UTTR BEST TELEMETRY SOURCE SELECTOR

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ABSTRACT

The UTTR (Utah Test & Training Range) offers the largest over land test and training airspace in the continental United States. It provides excellent telemetry data processing capability through a number of TM (telemetry) sites. Selecting the best source of telemetry data for optimum coverage from these many sites can be very involved and challenging for ground station personnel. Computer-based best source selection automates this process, thereby increasing accuracy and efficiency. This paper discusses the capabilities of the BTSS (Best Telemetry Source Selector), its background, design and development, applications, and future at the UTTR.

KEY WORDS

Best source selector, frame synchronization, data router, data analyzer, and UTTR

INTRODUCTION

In the days of analog microwave transmission on the UTTR, our TM coordinator accomplished best source selection by viewing analog wave forms on small oscilloscopes. This task became increasingly difficult in recent years as the UTTR began transmitting telemetry streams over a new digital microwave system. Consequently, The Air Force tasked CSC (Computer Sciences Corporation) to develop an automated BTSS.

RESEARCH

The initial plan was to purchase a number of PCM decommutators and then track the status of each one for best source selection. However, insufficient funds and a high price tag made this a costly and unpopular method. We then searched for a source of inexpensive cards that performed only frame synchronization, this being the only function we needed from the decoms. The solution for switching also presented a problem. The switch inputs needed to be digital and not degrade the signal at high data rates. We were unable to find a COTS solution. Consequently, our hardware engineer developed four types of cards for our system:

1. frame sync (allows for best source selection)
2. matrix or mux (used for data routing)
3. I/O (input/output)
4. BNC (adapts I/O lines to/from ribbon cable)

OBJECTIVE

Our goal for the system was that it must be:

- a low-cost solution
- able to switch one to many automatically
- redundant
- easy to operate
- useful

The BTSS needed to not only select the best source, it had to be a useful tool in other areas as well. The definition and scope of this goal were at our discretion. Our motto for the project was "No Assumptions." Our desire was to make the most of the system.

ARCHITECTURE

The BTSS consists of a 20 ISA-slot, rack mounted PC. A single board computer takes up 2 slots. The rest of the slots are comprised of 13 frame sync boards, four mux boards, and one I/O board. For redundancy, we built a second, identically configured PC (see Figure 1).

The 4 mux cards in the BTSS allow for 32 data/clock inputs and 32 data/clock outputs. The mux configuration follows a one-to-many approach, meaning that any of the inputs can be connected to any or all of the outputs. The first 13 inputs are routed to the frame sync cards (in addition to the mux cards) to enable best source selection. The remaining 19 inputs can be used for simulator inputs, tape inputs, or any other TM data source. The 32 outputs are mainly utilized by the TM processing systems. There are four best source outputs that return to the ground station patch panel. These are used to record the best source data to tape or simply for monitoring purposes.

Two workstations – each consisting of a monitor, a keyboard, and a mouse – control the two PCs. The workstations and PCs are connected together by a matrix switch. The workstations can switch between either of the PCs by a simple keyboard operation. Both workstations may be switched to the same PC simultaneously.

