This ATM is in response to a request by MSC on 11 August 1966 at the Interface Conference for documentation of technical characteristics and schedule impact of a change in the word format of the Active Seismic Experiment. It also serves to document Action Item B6-0805-5B, which states "Bendix to evaluate Stanford proposed data format;" this Action Item was answered informally, Dye to Kovach, on 11 August 1966.

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SUMMARY

This ATM describes and compares three different word formats for the Active Seismic Experiment. These are designated Present Design, Alternate 1 and Alternate 2.

The Present Design meets the requirements of Exhibit B, ALSEP Technical Specification, specifically Sec. 3.2.2.8.1 ("7-bit digital words sampled no less than 486 times per second from each of three geophones"). It permits determination of time of first output from the geophones due to seismic energy to ± 1 m sec; except when energy arrival occurs during the control word, and then time determination is to ± 2 m sec. The Present Design does not sample the geophones at equal time intervals, due to loss of samples during control word transmission.

Alternate 2 is identical to the Present Design, except that the control word occurs one-half as often. Consequently, the probability is one-half that of the Present Design that energy arrival will be detected to only ± 2 msec instead of ± 1 msec. Geophone output is still sampled nonuniformly. BxS recently (5 August, at Stanford) suggested the possibility of converting the Present Design to Alternate 2 to reduce probability of degrading time of arrival measurement accuracy. However, further investigation has revealed an increase by a factor of 8 in the time required for the MSFN receiver to synchronize, or to resynchronize if sync is lost. For this reason, BxS is opposed to implementing Alternate 2.

Alternate 1 is an adaptation of a word format proposed by Stanford to meet the specific requirements of the Active Seismic experiment design. It uses 5 bit words for each geophone, instead of 7 bit words. Its principal advantages are: (1) ± 1 msec accuracy of time of arrival determination; (2) uniform sampling of geophones. It also permits MSFN receiver sync and resync in a shorter period of time than the Present Design.

As shown on the schedule herein, conversion from the Present Design to Alternate 1 would delay completion of prototype and qualification models past the dates that the Active Seismic Experiment could be incorporated into Flights #1 and #2 (i.e., as Array A backup). Hardware would be available for Array B, Flights #3 and #4. If a parallel design were started now on Alternate 1, the Present Design could be used to meet Flight #1 and #2 dates, and Alternate 2 design could be used for Flights #3 and #4. If the Active Seismic Experiment were not flown on Flights #1 and #2, then the Present Design hardware could be refurbished to convert it to the Alternate 1 design to be used as spares.

FRAME AND WORD FORMAT

Figures 1 and 2 illustrate the frame and word format of the Present Design and the Alternate #1 respectively. Alternate #2 is similar to the Present Design except that there are 128 21 bit words per frame; that is 1 control word plus 127 seismic data words per frame.

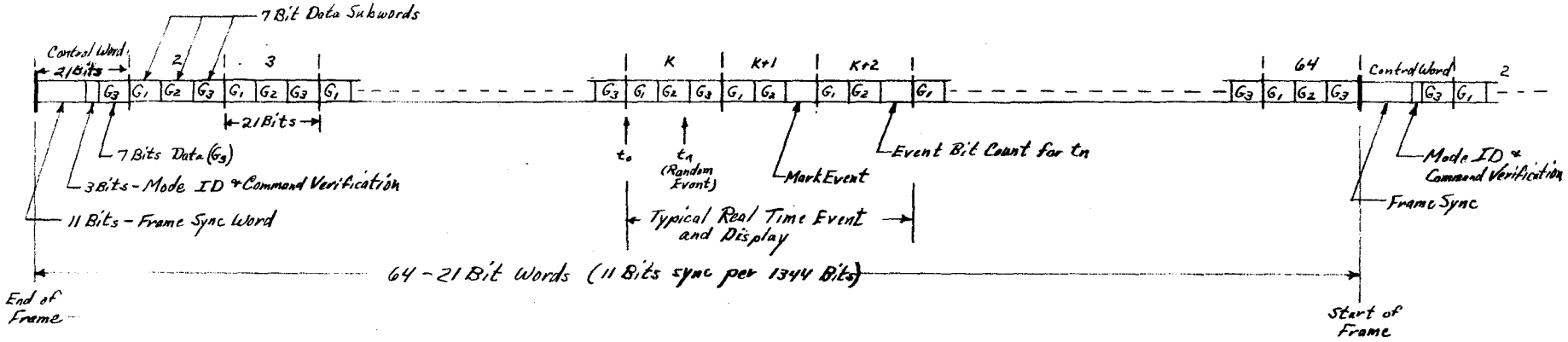
In comparing the Present Design and Alternate #1, both systems have the capacity to transmit all engineering data and can indicate real time events to $\pm$ .1 millisecond. The geophone sampling rate for the Present Design is $49\overline{3}$ per second which compares to 503 per second for Alternate #1.

