A Commercial Approach for using TCP/IP in Range Operations

Richard Prickett

Space Frontier Operations Inc.

A thumb nail of history is needed to base the premise for these proposals

The first computers used in Launch Range Operations were analog followed by analog converted to digital, discrete analog to digital, and then digital/digital

Custom systems, for custom uses, was the norm and black boxes to convert all of the data in what ever format to some other general format, was the standard.

Aerospace as an industry had many needs to compute.

- Raw data from sensors and mechanisms
- Controller operations
- Historical data storage
- Accounting and scientific development

All these needs seemed to require custom computers

These custom computers were not compatible with the other custom systems

Around 1974 networking of computers was getting some attention in the commercial arenas

IBM, DEC, APPLE, and other hardware manufacturers all had their own vendor-proprietary networking communication protocols, and unique cabling schemes.

None of these systems logically or physically would connect together with out some conversion

It was common to find an Apple computer connected to a network Novell server, to get to a Dec minicomputer, to utilize an IBM mainframe running SNA.

At KSC complex 39, the onboard Shuttle IBM GPC (General Purpose Computer) cabled to ModComp systems in the firing rooms, then to the RTIF (Real Time Interface), and on to the Honeywell 6680 CDS (Central Data Subsystem) with all this tied to TSS (Time Sharing System) terminals.

Every interconnection was a custom problem.

The ISO (International Standards Organization) began to formalize OSI (Open System Interconnection) as a standardizing scheme for all computers.

OSI (Open System Interconnection)

- OSI was originally backed by the US government.
- Huge in scope
- Difficult to understand
- Lost favor internationally

Same time frame a competing protocol called TCP/IP was being developed by the Department of Defense

Calendars had a date that TCP/IP would be dead and the OSI model would be “King”.

Thankfully this did not happen

TCP/IP (Transmission Control Protocol/ Internet Protocol)

- Developed as a volunteer team effort
- Became the international standard protocol of choice
- Driven by commercial development
- Well understood by many
- Computer addressing strengths

Addressing in computers is accomplished several ways but in order to understand why TCP/IP is so powerful the term MAC (Media Access Code) has to be conceptualized

A LAN (local Area Network) interface card, has a chip imbedded called a PROM (Programmable Read only Memory), which contains;

- A BIA (burned in address), that is a unique number.
- Unique numbering allows systems to be located strategically on a network by the mechanisms of TCP/IP,

At present there is a plethora of different equipment and protocols being utilized in range telemetry and operations functions.

A casual glance at any major juncture for communications indicates it to be a mess at best.

- Some nice equipment
- A lot of under performing, weak, old schemes
- Black boxes
- Odd cable configurations
- Local knowledge of custom setups

Black box approaches, although effective, are very expensive to develop, maintain, and require a more than competent staff to maintain their functionality.

We have ageing ground stations and telemetry sites all over the world that are being maintained at higher cost due to the (mil. Spec.) Standard being carried completely through the system.

TCP/IP can be a reliable, secure, efficient, and powerful protocol for data communication.

TCP/IP is about to go through a major Growth in addressing capability.

- This change will effect addressing capabilities exponentially

When TCP/IP is coupled with intelligent switching and routing techniques the data is reliably transferred to its destined target with surgical precision

In the event of a data path failure the intelligent switching and routing functions become initiated and through a short convergence time a new next path and secondary data path are identified and the data is again delivered with surgical precision

Proposal

Cheaper, faster, quality equipment can be acquired at a fractional cost to (mil. Spec.), for a great deal of the systems we are presently using.

Commercial, off the shelf products have been proven to be of high quality at fractional cost

- Certification related testing can be used to verify reliability under (mil. Spec.), conditions if required.

The purpose of this proposal development is **not** to suggest the elimination of (mil. Spec.) Protocols, such as (1553), but to suggest a migration to TCP/IP, and the associated internet related hardware, earlier in the scheme than presently being done.

Mobile telemetry stations consisting of self powered trucks and trailers could be assembled.

Transported to any place on earth.

A stable of mobile telemetry units could be pooled for quick replacement and reconfiguration, as requirements change

Reduction of cost for upgrades and basic repair cost can be accomplished by analysis of the ORU (optimum replaceable unit).

A rack mounted equipment scheme should be in the design enabling these mobile units to be serviced quickly and efficiently maintained

Rack mounted equipment is a rugged construction format, with highly flexible configurations being made possible by the uniform layout of the frames that anchor the equipment in place

Rack mounted equipment is by its structure considered commercial equipment and not manufactured from inferior components

These mobile telemetry sets could be connected to commercially leased internet band width which is now available in almost every place on earth and in space.

Mobile telemetry units designed to be universally connectable to the; internet, government owned, and commercially owned satellite systems could be one of the most powerful tools mankind might ever assemble.

By configuration of mobile telemetry units to be connected to both multiple satellites, and local internet resources, the alternate data path for backup reliability can be accomplished.

With each data path resource having the redundant data path feature, the reliability of this scheme approaches 100%.

To be leased internet resources that require upgrading could use the lease money to upgrade their hardware and as a side-benefit the new and improved WWW (World Wide Web) now becomes an active part in the entire space endeavor as part of a global community.

Commercial television stations and networks use a similar scheme in their normal mobile camera operations.

This band width is everywhere, is cheap, and by the ads' we see on TV and other media these leasers of band width are competing with each other to sell it.

The advances that have occurred in the technology and improved connect ability of the WWW has been driven by the money involved to keep its performance up.

It is, a pure business attribute, that if a segment of the WWW is weak, and not performing with respect to its fiscal capabilities it would be upgraded or replaced in short order.

This is a great advantage to a customer of the band width, and becomes a no loose situation because the maintenance is the responsibility of the supplier for this band width and shifts a great fiscal load away from the space related agency.

A semi canned agreement plan could be developed so that most lease agreements would be identical in form and simplifying the discussion with possible suppliers of the bandwidth for their services.

With a pay as you go lease agreement only the bandwidth actually used would impact the cost of the endeavor, further reducing the cost of utilizing these resources.

From the commercial standpoint "consortiums" of bandwidth providers could be formed

- to further improve their performance,
- reliability,
- and reduce their cost,
- which would in turn reduce the direct cost for the endeavor.

On the security side of the discussion, TCP/IP was a development which had its' roots in the Department of Defense.

- In the basic design security was paramount.
- TCP/IP being reliable and with present data encryption techniques all data communication can be secured with minimal overhead cost.

There are other problems and advantages not brought to light here, but many solutions can be analyzed for the best approaches.

New launch trajectories could be explored due to the flexibility of strategic positioning for mobile telemetry equipment.

Time stamping when required can be included in data fields instead of in the protocol control areas.

The true benefits of this flexibility can not even be imagined until the scheme is invoked.

Finally, the construction of another layer of mesh to fabric of Earth communications is not limited to space or range operations, this could be used for helping solve many problems globally.