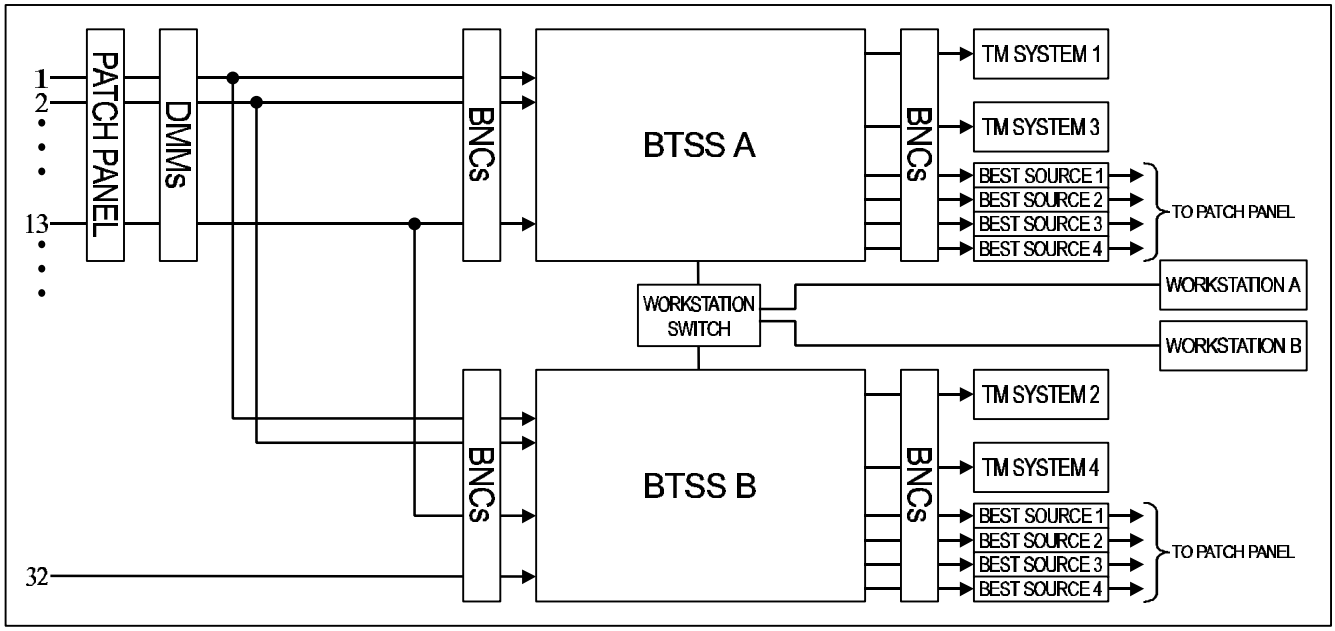

Figure 1: System Architecture

FUNCTIONALITY

The system has three functions: (1) best source selection, (2) data routing, and (3) data analysis.

Best Source Selection

The BTSS allows two or more sources to be combined into teams. Because there are 13 frame sync sources, the system allows for up to six teams. All 13 sources could be assigned to the same team. The system selects a best source from each of the teams.

Data Routing

The BTSS allows outputs to be connected to team best sources or to individual sources during setup and during real-time. Any source or team can be connected to any output. Connections remain in effect until the software selects a new best source or the user makes a new connection.

Data Analysis

The system provides many analysis tools. A frame lock plot appears on the main display. This plot displays the last 10 seconds of lock percentages. Different lock percentages are shown in different colors. There are three different thresholds or ranges. The top range is displayed in green, the middle range in yellow, and the bottom range in red. The user defines these ranges during setup. This plot is not only useful during real-time to show trends, it is also very useful during pre-mission checkouts. The plot is a great indicator of whether a source is supplying solid data or not.

Statistics are calculated and are also a very useful analysis tool. A running total of the historical frame lock percentage provides meaningful insight on how different sources stack up against each other during a mission and from mission to mission. A running percentage of the time each source was used as a best source is also very useful. This statistic indicates which sources are the most important and how many sources are really useful and needed.

Another means of analysis is available through archiving data read from the frame sync cards and position information from a telemetry system. Here, the historical percentages and totals are also provided. The data from this archive file provides the opportunity to map the data quality of a source around the range. This allows our TM personnel to identify blind spots where mobile telemetry sources may be positioned to allow for better coverage. Given the size of the UTTR, this is very helpful information (see Figure 2).

