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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

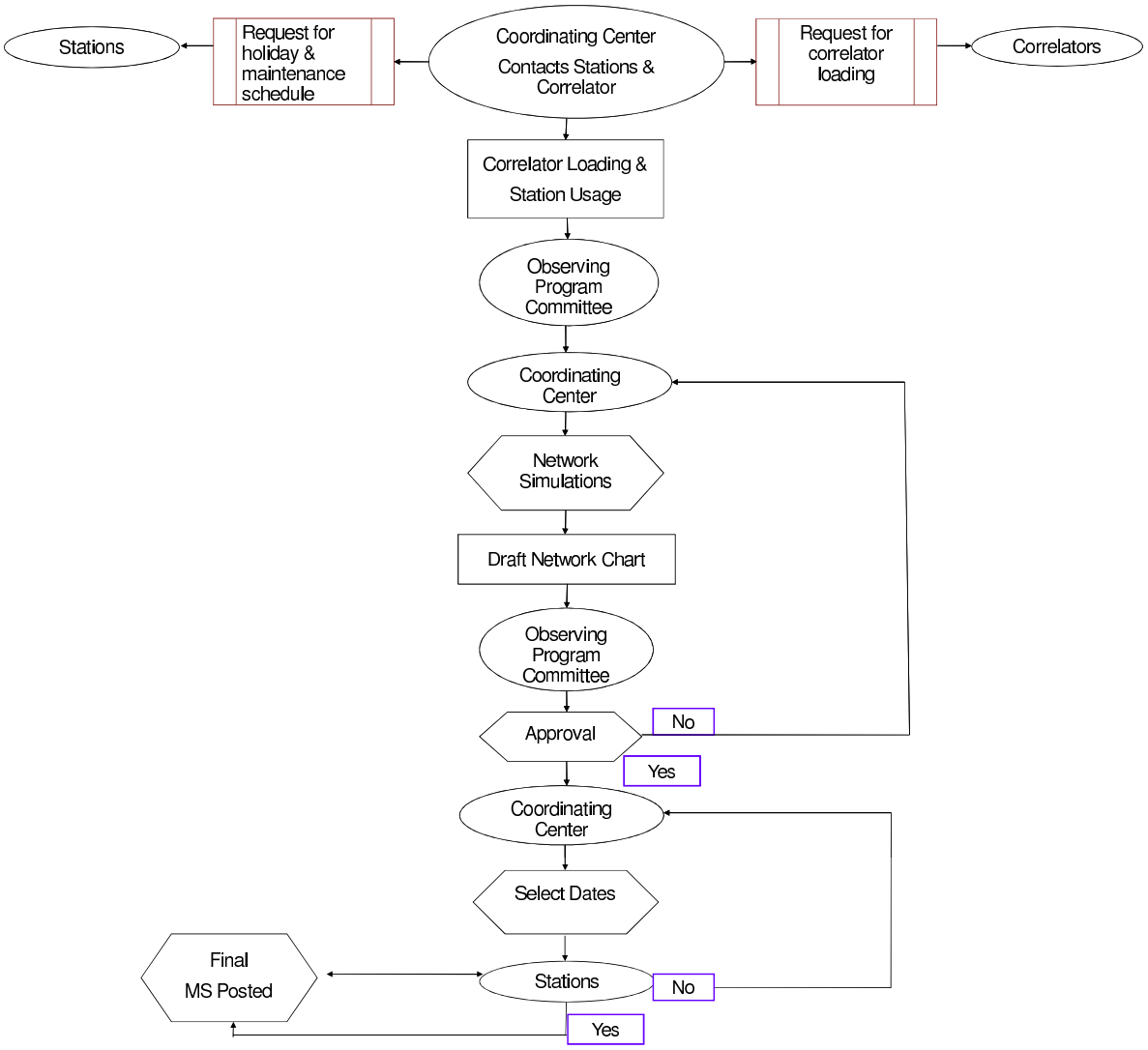

Figure 1. Flowchart showing the general steps of how the master schedule is created.

