

## Re: Interplanetary communications protocols

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**From:** Paul Hovnanian P.E. (*Paul\_at\_Hovnanian.com*)

**Date:** 01/20/05

Date: Thu, 20 Jan 2005 00:21:38 -0800

To: sci-space-tech@moderators.isc.org

Ami Silberman wrote:

>  
> *"Henry Spencer" <henry@spsystems.net> wrote in message*  
> *news:IAIuML.C7s@spsystems.net...*  
> > *In article <1105902023.240764.257410@z14g2000cwz.googlegroups.com>,*  
> > *<dave.harper@gmail.com> wrote:*  
> > > *I was wondering what communications protocols have been used in the*  
> > > *past with probes traveling beyond the earth-moon system?*  
> >  
> > *The CCSDS protocols <<http://www.ccsds.org>> are essentially universal in*  
> > *deep-space missions, although there is some interest (mostly outside the*  
> > *traditional deep-space organizations) in TCP/IP as an alternative.*  
> > --  
> > *"Think outside the box -- the box isn't our friend." | Henry Spencer*  
> > -- *George Herbert |*  
> *henry@spsystems.net*  
> *Blech! I once assigned my Operating System class an assignment to look at*  
> *changes that would need to be made to TCP/IP to be used over interplanetary*  
> *distances. It makes a radio network look pretty awful. A cursory glance at*  
> *"Next-Generation Space Internet: Prototype Implementation" from the ccsds*  
> *site leads me to believe that the authors propose to use TCP/IP for*  
> *communication among and to/from a constellation of NEO satellites.*  
> *(Currently there are applications that do use a modified TCP/IP over*  
> *satcom.) Fundamentally, it isn't much different in concept that running it*  
> *over a radio net -- you have less bandwidth than in the wired world, and*  
> *much longer end-to-end delays.*  
>  
> *I don't see the point, however, for deep space missions. TCP/IP adds a lot*  
> *of overhead, mostly to manage routing and reliable delivery. Deep space*  
> *missions are essentially fixed to point to one of a small set of fixed*  
> *points, and the long time delay really prevents a sliding window*  
> *acknowledgement-based protocol. Ideally, you just want the ability to, if*  
> *you really have to get some data you missed in transmission, to request the*  
> *probe resend it. The only acknowledgements per se you need are those from*  
> *the probe in response to commands sent from earth.*

Agreed. But the question remains as to what sort of protocols are used

to check and acknowledge data packets. Some sort of protocol needs to be used to request re-sends or acknowledge proper receipt allowing the sender to delete data from its transmission queue. Additionally, TCP/IP provides a method to multiplex separate connections over one physical link.

The overhead of IP addressing supporting routing functions and bridging between differing physical media is overkill for simple deep space applications.

The TCP and IP protocols are only two layers of a complete communications system and don't address physical and link layer protocol issues such as modulation and error checking and correction.

> *One place that TCP/IP might be useful in a deep space mission is if you have  
> a constellation of sub-probes. Possibly a situation like Huygens where one  
> probe is acting as a relay for another might benefit from a stream-based  
> TCP/IP connection between the two probes, but for communication over  
> interplanetary distances it is probably a very suboptimal protocol.*

In this case, it would be conceivable that the relay satellite would provide a routing function. It would depend on the storage capacity and lifetime of the probes vs the relay platform. A request to re-send a data packet, forwarded through a relay to the originating probe would be useless if the probe had too short a lifetime or risked being destroyed or lost. A store and forward protocol (like e-mail) might be more appropriate.

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The large print giveth and the small print taketh away.  
-- Tom Waits