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The Composition of the Master Schedule

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Abstract

Over a period of about four months, the IVS Coordinating Center (IVSCC) each year composes the Master Schedule for the IVS observing program of the next calendar year. The process begins in early July when the IVSCC contacts the IVS Network Stations to request information about available station time as well as holiday and maintenance schedules for the upcoming year. Going through various planning stages and a review process with the IVS Observing Program Committee (OPC), the final version of the Master Schedule is posted by early November. We describe the general steps of the composition and illustrate them with the example of the planning for the Master Schedule of the 2010 observing year.

1. Introduction

One of the major tasks of the IVS Coordinating Center (IVSCC) is the creation and maintenance of the yearly observing plan—the Master Schedule. The Master Schedule is the central tool for coordinating and optimizing the usage of available resources such as station observing time, correlator time, and recording media. Given the importance of the observing plan, the Master Schedule is prepared for an entire calendar year well in advance of the start of the year. The IVSCC commences work for a new Master Schedule in early July of the preceding year by sending a request to the IVS Network Stations for their available station time as well as for their holiday and maintenance schedules. Furthermore, a request is sent to the IVS Correlators for their loading potential. After going through several planning phases and a review process with the IVS Observing Program Committee (OPC), the final version is made available on the IVS Web site by early November. However, the Master Schedule continues to require maintenance, because updates during the year need to be made for stations going “down”, for additional or canceled sessions, or for correlator changes.

2. Master Schedule Creation Process

The IVS observing program follows the overall structure as outlined in the general guidelines of the IVS Working Group 2 report. It consists of several series of 24-hour observing sessions and daily 1-hour Intensive sessions. The program is planned by the OPC, coordinated by the IVSCC, and executed by the Network Stations, Operations Centers, and Correlators. The result of the observing program is data held in the Data Centers, which is then available for analysis.

The general steps involved in creating the Master Schedule for a new observing year are illustrated in Figure 1. The IVSCC contacts each station about their availability for the upcoming observing year and each correlator about how much data they can process. The acquired information is used to formulate the Station Usage Chart and the Correlator Projection Report. The