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 oberving 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-STN	12-STN	8-STN	15-STN	3&4-STN	2-STN	6-STN	8-STN	7-STN	16-STN	9-STN			2010	2009	
Number of Sessions	52	2	6	7	6	3	12	6	10	6	52					
	Mon	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Wed	Wed	Thu	TOTAL	%	Availability	Actual	
STATIONS	IVS-R1	APSG	EUROPE	IVS-T2	CRF	CRFMS	AUSTRAL	C-OHIG	R&D	RDV	IVS-R4				Usage	
Aira		2		7								9	100%	9	10	
Badary - M5B			2	1							39	42	100%	42	60	Availability early Nov.
Chichijima		2		7								9	100%	9	10	
DSS13				4		3						7	100%	7	5	
DSS15				2	3							5	100%	5	3	
DSS45				2			6					8	100%	8	3	
DSS65			6	2								8	100%	8	5	
Effelsberg			2									2	100%	2	2	
Fortaleza	32			4	3	3		6			52	100	100%	100	81	
HartRAO - EVN	26			1	3		12	6		4		52	100%	52	0	
Hobart 26m	6			1			3	3			4	17	100%	17	62	
Hobart 12m	33	2		2	3		12	6		2	23	83	100%	83	0	
Ishigakijima				7								7	100%	7	3	
Kashima34m				1	3					6		10	100%	10	11	
Katherine	13	2		2			12	3			16	48	100%	48	0	
Kokee	26	2		1	3			6	10	4	52	104	100%	104	104	
Matera	13		2	1					2	1	33	52	100%	52	50	
Medicina - EVN			2	1					2		19	24	100%	24	23	
Metsahovi - 3mm			4	3								7	100%	7	6	Prefer multiple sessior
Mizusawa				7								7	100%	7	3	
Noto - EVN			6	3	3							12	100%	12	7	
Ny Alesund - M5A & B	52		2	2					10	6	15	87	100%	87	79	
O'Higgins				2				6				8	100%	8	11	
Onsala - EVN & 3mm	13		3	2					8			26	100%	26	23	
Parkes M5B		2			1		4					7	100%	7	3	
Seshan - EVN	13	2		5								20	100%	20	22	Only 10 sessions from
Simeiz			6	6								12	100%	12	12	
Shintotsukawa		2										2	100%	2	3	
Svetloe	13		2	1							26	42	100%	42	60	Availability early Nov.
Syowa								6				6	75%	8	6	
Tigo	46			7				6	8		52	119	99%	120	115	
Tsukuba	52	2		7					10	6		77	74%	104	51	
Urumqi		2		7								9	75%	12	9	
Warkworth	13	2		6			12	3			11	47	100%	47	0	
Westford - M5B	52								10			62	91%	68	46	
Wettzell	52		6	7					10	6	52	133	99%	134	131	
Yarragadee	13	2		2			12	3			16	48	100%	48	0	
Yebes - M5B & EVN			4	1							13	18	100%	18	16	
Zelenchukskaya			1	1						1	39	42	100%	42	58	Availability early Nov.
# OF SESSIONS	52	2	6.0	7.7	5.5	3.0	12.2	6.8	10	6.0	57.8	168.8				
Total Days	468	24	48	115	22	6	73	54	70	36	462	1378		1418	1093	
Targeted Stn Days	468	24	48	105	24	6	72	48	70	36	468					
Extra Stn 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

	ESTIMATED CORRELATOR USAGE					HAYSTACK USAGE					WASHINGTON USAGE					BONN USAGE				
EXPERIMENT	# 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											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											6	9	6.0	1.0	6.0
IVS-OHIG	6	8	6.0	1.0	6.0											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		207	11		11		26.0	78		78		96.0	67		67		85.0
	88%		88%		95%	100%		100%		100%	89%		89%		91%	97%		97%		98%
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	16.25		16.3		11.9						9.88		9.9		9.9	2.04		2.0		2.0
	9%		9%		5%						11%		11%		9%	3%		3%		2%
Total Planned SGP	178.3		178.3		218.9	11		11		26	87.88		87.9		105.9	69.04		69.0		87.0
Total Actual SGP					218.9															

Maximum loading is 250.5 days (48.0 + 202.5)

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

80.0 hrs/wk @ 52 wks = 173.3 days (Washington Allowance)

2700 hrs per year = 112.5days

Washington can expand up to 120 hours per week if needed

Note: The AUSTRAL sessions may be correlated at the CURTIN Correlator.

Figure 3. Correlator Projection Report. With the advent of the Mark IV correlator, the IVS observing program is no longer driven by available correlation time but rather by station time and media.

