NASA/Contractor Partnership on the Second TDRSS Ground Terminal Program - Breaking Barriers

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In December of 1988, NASA awarded a contract to GE Aerospace for development of the Second TDRSS Ground Terminal, a major addition to NASA's Space Network. This ground terminal was planned to enhance availability of user service by providing a backup to the existing White Sands Ground Terminal and to provide the additional capacity needed to support the growing needs of the '90s.

This paper briefly introduces the STGT Program from its technical and programmatic backgrounds and then describes several techniques to enhance communication and empower the NASA Contractor team. A major factor in our success was an approach we used to shorten the time span of the Critical Design Review phase. This approach is described. The relationships involving NASA's O&M contractor are discussed. The paper concludes with a set of lessons learned.

STGT Description

Figure 1 shows the architecture of the Space Network including the Second TDRSS Ground Terminal. The purpose of the network is to relay data from satellites in low earth orbit to the scientific users and manned flight controllers for such missions as the Space Transportation System, Hubble Space Telescope and in the not-too-distant future, Space Station Freedom. The Network is scheduled by the Network Control Center at the Goddard Space Flight Center and ultimately relays mission data to and from the various Project Operation Centers. The relay satellites are in geosynchronous orbits providing ready access to user satellites. The currently existing White Sands Ground Terminal is located in Las Cruces, New Mexico, just west of the San Augustine mountains. The Second TDRSS Ground Terminal is being installed and tested in a 85,000 square foot facility, three miles north of the existing terminal. In the final configuration the two stations share operations of the relay satellites and provide the needed capacity for user service.

Programmatic Background

STGT is a very robust architecture with a highly distributed design, automated switching to redundant equipment, and sophisticated signal processing. Technically challenging, STGT is also being developed to an aggressive schedule. These factors combine with a large number of contributors to the program. We at GE had over 500

people at the peak point of the program as well as 15 large subcontracts. NASA Goddard, as the customer, is supported by a System Engineering contractor and the contractors who operate the existing White Sands Terminal and who will operate STGT following achievement of Initial Operational Capability in January 1994. These ingredients demand frequent and tight communications to meet the challenges of this development program.
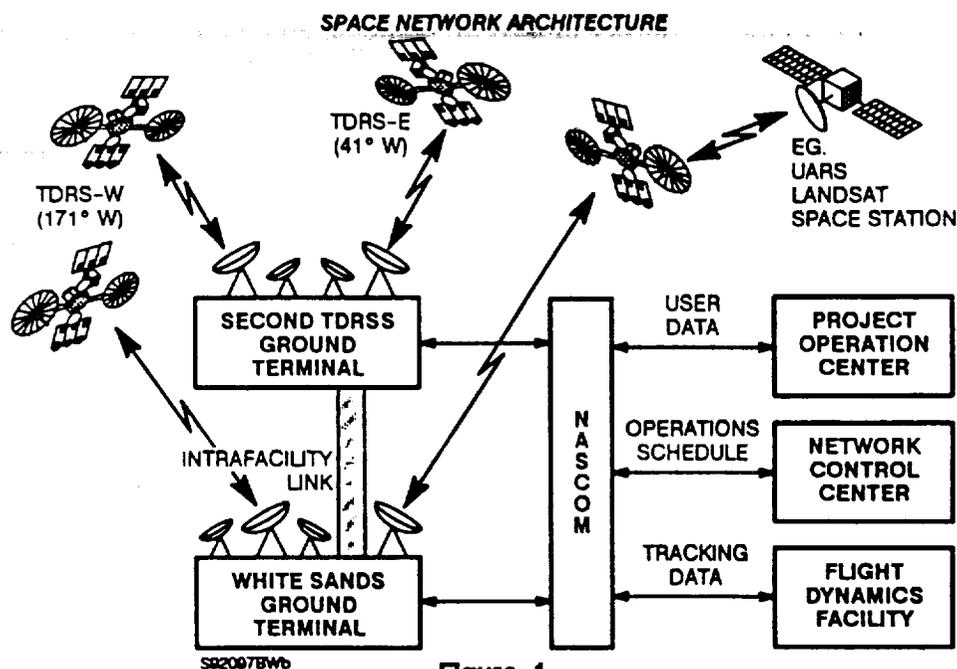
SPACE NETWORK ARCHITECTURE

Figure 1.

Enhanced Communication on STGT

We began our development for STGT with two broad concepts for communication. First, we (NASA and GE) began by holding progress reviews on a six week cycle. After a few sessions, we established a format for these that everyone was comfortable with. We had one or two days of detailed technical sessions and then a full day, program level review, during which we addressed all key areas. One criterion we established early was that these sessions were open to all program participants; NASA Headquarters as well as our direct customer at Goddard, NASA's associate contractors and our own subcontractors. We decided that for a team to work effectively all the participants should be hearing the same data at the same time. With the exception of financial data, we ran these meetings, and the entire program in fact, as an open book.