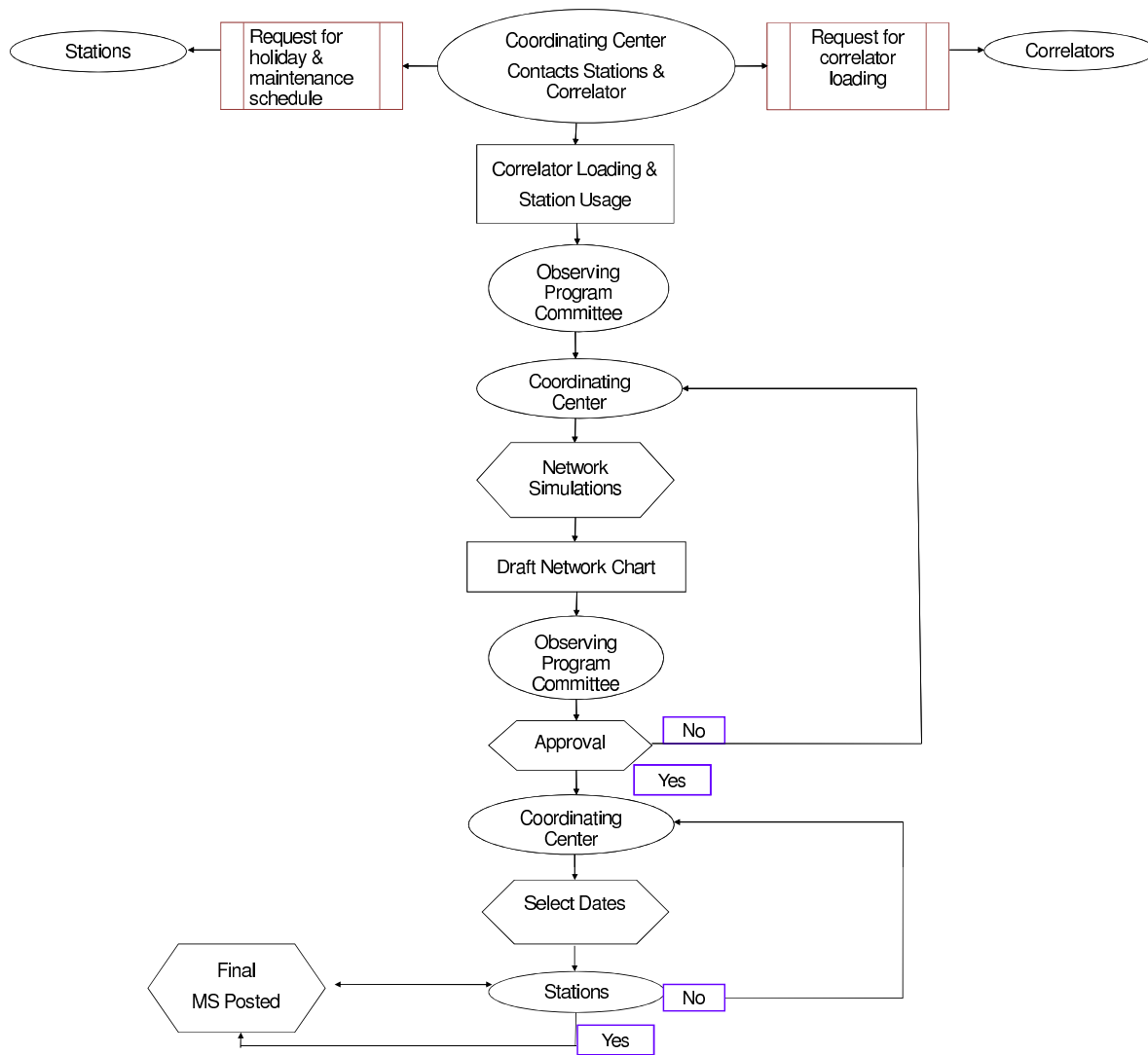


Figure 1. Flowchart showing the general steps of how the master schedule is created.

Station Usage Chart (Figure 2) displays each station’s availability for the upcoming year and the number of times each station will participate in various session types. The Correlator Projection Report (Figure 3) displays which sessions will be processed at each correlator, the number of sessions processed at each correlator, and the estimated processing factor for each session. After the report and the chart are produced, the information is presented to the OPC for review. At that time the IVSCC asks the members of the OPC for any additions or changes for the next observing year. Any suggested additions or changes are taken into consideration when formulating the next year’s observing schedule.

The IVSCC organizes the available station time into the various networks. Then simulations are done for the IVS-R1 and IVS-R4 networks to ensure that the EOP guidelines are met. The simulation results along with the various networks are incorporated into the Draft Networks Chart

