



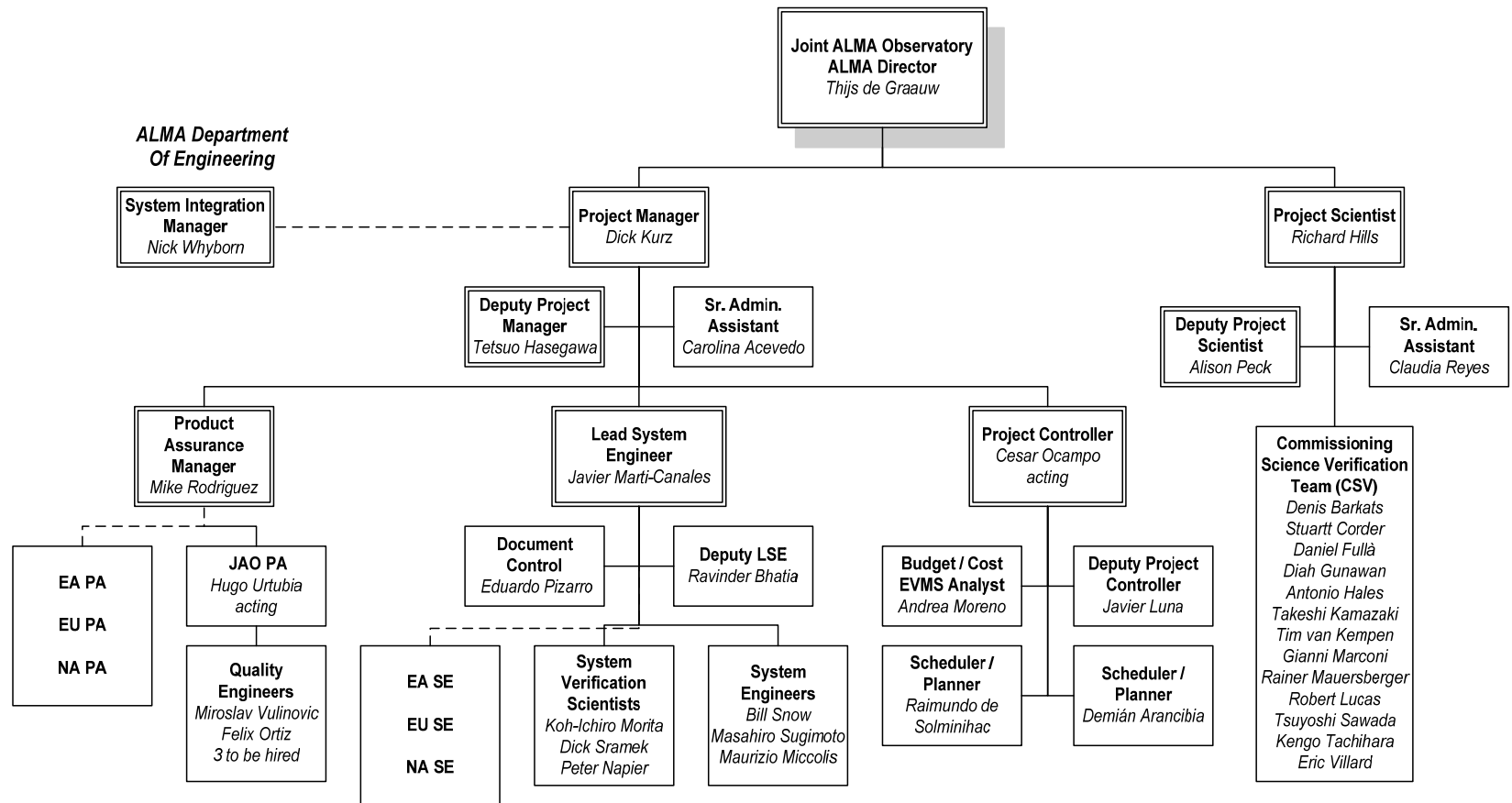
System Engineering Report

Dr. Javier Marti
ALMA Lead System Engineer



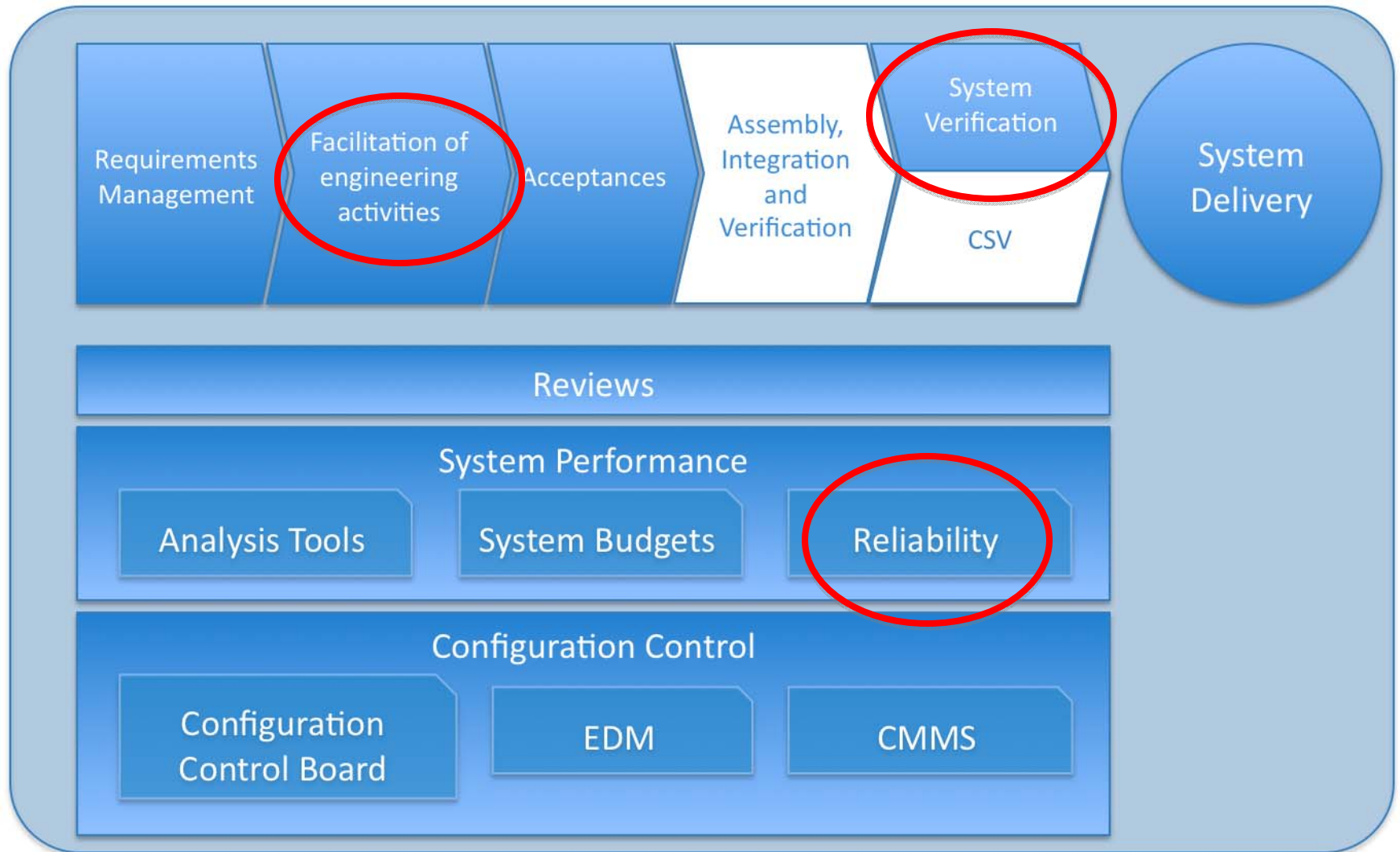


JAO Construction organigram





SE Activities





Facilitation of Engineering activities

Focusing on key issues

- Top10 Issues initiative

Top10 Priority	Key	Summary	Assignee	Reporter	Status	Res
1	TOP-35	System - Timing Event errors	Maurizio Miccolis	Javier Marti-Canales	Open	UNF
1	TOP-31	System - Tuning and locking not sufficiently reliable	Nick Whyborn	Javier Marti-Canales	Open	UNF
1	TOP-23	Software - System robustness: tolerance to hardware failures	Brian Glendenning	Javier Marti-Canales	Open	UNF
1	TOP-17	FE Calibration Devices. Reliability and "blocked motor" issues.	Juan Pablo Garcia	Javier Marti-Canales	Open	UNF
1	TOP-12	DV antennas - ACU connection lost, drive systems drop-out, brakes come on, etc	Jeff Zivick	Javier Marti-Canales	Closed	Fixe
1	TOP-10	DV antennas - Drifts and/or steps in zero points of inclinometers which produce large pointing offsets	Art Symmes	Javier Marti-Canales	Open	UNF
1	TOP-3	Grounding and electrical situation in the AOS building, including lightning protection	Patricio Garcia	Javier Marti-Canales	In Progress	UNF
2	TOP-37	DV antennas - drive amplifier drop-outs	Art Symmes	Javier Marti-Canales	Open	UNF
2	TOP-36	DV antennas - encoder reports error state	Art Symmes	Javier Marti-Canales	Open	UNF
2	TOP-29	Software - Correlator	Brian Glendenning	Javier Marti-Canales	Closed	Fixe
2	TOP-28	Software - Control of focus and pointing offsets not complete	Brian Glendenning	Javier Marti-Canales	Closed	Fixe
