Evolution of the Geodetic Media Pool

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Abstract Over the years, VLBI has upgraded its recording capabilities by transitioning from thick to thin tapes, then thin tapes to disks, and currently the plan is to transition from Mark 5 disk recording with proprietary hardware and software to Mark 6 disk recording with open source software, commercial off-the-shelf hardware, and higher bandwidth for VGOS stations. The purpose of this paper is to show how this process will affect the geodetic media pool. Currently there are about 34 legacy stations participating in the IVS Observing Program that use the Mark 5 recording system. According to the VGOS Observing Plan [1], eight VGOS stations, including three converted legacy stations, will be operational by the end of 2014. We show the impact of the VGOS Trial Operations in 2015 and the VGOS Pilot Project in 2016 on the geodetic media pool. This includes the projected number of modules needed to maintain the Mark 5 pool for legacy stations and the projected number of Mark 6 modules needed to support the Trial Operations and the Pilot Project. We will also provide an estimate for the number of Mark 6 modules that need to be purchased by each station to support regular VGOS observing as well as an annual purchase of Mark 6 modules needed to mitigate media pool attrition.

Keywords Media, legacy stations, Mark 6, VGOS

NVI, Inc.

1 Introduction

Over the years, VLBI has transitioned from thick to thin tapes and then to disks. The geodetic media pool is currently comprised of Mark 5 modules from various stations and institutions. Each module contains eight disks, all of one type, either PATA (Parallel ATA) or SATA (Serial ATA). Most of the older and smaller

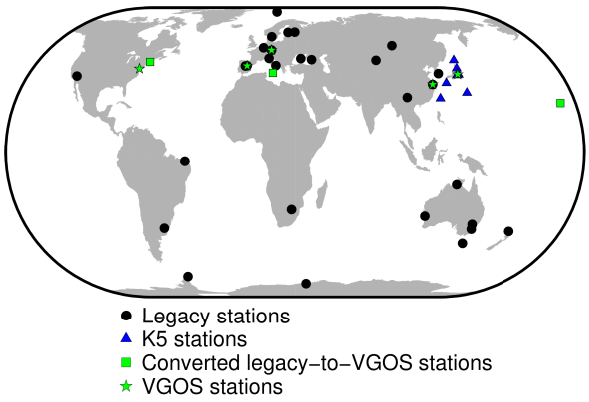

Fig. 1 A world map displaying a graphic view of the various types of geodetic stations that will support VGOS observing starting during 2015, according to [1]. The networks will increase from a proposed eight in 2015 to 16 in 2016 to 30 by 2018. Legacy stations use Mark 5 SATA and PATA modules only. Many of the legacy stations e-transfer their data to the correlators, which cuts down on shipping costs. K5 stations do not require modules at their site because the data is recorded on their servers. The K5 stations' data is e-transferred to the correlator from their servers. There are three stations that are converted legacy-to-VGOS stations: Kokee, Westford, and Noto. Westford currently switches from S/X to VGOS by changing receivers manually. Soon Westford will switch between the two receivers electronically. There are five VGOS stations that are tentatively scheduled to be operational by 2015: Ishioka, Sheshan, GGAO, Yebes, and Wettzell. GGAO has recorded broadband data.

modules are PATA, and all of the newer larger modules are SATA. The SATA modules can be converted from Mark 5 to Mark 6 by replacing the chassis for a nominal price. Although our plan is to use new Mark 6 modules for the VGOS observing, eventually we may have to convert some Mark 5 SATA modules to Mark 6 due to budgetary reasons. The Mark 6 geodetic pool may consist of the converted Mark 5 modules and newly acquired Mark 6 modules. The size of the modules in the geodetic media pool currently ranges from 0.96 TB (A-size) to 16 TB (L-size), and the modules are used for recording Mark 5 data only. Our plan is to transition from legacy Mark 5 recording to VGOS Mark 6 recording. According to the VGOS Observing Plan [1], eight VGOS stations, including three converted legacy stations, will be operational by the end of 2014 (see Figure 1). The focus of this paper is to determine what effect this change will have on the current media pool, future purchases, and maintenance of two geodetic media pools (Mark 5 and Mark 6).

2 Mark 5 Media Pool

We anticipate that the Mark 5 media pool will be static except for replenishment. Figure 2 shows how many modules of a particular size (A-size - 0.96 TB, B size - 1.4 TB, etc.) are needed to support the legacy stations for 2015 and beyond based on the 2014 media requirements. Also displayed are the available modules in a particular size and how many of those modules are PATA or SATA modules. There are not enough D-size (2 TB) and G-size (4 TB) modules. The correlators can ship the larger modules to the stations to compensate for the lack of smaller modules.