2010 STATION USAGE CHART

23-Sep-09 C. Thomas

NETWORK SIZE	9-SIN		12-SIN		8-SIN		15-SIN		3&4-SIN		2-SIN		8-SIN		7-SIN		16-SIN		9-SIN		2010		2009		
	52	2	6	7	6	3	6	3	12	6	10	6	52								TOTAL	%	Availability	Actual	
STATIONS	MON	TUE	TUE	TUE	TUE	TUE	TUE	TUE	TUE	TUE	WED	WED	THU	TOTAL	%	Availability	Actual	Usage							
Aira				7																9	100%	9	10		
Badary - MSB		2		1										39	42	100%	42			9	100%	9	10	Availability early Nov.	
Chichijima		2		7										9	100%	9			7	100%	7	5	3		
DSS13				4										7	100%	7			5	100%	5	3			
DSS15				2										2	3	100%	3		6	100%	6	3			
DSS45				2										8	100%	8			8	100%	8	3			
DSS65				6										8	100%	8			8	100%	8	5			
Effelsberg				2										2	100%	2			2	100%	2	2			
Fortaleza	32			4			3		3					52	100%	100			52	100%	52	0			
HartRAO - EVN	26			1			3				12			4	52	100%	52		17	100%	17	62			
Hobart 26m	6			1							3			4	17	100%	17		17	100%	17	62			
Hobart 12m	33	2		2			3				12			6	2	23	83	100%	83	0					
Ishigakijima				7										7	100%	7			7	100%	7	3			
Kashima-4m				1			3							4	100%	4			11	100%	11				
Katherine	13	2		2							12			6	16	43	100%	43	48	100%	48	0			
Kokoe	26	2		1			3				6			10	4	52	104	100%	104	100%	104	104			
Matera	13			2			1							2	1	33	52	100%	52	50	100%	50			
Medicina - EVN				2			1							2	19	24	100%	24	24	100%	24	23			
Metsahovi - 3mm				4			3							7	7	100%	7		7	100%	7	6		Prefer multiple session	
Mizusawa				7										7	100%	7			7	100%	7	3			
Noto - EVN				6			3							12	100%	12			12	100%	12	7			
Ny Alesund - MSA & B	52			2			2							6	10	6	15	87	100%	87	79				
OT Hoggins				2										8	100%	8			8	100%	8	11			
Onsala - EVN & 3mm	13			3			2							8	26	100%	26		26	100%	26	23			
Parikes MSB		2									4				7	100%	7		7	100%	7	3			
Seshan - EVN	13	2					5							20	100%	20			20	100%	20	22		Only 10 sessions from	
Simeiz				6			6							12	100%	12			12	100%	12	3			
Shiratsukawa		2												2	100%	2			2	100%	2	3			
Svetloe	13			2			1							26	42	100%	42		60	100%	60	60		Availability early Nov.	
Syowa											6			6	75%	8			8	6	75%	8	6		
Tigo	46			7							6			8	52	119	99%	120	115	99%	120	51			
Tsukuba	52	2		7										10	6	77	74%	104	51	74%	104	51			
Urumbi		2		7										9	75%	12			12	9	75%	12	9		
Warkworth	13	2		6							12			3	11	47	100%	47	0						
Westford - MSB	52			4			105							24	6	62	91%	68	46	91%	68	46			
Wetzell	52			6			7							10	6	52	133	99%	134	99%	134	131			
Yarragadee	13	2		2							12			3	16	48	100%	48	0						
Yeboe - MSB & EVN				4			1							13	18	100%	18		18	100%	18	16			
Zelenchukskaya				1										1	39	42	100%	42	58	100%	42	58		Availability early Nov.	
# OF SESSIONS	52	2		60			77			5.5	3.0		12.2	68	10	6.0	57.8	163.8							
Total Days	468	24		48			115			22	6		73	54	70	36	462	1378							
Targeted Sin Days	468	24		48			105			24	6		72	48	70	36	468								
Extra Sin Days	0	0		0			10			-2	0		1	6	0	0	-6								

1. The numbers listed in the availability column in red have not been confirmed.
 2. The black and red numbers listed in the IVS-CRF column represent two different networks.

Figure 2. Station Usage Chart. The total station days at the bottom of the chart show which networks utilize most of the station resources.

2010 CORRELATOR PROJECTION REPORT

2010 CORRELATOR PROJECTION REPORT

9/7/2010-C. THOMAS

EXPERIMENT	ESTIMATED CORRELATOR USAGE				HAYSTACK USAGE				WASHINGTON USAGE				BONNI USAGE							
	# OF NO. STNS	OBS. DAYS	P FACT	CORR DAYS	# OF NO. STNS	OBS. DAYS	P FACT	CORR DAYS	# OF NO. STNS	OBS. DAYS	P FACT	CORR DAYS	# OF NO. STNS	OBS. DAYS	P FACT	CORR DAYS				
IVS-R1	52	9	52.0	1.0	52.0															
APSG	2	10	2.0	1.0	2.0					2	10	2	1.0	2.0						
IVS-T2	7	14	7.0	7.0	49.0	1	14	1.0	7.0	7.0	3	14	3.0	7.0	21.0	3	14	3.0	7.0	21.0
IVS-CRFMS	3	2	3.0	1.0	3.0						3	2	3.0	1	3.0					
IVS-CRF	6	4	6.0	1.0	6.0						6	4	6.0	1.0	6.0					
EUROPE	6	9	6.0	1.0	6.0															
IVS-CHMG	6	8	6.0	1.0	6.0															
AUSTRAL	12	6	12.0	1.0	12.0						12	6	12.0	1.0	12.0					
R&D	10	6	10.0	1.9	19.0	10	6	10.0	1.9	19.0										
IVS-R4	52	9	52.0	1.0	52.0						52	9	52.0	1.0	52.0					
Total IVS	156	156	156	207	207	11	11	26.0	26.0	26.0	78	78	96.0	96.0	96.0	67	67	85.0	85.0	85.0
	88%		88%	95%	95%	100%	100%	100%	100%	100%	89%	89%	91%	91%	97%	97%	97%	93%	93%	
VLBA	6	17	6.0	0.0	VLBA															
Total RDV	6	6.0		0																
	3%	3%		0%																
INTENSIVES																				
IN110	213	2	8.9	1.0	8.9						213	2	8.9	1.0	8.9					
IN110	24	3	1.0	1.0	1.0						24	3	1.0	1.0	1.0					
IN210	104	2	4.3	0.0	GSI															
IN310	49	3	2.0	1.0	2.0											49	3	2.0	1.0	2.0
Total Intensives	1625	163	163	11.9	11.9	9%	9%	9%	9%	9%	9.88	9.9	9.9	9.9	9.9	2.04	2.0	2.0	2.0	2.0
											11%	11%	9%	9%	3%	3%	3%	2%	2%	
Total Planned SGP	178.3	178.3	218.9	218.9	218.9	11	11	26	26	26	87.88	87.9	105.9	105.9	105.9	69.04	69.0	87.0	87.0	87.0
Total Actual SGP																				