2	TOP-27	Software - Archive reliability, efficiency and ease of use of the archive	Joseph Schwarz	Javier Marti-Canales	Open	UNF
2	TOP-25	Software - Telescope Control and Monitor Data Base	Ravinder Bhatia	Javier Marti-Canales	Open	UNF
2	TOP-22	Software - System robustness: reliable start-up	Gianni Raffi	Javier Marti-Canales	Open	UNF
2	TOP-13	DV antennas - Shutters tend to jam	Jeff Zivick	Javier Marti-Canales	Closed	Fixe
2	TOP-5	HVAC in the OSF control room needs to work and be quiet	Fabio Biancat Marchet	Javier Marti-Canales	Open	UNF
2	TOP-2	Reliability, quality and quantity of the power	Richard Kurz	Javier Marti-Canales	Open	UNF
3	TOP-30	Software - Data rate limitations	Brian Glendenning	Javier Marti-Canales	Open	UNF
3	TOP-14	DV antennas - Stow pins	Jeff Zivick	Javier Marti-Canales	Closed	Fixe
3	TOP-8	Membrane - Standing Waves	Ravinder Bhatia	Javier Marti-Canales	Open	UNF
3	TOP-1	Timely delivery and acceptance of complete antenna stations with power, communications, inserts, etc	Volker Heinz	Javier Marti-Canales	Closed	Fixe
4	TOP-34	System - Phase jitter	David Padgett	Javier Marti-Canales	Open	UNF



Facilitation of Engineering activities Monitoring & Control and Alarms

- System level architecture of M&C to address operations, diagnostics, maintenance and safety needs
- Work roadmap in coordination with all players
 - Definition of M&C signals for array and infrastructure
 - Definition of required sampling and archiving frequency
 - Update of existing ICDs
 - Definition and implementation of system Alarms and Reduction Rules
