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Our Cover: Final preparations were under way for test of the Phase IIIB satellite when this photo was taken. Gordon Hardman, KE3D/ZS1FE performs the task with precision.

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Ellipsis...

An Editorial By Vern Riportella, WA2LQQ*

Poised as we are on the brink of substantially new ways of communicating with the rest of the world's amateurs, it might be a particularly good time to briefly examine how we got here in the first place. More important even than the lessons of the past, we suspect, are the methods we use to plan for the future. How will they be different as we bridge from Phase II to Phase III and later satellites?

For the last 20 years or so satellites have been "born" mostly of opportunity. Launch opportunity. Given a specific "ride," our people have consistently come up with the resources to build a piece of hardware which made the most of what they had available. Under these circumstances, however, it is difficult to plan for the long term. After all, why should one build an attached garage when it is unsure that the house will be standing when the garage is done?!?

Seen another way, the time between available launches has tended to be similar to the life of the satellites we've built. AMSAT-OSCAR 7 was a notable exception in that it maintained a substantial fraction of its overall mission capability until nearly twice its design life had elapsed. Thus we had at that time the rare pleasure of having TWO OSCARs to enjoy concurrently. Now of course we are immersed in wealth of sorts having (would you believe it?) 7 (or 7½) satellites to enjoy. But still with expected usable lifetime comparable to intervals between launches, it remains difficult to think in terms of multi-satellite systems, system capability and so forth.

In fact, until now we have been building these marvelous little machines one at a time. Given the limited resources, volunteer environment and costs involved we wonder how it could possibly have been done differently. That is, given the terribly risky nature of getting "here" from "there," it is difficult to reckon more than even a few alternate paths to where we now find ourselves. Frankly, we've gotten here by a rare combination of good fortune and the sweat, guts, heartbreak and determination of less than a score of key "doers."

The complexion of our very special hobby will be markedly changed by this time next year. Thousands, perhaps tens of thousands of potential new satellite users will appear all at once on the scene responding to the enormously attractive vistas Phase IIIB will paint. AMSAT leadership has wrestled with the problems perceived in responding to a ponderous growth impulse such as is forecast by some. On the positive side of the forecast growth is the anticipation that with growth will come the resources to change the way we do "business." The planning business, that is.

Thus, as we stand on the brink of Phase III, we bridge two great ages in amateur satellites. Until now we've been treating amateur satellites as if they were experimental. All the OSCARs and RSs which have flown have required special equipment and, more important we suspect, special knowledge and training. Let's face it. OSCAR 8 doesn't come with an automatic transmission. Some folks can't drive stick shift, you know! Our growth has been limited by the nature of folks who want to turn on their radios and have the darn thing there to use...almost like the ionosphere. But Phase III will mark the beginning of amateur satellites as a *utility*. With easier use will come the utilitarians. Their presence in our numbers will allow us to approach the task of planning in new and exciting ways. Moreover, the advent of long-life satellites will prove conducive to thinking in terms of multi-satellite systems; in terms of system capabilities.

Given a steadily growing user base from which to draw resources we can for the first time *afford* to design systems the way they should be designed. In the past the "driver" in system design has been mainly what we could accomplish within certain limited envelopes. First came the basics; the ride itself; where the ride was going and how much weight it could carry determined just about everything in all previous amateur satellite missions. Indeed this overall constraint persists since it largely dictates what will become of Phase IIIB. It will likely affect Phase IIIC also when a ride is confirmed for it. In the future we may be able to specify a long-term goal and then build in the short-term to meet that goal. Perhaps a concrete, familiar example will help to illustrate the idea.

Early in his Presidency, John Kennedy crystalyzed national resolve by setting a long-term, ambitious, imaginative goal: To place a man on the moon in the decade of the Sixties. As we recall it was done in 1969. But to attain that goal required the efforts of millions of individuals, billions of dollars and most of a decade. But in the end it worked. It worked to put a man on the moon. It worked because to reach that lofty goal required the attainment of millions of smaller, intermediate goals.

(Continued on page 7)

**Editor-in-Chief,* ORBIT *Magazine*

Apple II Computer Antenna and Station Control System

By William D. McCaa, Ph.D.,* K0RZ

Personal Computers are quickly taking hold in the Ham Shack. Here we find the PC controlling major station functions.

The microprocessor control of satellite ground station antenna systems is certainly not a new subject to the amateur satellite user. Over the years, the amateur journals have published numerous technical articles on this subject. However, most of these require that the prospective builder have a good understanding of computer programming, electronic digital circuits, and circuit board construction practices. It is the intent of this article to provide the satellite user who already has an Apple-II Computer a how-to-do-it simply and effectively, without undertaking an extensive construction project and programming effort.

The system as described can be used to perform in *real time* a number of station functions. It can be used to point the antennas, control the station ac power, select the appropriate station transmitter, rf power, and receiver, correct for doppler shift, and do most if not all of the station functions that a satellite user must do while operating a pass. In addition, the software can be prepared so as to provide the operator a *real time* display of the satellite status of several satellites simultaneously, their Reference Crossing, time remaining in the present pass, time to next pass, and antenna pointing data for other ground station locations.

Fig. 1 is a photograph of the CRT display for Boulder, Colorado driven by the Apple-II. The display does not scroll but instead updates a stationary line at a time. It requires about 35 seconds for the entire screen to update. The top line displays the date and time in UTC. The second line indicates that the antenna system is tracking RS-4. Inverted video is displayed whenever the system is locked and tracking a selected satellite. Looking across the fourth through the eleventh line we see the following data displayed for each satellite: the name, the present orbit number, the ground track or sub-satellite point latitude and longitude, the time in minutes to the next acquisition of AO-8, UO-9, RS-6, and RS-3, or if the satellite is in range the time remaining in the pass until loss of signal as is the case for RS-8, RS-4, RS-5, RS-7 and finally the azimuth and elevation to each satellite in range. The bottom set of lines thirteen through twenty display the reference data for each satellite as well as the UTC time of acquisition and loss of each satellite.

General System Configuration

The Apple II computer controls the pointing of satellite antenna systems as well as other station functions automatically thru the use of a Mountain Computer 16 Channel A/D + D/A board and Apple Clock board. The Apple II must be equiped with Applesoft in ROM or a Language System, 48K of RAM, and at least one Disk II drive, as well as the above mentioned Mountain Computer boards. The rotators must be capable of providing a DC voltage proportional to their position and have their brake released during tracking times. The A/D + D/A operates between −5 and +5 VDC and rotators that provide a higher position voltage can be used by dividing the voltage down to the 5 volt level. In addition to the hardware already mentioned the user will have to construct a few simple circuits to enable telling the Apple II what satellite to track, and to allow the Apple II to control the rotators and any other function desired such as powering the station on acquisition of a selected satellite.

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