Maximum loading is 250.5 days (48.0 + 202.5)

24.0 hrs/wk @ 52 wks = 52.0 days (Haystack Allowance)

80.

and presented to the OPC for approval. The Draft Networks Chart (Figure 4) displays the various networks with simulated EOP results and other schedule information. There are several networks within each session type; for instance, there are 52 IVS-R1 sessions with five different networks. If the upcoming observing program is not approved, suggested changes and/or comments are used to run additional simulations. This process is iterated until the OPC approves the upcoming observing schedule.

2010 DRAFT NETWORKS

Tuesday, September 29, 2009
C. Thomas

Session	Day of Week	Week	# of Stations	# of Sessions	# of Str Days	Network	X	Y	UT1	PSI	EPS	Comments	# Obs	San Hrs	Tc/ Hr.	Avg Sca	Avg GB	Avg SNR	Med SNR	
R1370	Mon	\$09MAR16XA	8			NyWwWzTsKkHoMaTc	342	36.1	1.5	8.1	23.9	Simulation	3994	17.0	11.0	93	1174	53.328.7	40.25	
R1370	Mon	\$09MAR16XA	8			NyWwWzTsKkHoMaTc	40.0	40.0	1.5	73.0	31.0	Actual	3994	17.0	11.0	93	1174	53.328.7	40.25	
R12010B	Mon	Random	9	6	54	NyTsWwWzFHHKkYgJk	35.84	38.02	1.42	57.20	17.9		828	25.0	14.0	58	2218	32.348.4	55.35	
R12010C	Mon	Random	9	7	63	NyTsWwWzTcHkKkYgJk	33.24	33.83	1.50	80.80	15.8		739	24.0	14.0	69	2478	33.851.4	50.35	
R12010D	Mon	Random	9	7	63	NyTsWwWzFHHKkTcMa	31.40	35.96	1.61	41.20	16.9		804	20.0	15.0	70	2131	33.453.0	45.35	
R12010D1	Mon	Random	10	6	60	NyTsWwWzFHHKkTcMaHo							822	19.0	14.0	66	1948	37.182.4	50.35	
R12010E	Mon	Random	9	10	90	NyTsWwWzFHHHhTcWw	33.30	34.92	1.53	55.50	14.5		5140	20.0	13.0	68	2008	33.648.2	50.35	
R12010F	Mon	Random	8	3	24	NyTsWwWzFHHhTcWw	33.52	35.22	1.56	44.80	16.6		4318	19.0	13.0	66	2054	33.647.4	50.35	
R12010G	Mon	Random	9	13	117	NyTsWwWzHhOnShSvTc	34.09	35.58	1.45	56.80	21.8		6888	18.0	13.0	61	1648	134.582.6	8045	
APSC	Tues		12	2	24	AiChHkKkPaSns3TsuRwWYg														
EUROPE	Tues	Every 2nd month	8	2	16	65NiSmWzVhNysOnBd														
EUROPE	Tues	Every 2nd month	8	1	8	65NiSmWzVhNysOnZc														
EUROPE	Tues	Every 2nd month	8	1	8	65NiSmWzVhNysSvMa														
EUROPE	Tues	Every 2nd month	8	1	8	65NiSmWzVhMcNvEbMa														
EUROPE	Tues	Every 2nd month	8	1	8	65NiSmWzVhMcNvEbsv														
IVS-T2	Tues	January	16	1	16	AiChMzTcTsUrWzOhF4513kKkNiShSmMh														
IVS-T2	Tues	March	15	1	15	AiChMzTcTsUrWz1365HhMcNvSvSmWw														
IVS-T2	Tues	May	15	1	15	AiChMzTcTsUrWz1365HhNkKkShSmWw														
IVS-T2	Tues	July	16	1	16	AiChMzTcTsUrWzF8d13kKkVwNkShSmYg														
IVS-T2	Tues	September	15	1	15	AiChMzTcTsUrWz15FhMaMhOnSmWwZc														