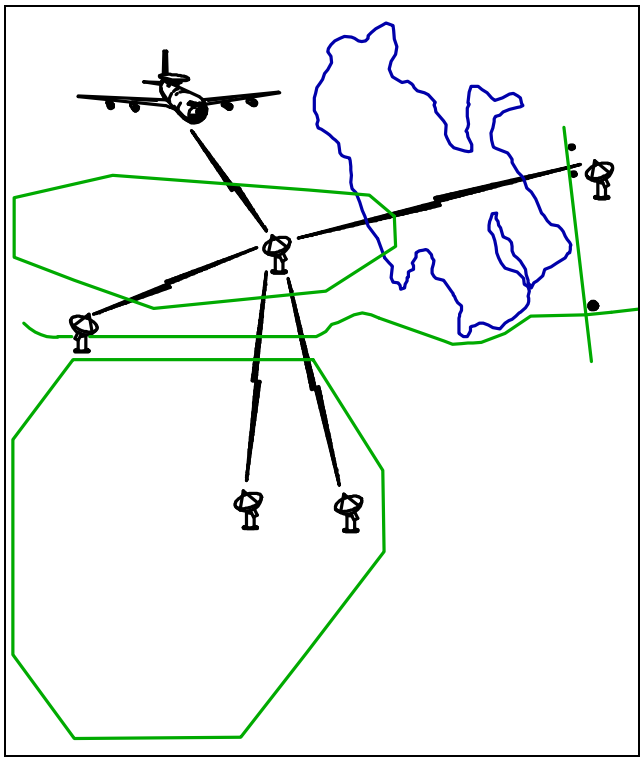

Figure 2: UTTR and TM Sources

BENEFITS

The BTSS provides the UTTR with many benefits. Besides the analysis opportunities and faster switching (down to 3ms) for improved data coverage, the BTSS allows our TM coordinator to focus more on other important aspects of her job. For example, she is now able to spend more time identifying and solving communications and equipment problems.

OPERATION

The BTSS is setup by entering information in three dialog boxes: (1) a frame sync dialog box, (2) a switch dialog box, and (3) a statistics dialog box.

Frame Sync Card Setup

The first dialog box contains information for the frame sync cards. The user enters the frame sync pattern, the frame sync strategy, the number of bits between frame sync patterns, and the stream data rate for each frame sync card. Here, the user also enters two best source selection parameters: (1) the number of milliseconds between frame sync card polls and (2) the number of frame locks that a source must have beyond the current best source in order to be selected as the best source. Each time the frame sync cards are polled, the system checks to see if a new best source should be selected for each of up to six teams.

Switch Setup

The second dialog box contains switch information. The user enters a label for each input and output that will be used, selects a best source team for each of the frame sync sources, connects outputs to the best source of a team or to an individual source, and enters a mission title.

Statistics Setup

The third dialog box contains information about statistics. The user enters the archive rate, options for inclusion of position information and IRIG time, and the choice of statistics to display during real-time. The following parameters are available for real-time display:

1. the historical frame lock percentage
2. the percentage that each source has been selected as the best source for its team
3. the number of bits detected in the latest frame sync card poll
4. the number of frame syncs detected since the last screen update
5. the number of frame locks detected since the last screen update
6. the number of compliment frame syncs detected since the last screen update.

The information entered in these dialog boxes can be saved in a configuration file that can then be opened and loaded into the system at any time.

During real-time operation, users have various options available to them. They are able to make connections between individual sources and outputs, and between the best source of a team and any outputs. Users are able to delete individual sources or outputs, change the team assignment of a frame sync source, and start or stop the archiving of statistics.

The real-time display includes a button for each defined source and output (see Figure 3). Each button contains the label entered by the user on the switch setup dialog box. The current connections between sources and outputs are displayed – the best sources being color-coded. Each team has a unique color. Connections between an individual source and an output are drawn in black. Each defined frame sync

card source also has a frame lock box that shows the current quality of the source. The box is colored green if the frame lock quality is good, yellow if the quality is average, and red if the quality is poor. Each frame sync card source has a combo box that allows the user to change the team assignment. Finally, each frame sync card source has a box that shows the stream polarity. If the box is red, the stream has normal polarity; if the box is black, the stream in inverted.