ALSEP-MSFN LINK SYNC CHARACTERISTICS

Table 1 compares the Sync Characteristics of the ALSEP to MSFN link for the three word formats. Note that the sync and resync time for Alternate 1 is 1/3 that of the Present Design; however, the sync and resync time of Alternate 2 is 8 times that of the Present Design.

Figure 1

Present Design
Seismic Data Format



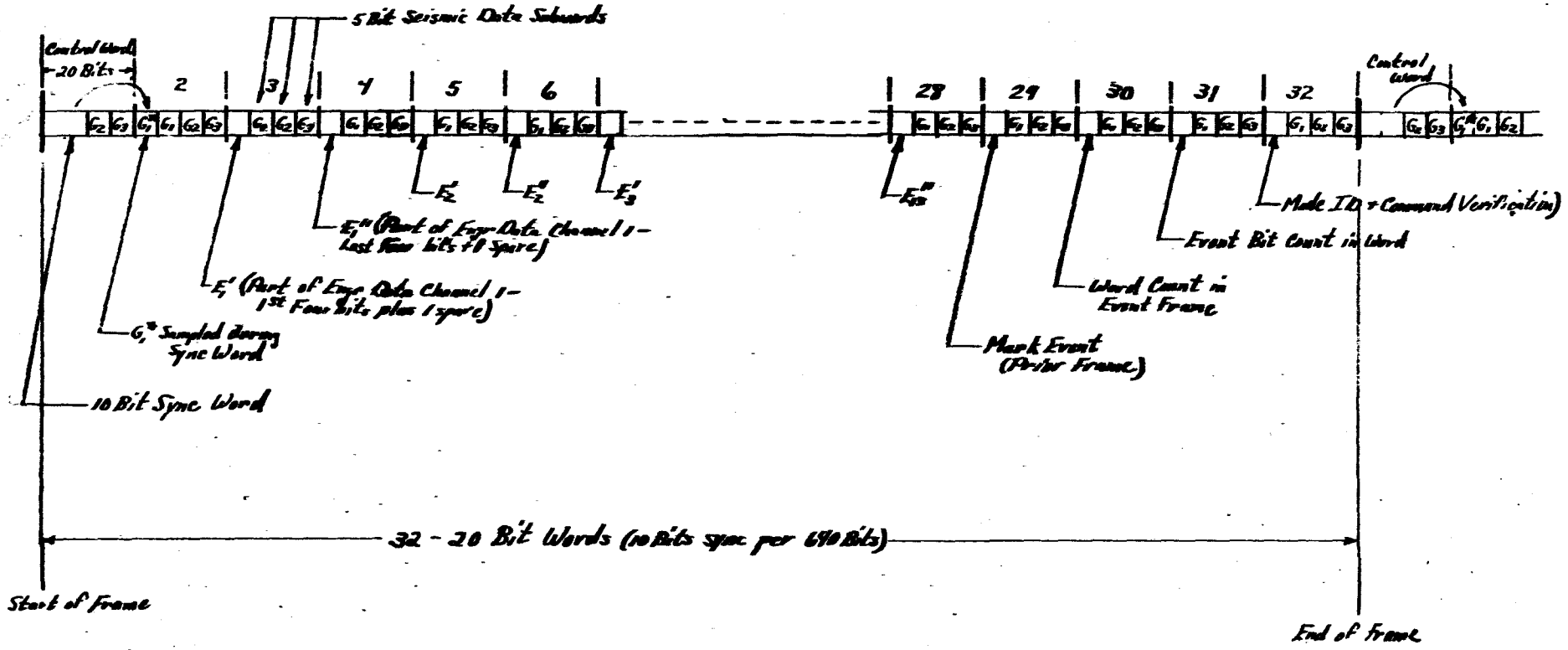
Notes

1) $G_1 G_2 G_3$ - Geophone Data (7 Bits)

2) Engineering data obtained by 2nd data mode in which all 21 Bit Seismic words are replaced by 21 bit Engineering words. Channels 2 thru 16 read out 4 times each frame. Channel 1 read out 3 times each frame.

3) Real Time Events are events such as Thumper ASI Shock or Grenade Impact & Explosion Instant.