IVS-T2	Tues	October	15	1	15	AiChMzTcTsUrWz15FhMhOnSmWwYsSh														
IVS-T2	Tues	November	16	1	16	AiChMzTcTsUrWzOh45HhHkKkYgNiSh														
IVS-CRF	Tues	Random	5	1	5	15HhKkPa														
IVS-CRF	Tues	Random	4	2	8	15HhKkPa														
IVS-CRF	Tues	Random	3	3	9	FHHhT														
IVS-CRFMS	Wed	Random	2	3	6	Ft13														
AUSTRAL	Wed	Random	7	3	21	HHhKkVwYgHo45														
AUSTRAL	Wed	Random	6	3	18	HHhKkVwYg45														
AUSTRAL	Wed	Random	6	4	24	HHhKkVwYgPa														
AUSTRAL	Wed	Random	5	2	10	HHhKkVwYg														
IVS-OHIG	Wed	February	8	3	24	FiHhHoHkKkOhTcSv														
IVS-OHIG	Wed	November	10	3	30	FiHhHkKkOhTcSvKkVwYg														
R8D	Wed	Random	7	6	42	NyTsWwWzKkOnTc														
R8D	Wed	Random	7	2	14	NyTsWwWzKkMa														
R8D	Wed	Random	7	2	14	NyTsWwWzKkOnTc														
RDVE2	Wed	Every 2nd month	16	4	64	VakbNyTsWzHhKk														
RDVF2	Wed	Every 2nd month	16	1	16	VakbNyTsWzHhZc														
RDV2	Wed	Every 2nd month	16	1	16	VakbNyTsWzHhMa														
R4382	Thur	\$06JUN10XE	8			KkTcWzSvNyhObdZc	41.7	44.9	2.2	87.3	30.8	Simulation	3045	11.0	6.0	122	568	122.856.1	8045	
R4382	Thur	\$06JUN10XE	8			KkTcWzSvNyhObdZc	48.0	48.0	2.0	100.0	35.0	Actual	3045	11.0	6.0	122	568	122.856.1	8045	
R42010A	Thur	Random	9	13	117	FkKtCwZbBdHhKkMcYg	37.0	55.8	2.3	60.8	23.8		3713	13.0	9.0	155	1548	105.253.7	50.35	
R42010B	Thur	Random	9	6	54	FkKtCwZbBdHhKkMcYg	39.6	53.0	2.4	80.2	30.2		4117	11.0	10.0	151	1387	112.651.8	70.35	
R42010C	Thur	Random	9	7	63	FkKtCwZbBdHhKkMcYg	41.6	54.9	2.5	88.0	30.0		4156	11.0	10.0	157	1380	136.464.4	8045	
R42010D	Thur	Random	9	6	54	FkKtCwZbBdHhKkMcYg	39.8	55.8	2.5	81.9	29.6		3532	11.0	9.0	153	1345	154.770.1	8540	
R42010E	Thur	Random	8	7	56	FkKtCwZbBdHhKkMcYg	40.1	55.9	2.4	63.1	27.7		2538	11.0	10.0	164	1447	97.951.2	55.35	
R42010F	Thur	Random	9	3	27	FkKtCwZbBdHhKkMcYg	39.5	55.2	2.4	87.2	33.3		4578	12.0	9.0	150	1374	125.867.6	7545	
R42010G	Thur	Random	8	3	24	FkKtCwZbBdHhKkMcYg	41.1	55.7	2.7	85.9	32.4		3258	11.0	9.0	168	1447	108.655.4	80.35	
R42010H	Thur	Random	9	3	27	FkKtCwZbBdHhKkMcYg	37.7	47.4	2.2	59.8	23.1		3693	12.0	9.0	161	1518	79.547.9	50.35	
R42010I	Thur	Random	10	4	40	FkKtCwZbBdHhKkMcYg	34.5	42.4	2.3	72.3	24.4		4145	12.0	9.0	151	1433	138.261.1	7045	

1434

Figure 4. Draft Networks Chart. As the year progresses, the number of different networks within a particular session type can, and most often does, increase. This is due to different stations dropping out of the networks for various reasons.