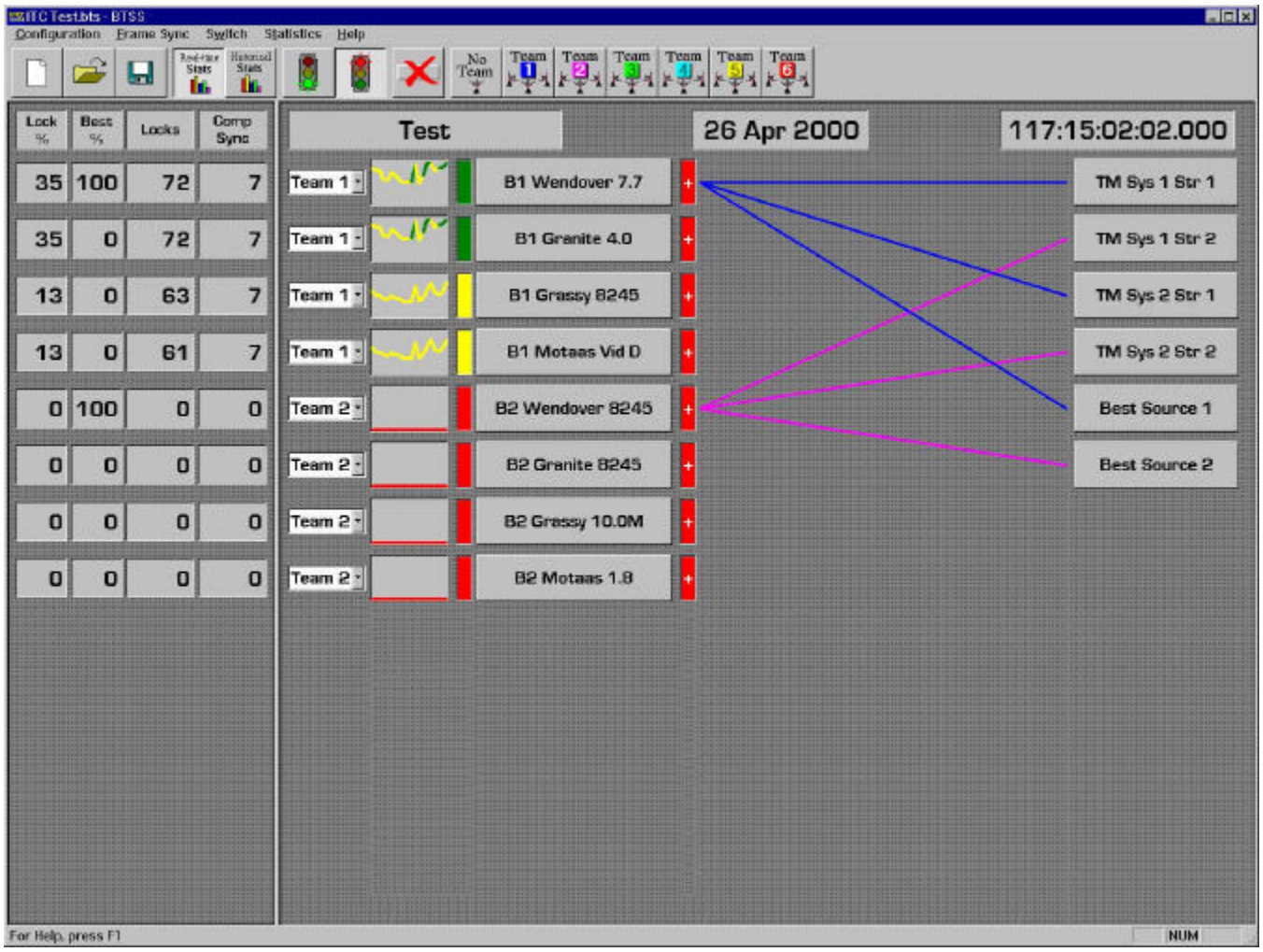

Figure 3: BTSS Screen

CONCLUSION

The BTSS has proven itself to be a highly effective, low-cost solution for automatic best source selection, data routing, and data analysis. We plan to upgrade the BTSS in the future, moving from an ISA back plane to a PCI back plane. We also plan to design new PCI frame sync cards capable of handling four streams each. This will enable us to increase the number of frame sync sources, and therefore teams, that can be handled.