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 Stn Days	Network	X	Y	UT1	PSI	EPS	Comments	# Obs	Scn/ Hrs	Tc/ Hr.	Avg Scn	Avg GB	Avg SNR	Med SNR
R1370	Mon	$09MAR16XA	8			NyWfWzTsKkHoMaTc	34.2	36.1	1.5	58.1	23.9	Simulation	3994	17.0	11.0	93	1174	53.3/28.7	40/25
R1370	Mon	$09MAR16XA	8			NyWfWzTsKkHoMaTc	40.0	40.0	1.5	73.0	31.0	Actual	3994	17.0	11.0	93	1174	53.3/28.7	40/25
R12010B	Mon	Random	9	6	54	NyTsWfWzFtHbKtYgKk	35.64	39.02	1.42	57.30	17.9		8288	25.0		58	2218	82.3/48.4	55/35
R12010C	Mon	Random	9	7	63	NyTsWfWzTcHbKtYgKk	33.24	36.83	1.50	80.80	15.8		7399	24.0	14.0	69	2478	89.8/51.4	50/35
R12010D	Mon	Random	9	7	63	NyTsWfWzFtHbKkTcMa	31.40	35.96	1.61	41.30	16.9		5804	20.0	15.0	70	2131	83.4/50.0	45/35
R12010D1	Mon	Random	10	6	60	NyTsWfWzFtHbKkTcMaHo							6822	19.0	14.0	66	1943	87.1/52.4	50/35
R12010E	Mon	Random	9	10	90	NyTsWfWzFtHbHhTcWw	33.30	34.92	1.53	55.90	14.5		5140	20.0	13.0	68	2006	86.6/49.2	50/35
R12010F	Mon	Random	8	3	24	NyTsWfWzFtHhTcWw	33.52	35.22	1.56	44.80	16.6		4318	19.0	13.0	66	2064	78.6/47.4	50/35
R12010G	Mon	Random	9	13	117	NyTsWfWzHhOnShSvTc	34.09	35.58	1.45	56.80	21.6		6858	18.0	13.0	61	1648	134.5/62.6	80/45
APSG	Tues		12	2	24	AiChHbKtKkPaShS3TsUrWwYg													
EUROPE	Tues	Every 2nd month	8	2	16	65NtSmWzMhYsOnBd													
EUROPE	Tues	Every 2nd month	8	1	8	65NtSmWzMhYsOnZc													
EUROPE	Tues	Every 2nd month	8	1	8	65NtSmWzMhYsSvMa													
EUROPE	Tues	Every 2nd month	8	1	8	65NtSmWzMcNyEbMa													
EUROPE	Tues	Every 2nd month	8	1	8	65NtSmWzMcNyEbSv													
IVS-T2	Tues	January	16	1	16	AiChMzTcTsUrWzOhFt45 13KkNtShSmMh													
IVS-T2	Tues	March	15	1	15	AiChMzTcTsUrWz1365HoMcNySvSmWw													
IVS-T2	Tues	May	15	1	15	AiChMzTcTsUrWz1365HbNyKbShSmWw													
IVS-T2	Tues	July	16	1	16	AiChMzTcTsUrWzFtBd13KtWwNtShSmYg													
IVS-T2	Tues	September	15	1	15	AiChMzTcTsUrWz15FtMaMhOnSmWwZc													
IVS-T2	Tues	October	15	1	15	AiChMzTcTsUrWz15FtMhOnSmWwYsSh													
IVS-T2	Tues	November	16	1	16	AiChMzTcTsUrWzOh45HhHbKtWwYgNtSh													
IVS-CRF	Tues	Random	5	1	5	15HbKbKkPa													
IVS-CRF	Tues	Random	4	2	8	15HbKbKk													
IVS-CRF	Tues	Random	3	3	9	FtHhNt													
IVS-CRFMS	Wed	Random	2	3	6	Ft13													
AUSTRAL	Wed	Random	7	3	21	HhHbKtWwYgHo45													
AUSTRAL	Wed	Random	6	3	18	HhHbKtWwYg45													
AUSTRAL	Wed	Random	6	4	24	HhHbKtWwYgPa													
AUSTRAL	Wed	Random	5	2	10	HhHbKtWwYg													
IVS-OHIG	Wed	February	8	3	24	FtHhHoHbKkOhTcSy													
IVS-OHIG	Wed	November	10	3	30	FtHhHbKkOhTcSyKtWwYg													
R&D	Wed	Random	7	6	42	NyTsWfWzKkOnTc													
R&D	Wed	Random	7	2	14	NyTsWfWzKkMcMa													
R&D	Wed	Random	7	2	14	NyTsWfWzKkOnTc													
RDVE2	Wed	Every 2nd month	16	4	64	VaKbNyTsWzHhKk													
RDVF2	Wed	Every 2nd month	16	1	16	VaKbNyTsWzHbZc													
RDVI2	Wed	Every 2nd month	16	1	16	VaKbNyTsWzHbMa													
R4382	Thur	$09JUN10XE	8			KkTcWzSvNyHoBdZc	41.7	44.9	2.2	87.3	30.8	Simulation	3045	11.0	6.0	122	566	122.8/59.1	80/45
R4382	Thur	$09JUN10XE	8			KkTcWzSvNyHoBdZc	48.0	49.0	2.0	100.0	35.0	Actual	3045	11.0	6.0	122	566	122.8/59.1	80/45
R42010A	Thur	Random	9	13	117	FtKkTcWzBdHbKtMcYg	37.0	55.8	2.3	60.8	23.8		3713	13.0	9.0	156	1548	105.2/53.7	50/35
R42010B	Thur	Random	9	6	54	FtKkTcWzBdMaNyScZc	39.6	53.0	2.4	80.2	30.2		4117	11.0	10.0	151	1387	112.6/51.8	70/35
R42010C	Thur	Random	9	7	63	FtKkTcWzBdMaSvYsZc	41.6	54.9	2.5	88.0	30.0		4155	11.0	10.0	157	1380	136.4/64.4	80/45
R42010D	Thur	Random	9	6	54	FtKkTcWzBdHbMcSvZc	39.8	55.8	2.5	81.9	29.6		3582	11.0	9.0	153	1345	154.7/70.1	85/40
R42010E	Thur	Random	8	7	56	FtKkTcWzBdMaWwZc	40.1	55.9	2.4	63.1	27.7		2539	11.0	10.0	164	1447	97.9/51.2	55/35
R42010F	Thur	Random	9	3	27	FtKkTcWzMaNyYsZcSv	39.5	55.2	2.4	87.2	33.3		4576	12.0	9.0	150	1374	125.8/67.6	75/45
R42010G	Thur	Random	8	3	24	FtKkTcWzMaNyYsZc	41.1	55.7	2.7	85.9	32.4		3256	11.0	9.0	168	1447	108.6/55.4	60/35
R42010H	Thur	Random	9	3	27	FtKkTcWzKtMaNyZcYg	37.7	47.4	2.2	59.8	23.1		3593	12.0	9.0	161	1519	79.5/47.9	50/35
R42010I	Thur	Random	10	4	40	FtKkTcWzHbMaWwSvZcHo	34.5	42.4	2.3	72.3	24.4		4145	12.0	9.0	151	1433	128.2/61.1	70/45
					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.