After the IVSCC receives approval, dates are selected for each session based on the constraints of the sessions, stations, other networks, and campaigns. Then the data is entered into an Excel spreadsheet, reviewed for errors, and then posted to the IVS Web site as a draft Master Schedule. The IVSCC utilizes the “Search A Master File” script to pull out a list of sessions for each station. Each list is added to the request-for-antenna-time message that is sent to each station. Modifications are made to the observing schedule based on responses from the stations. The final Master Schedule is then posted to the Web site.

3. Validation of Simulations

In order to ensure that the simulations for the IVS-R1 and IVS-R4 networks are representative of the actual results (or to properly scale the simulated EOP formal error estimates), for both the IVS-R1 and IVS-R4 series, a recent session is selected to compare simulated and actual EOP formal errors. In the example at hand the simulated EOP formal errors are too optimistic by about 10–20% for both sessions. For a more reliable statement with respect to the simulation results, we investigated the IVS-R1 and IVS-R4 sessions of the observing year 2009, for which we have simulated and actual results available. We selected only those IVS-R1 and IVS-R4 sessions that were observed, correlated, and analyzed with the fully scheduled network. We found that only eight IVS-R1 and fourteen IVS-R4 sessions fulfilled this requirement, because there were several stations that could not observe in their scheduled sessions and because some sessions had other problems which resulted in ‘incomplete’ data compared with the simulated data. Figure 5 displays the averaged values of the simulated vs. actual EOP formal errors from the selected 2009 sessions.

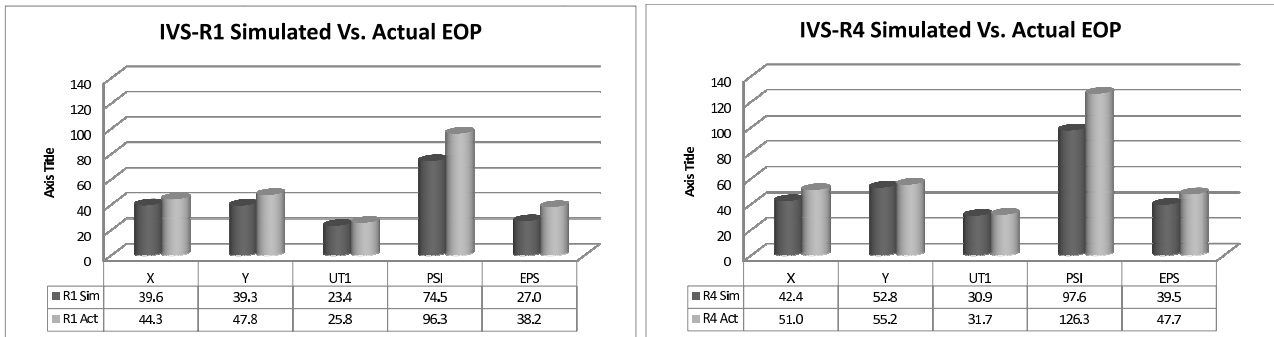


Figure 5. Averaged values of simulated and actual EOP formal errors from selected IVS-R1 (left) and IVS-R4 (right) sessions of the year 2009.

The results basically confirm the findings from the single session analysis: the simulation results are too optimistic by 10–20%. It can be seen that the simulated UT1 formal errors are very close to the actual values.

4. Conclusion

It takes about four months for the IVSCC to create the final version of the Master Schedule for a new observing year. The schedule composition accounts for the available resources of station time, correlator time, and media. The IVSCC gathers information from the stations and the correlators to create the schedule. The OPC and IVSCC work together to optimize network choices by generating test schedules and performing simulations. After the “final version” of the Master Schedule is posted, modifications continue to be made on an as-needed basis (sometimes even before the observing year starts) because of changes in the availability of resources; e.g., because a station has to change its availability for the year due to funding and/or personnel issues, because equipment failure requires a station to be “down” for a specific period, or because unscheduled maintenance becomes necessary at a station. Information about the IVS observing program can be found at <http://ivscc.gsfc.nasa.gov/program/>.