As in Figure 2, Figure 3 shows information about the number and the size of modules when adding a future CONT campaign. There are not enough modules of certain sizes. Some of the larger modules will be used to supplement the smaller modules. In addition, the 56 modules listed in Table 1 will be requested as a loan or purchase to support the next potential CONT campaign. Table 1 displays the number of modules needed per station to support regular legacy observing based on the 2014 observing level. The replenishment rate is based on a 5% failure rate, which is an estimate.

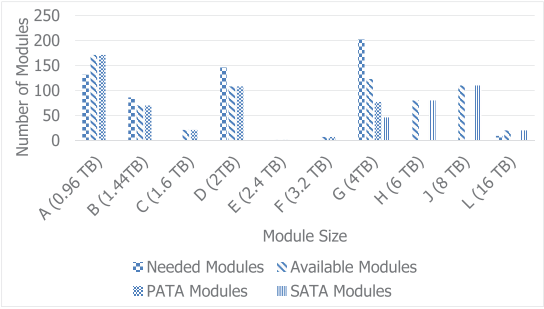

Fig. 2 Number of modules needed to support regular geodetic legacy observing.

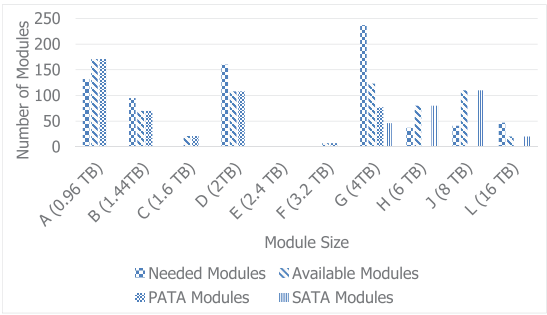

Fig. 3 Number of modules needed to support regular geodetic legacy observing plus a CONT campaign.

3 VGOS Observing Plan

As stated in the VGOS Observing Plan [1], there will be three trial VGOS campaigns starting in 2015. Each campaign will span a six-week period. It is estimated that one or two 32 TB modules per station, per day will be needed to support the three campaigns. The data will be processed and the modules released before the start of the next campaign. The first test campaign will need at most 12 32 TB modules per station to support the six 24-hour B7 sessions, a total of 96 modules. The B7 sessions will start on Sunday at 00:00 UT and end on Monday at 00:00 UT. The first trial campaign will be scheduled during a six-week period between January and April 2015. The tentative participating stations are Kokee, Ishioka, Sheshan, GGAO12, Westford, Yebes, Wettzell, and Noto. The S/X observing will not conflict with the first VGOS Observing Plan trial.

The second test campaign will consist of four one-hour sessions every six hours for six consecutive weeks. The six new VGOS stations will not participate in the S/X sessions. The new VGOS stations will

Table 1 Modules needed to maintain legacy geodetic observing. First, this table represents the total annual usage based on the current level of observing. Second, media has to be replenished based on failure rate and TB used.

Station	Bd	Ft	Ht	Hh	Ho	Hb	Ke	Kk	Km	Ma	Mc	Mh	Nt	Ny	Oh	On	Kv	Sh	Sm	Sv	Ag	Ur	Ww	Wf	Wz	Yg	Ys	Zc	Total
Regular Observing Usage	11	21	21	16	8	28	28	28	5	24	19	6	10	28	5	17	23	11	7	11	24	11	20	20	28	28	20	28	506
Annual Failure Rate - 5% (Replenish)	1	2	2	1	1	2	2	2	1	2	1	1	1	2	1	1	2	1	1	1	2	1	1	1	2	2	1	2	40
Additional CONT Need (2017)	8	0	0	0	8	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8	0	0	0	0	8	56

record the one-hour sessions every six hours without any interruption. Noto does not participate in the regular weekly R1/R4 sessions. Noto can be scheduled to avoid switching between S/X and broadband observing, but Noto has decided that they do not want to participate in the last two test campaigns. Kokee and Westford both participate in at least one of the weekly R-series. Westford will be able to switch electronically between S/X and broadband, so the second test campaign should not be a problem for them. It is unknown at this time how the transition between S/X and VGOS will operate at Kokee. According to the VGOS Observing Plan [1], the broadband media will be shipped out once a week. This is a potential complication that needs to be worked out, because the R-series are shipped as soon as the sessions are completed. The second trial campaign will be scheduled during a six-week period between May and August 2015. No additional modules will be needed because it is anticipated that the first trial campaign will be processed before the start of the second test campaign.