On a day to day basis we also insisted on open communications among all participants at all levels. Both NASA and GE put out lists of personnel showing their areas of responsibility and phone numbers. This was definitely unstructured and was not constrained by points of contact or rigid manager to manager interaction. It was not anarchy either. There were a number of natural NASA-Contractor relationships which provided a beneficial degree of channeling. One observable of wide open

communication is the speed with which "hot" news, especially bad news travels. There are some who want to be the first to fill in the boss on a juicy tid-bit and sometimes that can get the system agitated. On balance, it produces positive results. If a real problem is surfacing, it gets attention quickly. If it's a red herring, the rumor gets squashed just as quickly.

Two kinds of video conferencing were used as tools in our open style. One is the more typical video room with the capability of several cameras and wide band transmission to include slides and video tape. The second tool was a desk top system that can be thought of as a picture phone. They are small desk top units that connected my office directly with the NASA Project Manager for literally, face-to-face phone conversation. Both of these techniques worked well saving much travel time and money. On the other hand, old habits die hard; the desire (and need) for some face-to-face, in-person contact remains.

Enabling the Team

While the flow of meetings and the use of video conferencing may be indicative of open communications, there were two specific areas that exemplify the philosophy. As in all managed organizations, NASA ran a weekly staff meeting. Staff meetings can frequently be the forum where private data is discussed or where the restricted participation creates an "us against them" mindset. The NASA staff meetings were viewed as just another team function. NASA's support contractors and GE participated fully thereby emphasizing the team feeling.

GE for its part provided open access to project data, schedules, milestones, and discrepancy reports to name some specifics. What's more, most of this was computerized, so we granted access to NASA and to their support contractors to our computerized data files. All individuals were treated the same way in terms of being granted logon identifiers and passwords. The key observation here is that once a user is in the system, he or she can browse in other areas of information. In order to grant access in this broad way requires trust, trust that people are working together to meet common goals. The attitude that is created is a very positive one and a very powerful one.

Compressed Design Reviews

In the Critical Design Phase of the development, GE was planning for a series of design reviews with each of our subcontractors. Our first thought was to review each subcontractor's work ourselves and then to summarize the process for our customer, NASA, in a subsequent review. When we laid out a detailed plan, we found that we needed to fit 55 design reviews into a six month window and if each review meant two meetings, one with the subcontractor and one with NASA, that over 100 meetings would

be needed in the six month period. We concluded that was not practical. Having been operating under an open communication philosophy, the obvious idea surfaced; let all the reviewers sit down one time and do the design review once. That was the plan we adopted. Yes, there were risks. Suppose a particular design area was weak. Would NASA criticize GE for not staying in control of the subcontractor? How would we react when NASA tried to direct our subcontractors? We came up with lots of frightening scenarios but at the bottom line, we had no choice. Time was too short to conduct all the reviews in a way that would control all the data and discussion and also meet the schedule. Raising all these issues explicitly helped us formulate the detailed, do-it-once, plan of attack. The result was we met the very demanding schedule for the Critical Design Review. We had excellent synergy in the review team since GE, NASA, and NASA's associate contractors were all represented. Finally we all kept our relationships in focus so that subcontractors got their direction from GE; we in turn worked with our customer, NASA. We clearly took some risk in this approach, but our team trust and open discussion won the day.

NASA Operations and Maintenance Approach

The plan for STGT is for a GE development followed by operations and maintenance of the station by NASA and their O&M contractor. NASA has separate contractual relationships with the O&M personnel as an integral part of the development approach. Today there are about 50 O&M personnel in residence at our facility in suburban Philadelphia. They receive formal training and they also receive hands-on experience with the hardware and software as we are developing it. The O&M contractor personnel provide operational insight to our GE developers as well as direct assistance in a number of development tasks. One barrier that has been surmounted is the fact that we have competitors in our development facility. This creates an instinctive reluctance to work together. Here again, we took a very pragmatic approach and did all we could to ensure success. We feel that all the Government's objectives have been met. Their O&M contractor personnel are becoming well trained and experienced and GE has benefited from the operational expertise and direct labor support.

Lessons Learned

All efforts to instill a sense of teamwork and open communication worked with some making a larger contribution than others. All of our joint meetings and reviews, whether live or via video conferencing, worked very well. The single pass design review process made an impossible task possible. In my experience in this area a few themes rise to the surface:

1. In dealing with open communication and people's natural desire to be the bearer of good (or bad) news, it is possible for the same news item in several sets of words to race around your program community, what I would term an information race

condition. When this happens, a little patience is required to sort out the sometimes conflicting versions and get down to the real issue.

2. There will be times when constraints are needed and communications must be focused through points of contact. This can happen when the organization is running at a high level of stress because of an impending deadline or some crisis. On STGT, this also came about because of how we were organized. NASA had a functional structure (e.g., hardware or software) while GE was more product focused. This led to situations where a single contractor person spent their time in open communications with many individuals at the temporary penalty of their responsibilities being compromised. Generally, these spells ended quickly and were self-healing.

3. Open communication, teamwork, and authority can all be consistent if everyone is aware that the prime contractor works for the government and the subcontractors have their responsibility to the prime.

4. As in sports, each player has to trust all of the other team members. When all one's energy can be focused on winning and no energy is sapped on wondering "what if he......." or "suppose she.......", then partnership and full team work develop. At this level the team is not guaranteed a victory but the team will play the game to its fullest potential.