Figure 2
Alternate No 1



Notes

1) G_1, G_2, G_3 - Geophone Seismic Data (5 Bits)

2) Real Time Events are events such a Thumper ASI Shock or Grenade Impact + Explosion Instant.

3) Engineering Data Read out 8 Bits in 2 Subwords ($E_n' + E_n'' = E_n$)

TABLE 1

COMPARISON OF ALSEP-MSFN LINK SYNC

	Present Design 11/1344	Alternate 1 10/640	Alternate 2 11/2688
Probability of False Sync on Data	0.6×10^{-1}	0.64×10^{-1}	1.25×10^{-1}
Probability of Sync Word Recognition	0.9989	0.9990	0.9989
Probability of Losing Sync per Sync Word	2×10^{-6}	1.2×10^{-6}	2×10^{-6}
Number of Frames Required to Sync, or Resync	12	8	48
Time Required to Sync, or Resync when Sync is Lost	1.6 sec	0.51 sec	12.8 sec

IMPACT ON DESIGN EFFORT TO CHANGE FROM PRESENT DESIGN TO ALTERNATE 1

Brassboard logic hardware is complete except for 6 flat packs which have to be added to an existing board; checkout will be complete 1 September. Change to Alternate 1 design would require detail logic design of complete digital portion of central station electronics, then fabrication and test of a new Brassboard (logic portion).

Logic design for Engineering Model is complete. Art work on 15 printed circuit boards (5 triple layer logic units) is 60% complete; final release date for all art work is 23 August.

There are a total of 41 drawings (logic diagrams plus art work for printed circuit boards and assembly) which would require complete redrawing.

Alternate 1 would require the same number of circuit boards for the Engineering Model and subsequent hardware as the Present Design. Consequently, hardware using the Present Design could be refurbished to the Alternate 1 configuration by replacement of the digital logic assembly plus rewiring of the central electronics. Thus, should it be desired to proceed with Alternate 1 design in parallel with the Present Design, refurbishment of prototype, qualification and flight hardware is technically feasible.

The Experiment Test Set would require changes in control logic and front panel display; however, the design change would not be as extensive as in the experiment electronics.

SCHEDULE TO CONVERT FROM PRESENT DESIGN TO ALTERNATE 1

Figure 3 compares the current schedule for the Active Seismic Experiment with the revised schedule which would be necessary to convert from the Present Design to Alternate 1 design. Although there would be a 13 week slippage in completion of a new brassboard, the slippage can be reduced to 9 weeks for completion of Engineering Model tests. Prototype and Qualification hardware would be available with slippages of 8 weeks and 7 weeks, respectively. These slippages would prohibit the Active Seismic Experiment from entering system level prototype or qualification testing as an Array A backup experiment. Hardware would be available, however, for Array B qualification tests.

Bendix Systems Division, Ann Arbor, Michigan

MANAGEMENT CONTROL PLAN SCHEDULE

Active Seismic - Schedule for Alternate 1 Format Change

No: ATM-463	Revision	Group
Issued On:	Revised On	P/C Check

Line	Item	CY 19 Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	CY 19 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	CY 19 Jan	Feb	Mar	Apr	May
1																												
2	Brassboard Model	Completion; Current Schedule △ ← 13wks →																										
3	Design Electronics																											
4	Design Mech.																											
5	R-4 Release																											
6	R-6 Release																											
7	Issue PR																											
8	Receive Elec. Materials																											
9	Fab/Assy																											
10	Test																											
11																												
12	Engineering Model	Completion; Current Schedule ← 9wks →																										
13	Design Electronics																											
14	Design Mech.																											
15	R-4 Release																											
16	R-6 Release																											
17	Issue PR																											
18	Receive Elec Materials																											
19	Receiv Mech Materials																											
20	Fab & Assy																											
21	Test																											
22																												
23	Prototype Model																											
24	R-4 Release																											
25	R-6 Release																											
26	Fab/Assy																											
27																												
28	Master Sched. Proto. Tests, Array A																											
29																												
30	Qual. Model																											
31	R-4 Release																											
32	R-6 Release																											
33	Fab/Assy																											
34																												
35	Master Sched. Qual Tests, Array A																											
36																												
37																												
38																												
39																												
40	△ = Current Schedule.																											
41																												
42	◇ = Schedule for Alternate 1 Design																											
43																												

Digital Portion ← 8wks →

Digital Portion ← 7wks →

Subsystem Integration

Subsystem Integration

Approvals			MCP SCHEDULE	WBS Level	1	2		3	4	5	
Project Engineer Resp. for PWO	Program Control	Supervision	Page ____ of ____	PWO No.							
				PWO Title							

970-15C

Fig. 3