Mark IV relay orbiters, a spinoff of the old TDRSS and commercial satellite systems at the turn of the century. These stationary spacecraft provide direct communications and navigation support to Mars surface and orbital assets. In addition, a low-Mars-orbit constellation of smaller, simpler spacecraft augment the areostationary MarSats to provide solid, regular service to the planet's poles and to micropower surface assets.

Enabling Exploration: It was recognized in the first decade of 2000 that the long-view plan for Mars robotic exploration required an orbiting infrastructure of telecommunications/navigations spacecraft. With this in place and responsible for handling the long-haul link between Mars and Earth, the missions arriving at Mars could use far more efficient, low-power, low-mass transceivers with either omni or electronically steered antennas to close the short link from the surface to the orbiters. These kilograms of mass and watts of power saved enabled each mission to do more science and eliminate the majority of operational constraints that the telecom solutions before had imposed. The original proposers of this network also considered that the infrastructure they created would serve as the basis of what would come next and would only change incrementally due to the difficulties and financial pressures always inherent in Mars exploration, and so they chose to take into account eventual human habitation and needs as a logical customer of their network.

Don't Reinvent the Wheel: The inablility to appreciate and make use of a good, solid design when it wasn't invented here is a dangererous thing. The development of telecommunications started in the 19th century with the first data transfers via telegraphy, to scratchy, tinny voices carried over a copper pair, to a worldwide infrastructure of reliable landline communications, to a nascent but exponentially growing infrastructure of wireless telecommunications. We have the benefit of all the things that have passed. Wireless communications is absolutely the norm now, with strong and robust standards including WCDMA, CDMA2000, advanced TDMA, IEEE 802.11, Bluetooth, etc. Hundreds of billions of dollars have been poured by commercial companies into these standards and equipment and this investment has created a host of multimedia networks that are well-tested and unrivaled by anything that has come before. The standards and the equipment that this investment has fostered can be used anywhere that humans can exist.

Where Do We Go From Here?: Proposed Mars communications standards reflect the philosophies and standards of the 40-year old NASA Deep Space Network. An amazing and fantastically successful system, it was never intended to perform multi-user communications, provide communications between remote users, and certainly was never designed to by symmetric. Adopting and adapting the existing and proposed commercial network/telecommunications standards is not only good business sense, but probably the only way that those videos from home will make it to Mars.