The third test campaign will be scheduled like the second test campaign but the data will be e-transferred to the correlators during the five-hour gaps. The third trial campaign will be scheduled during a six-week period between September and December 2015.

4 VGOS Geodetic Media Pool

The first proposed eight VGOS stations are GGAO12, Ishioka, Kokee, Noto, Sheshan, Westford, Wettzell, and Yebes. There are now no 32 TB Mark 5 or Mark 6 modules in the geodetic pool. As shown in Table 2, the first eight stations will need to purchase 12 Mark 6 modules per station to have sufficient media. The modules will need to be purchased during 2014 to be available for recording during January through April 2015. The additional eight stations scheduled

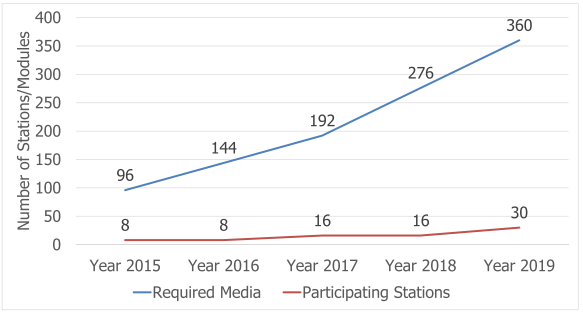

Fig. 4 The number of modules needed to support VGOS Operations from 2015 through 2019 is being displayed. 32 TB modules will be required. The initial 96 modules will have to be purchased in 2014 to support the 2015 Trial periods.

to participate in 2016 are Santa Maria, Tenerife, Flores, Onsala, Metsahovi, Changchun, Kunming, and HartRAO. In preparation for 2016 VGOS observing, these stations should purchase half of the needed modules in 2015 and the remainder in the first quarter of 2016. The two smaller purchases should be easier on each station's budget. The additional 14 stations scheduled to participate in 2018 are Ny-Ålesund, Badary, Zelenchukskaya, Ussurisk, Kaliningrad, Kokee, Hobart, Katherine, Yarragadee, Warkworth, and four new NASA stations. Each of the 14 participating stations should purchase 12 modules for the Mark 6 geodetic media pool. Each of the 14 stations should purchase six modules in 2017 and the remaining six in the first quarter of 2018 to put less strain on their budgets. In order to keep the media pool up to date with respect to attrition, each of the 30 stations should replenish the media pool with one module annually starting the following year after their initial purchase.

5 Special Considerations

In addition to the information already presented in this paper, there are some special considerations that should

Table 2 Start-up and maintenance of the VGOS media pool.

Information	8-Station Network	Additional 8 Stations	Additional 14 Stations
Total Purchase in 2014	96		
Total Purchase in 2015		48	
Total Purchase in 2016		48	
Total Purchase in 2017			84
Total Purchase in 2018			84
Failure – 5%	5	5	8
Replenish per station & year	1	1	1

be addressed when making final decisions about the legacy Mark 5 and VGOS Mark 6 media pools.

First, the PATA Mark 5 modules cannot be converted to Mark 6. As more Mark 5 legacy stations convert to Mark 6, the older PATA modules will be used less.

Second, the SATA Mark 5 Modules can be converted to Mark 6 by replacing the chassis for approximately 495 USD per module. The decision will have to be made, based on how many Mark 5 legacy stations will convert to Mark 6, and whether it is preferable to keep all of the current Mark 5 modules as Mark 5 or convert them to Mark 6. The failure rate of the older PATA modules will have to be factored into the decision as well.

Third, Kokee, Noto, and Westford will not contribute to the legacy geodetic pool once they become VGOS-only stations and do not switch between S/X and VGOS observing.

Fourth, the TRACK program needs to be updated or replaced and maintained to support the Mark 5 and Mark 6 geodetic pool. The TRACK program was developed by NRAO to keep up-to-date information on media (initially tapes and later modules) in the media pool. Fortunately, we just learned that NRAO is in the midst of a major TRACK overhaul. NRAO asked for input regarding the overhaul, and input will be provided.

Fifth, the 5% failure rate is an estimate, because currently there is no program or tool that can be used to keep track of the statistics. This is an additional feature that will be suggested to NRAO for the new version of TRACK.

6 Conclusions

The geodetic media pool will transition from Mark 5 to Mark 6 over the next several years, until VGOS is fully established. This paper shows the necessary media purchases to establish and maintain the geodetic media pool. An update or replacement of the TRACK program, which is in progress through NRAO, is needed to manage the media pools properly.

References

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