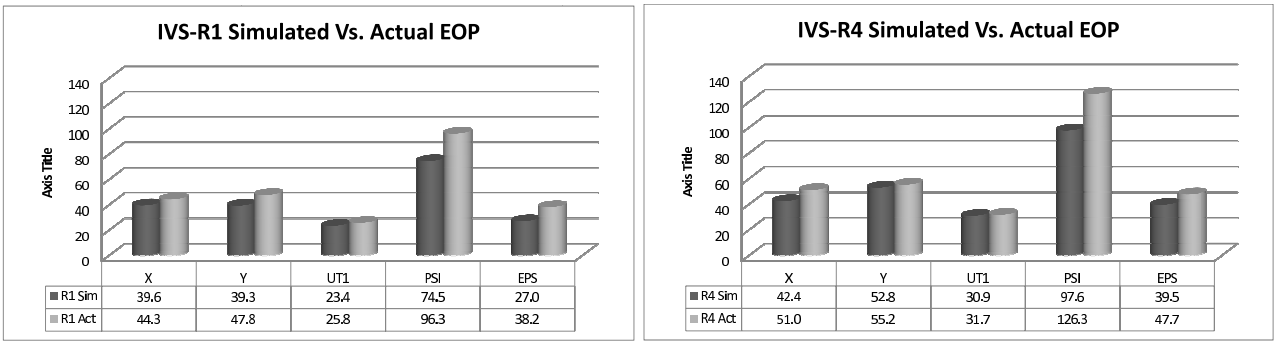

Figure 5. Averaged values of simulated and actual EOP formal errors from selected IVS-R1 (left) and IVS-R4 (right) sessions of the year 2009.

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/`.