 - Implementation by Computing



System Verification (SV)

- System Requirements are flown down from Scientific Requirements
- SV Needs:
 - Quantify the extent of compliance of the ALMA System (Array + Infrastructure) performance with respect to original requirements
- This is an engineering task performed in intimate collaboration with scientists
- Progressive verification campaign as system is growing
 - 10% completed, 26% on-going
 - amplitude gain and phase long term (300sec) stability
 - bandpass stability



A		B	C	D	E
SYSREQ		215			
System Ver Matrix		Parameter	Optics: Beam shape stability		
Requirements		Related SCI	BACK TO SUMMARY		
SYS Req#		Parameter	Time Line		
100		Ant: Number	2011		
120		Ant: Diameter	APR MAY JUN		
130		Ant: Aperture Eff			
131		Ant: Surface Area			
132		Ant: Forward Eff			
134		Ant: Geometric			
140		Ant: Offset Point			
151		Ant: Delay error time, drift			
152		Ant: Delay error time, noise			
154		Ant: Phase Center stability			
161		Ant: nutator, nut			
162		Ant: nutator, per			
164		Ant: Number St			
165		Ant: Number St array			
205		Optics: Beam S			
207		Optics: Aperture Alignment (NE)			
210		Freq Coverage			
215		Optics: Beam st			
220		Receiver Noise			
224		Optics: ON-axis polarization			
225		Optics: OFF-ax polarization			
226		Polarization: IF			
227		Signal Dynamic			
231		1st Mixer Sideb			
233		Front End: Conv			
234		Front End: IF p			
Verification Type		T			
Instrument		Inter			
Task		3-3			
Procedure		(a) Measure stability of beam shape and gain using interferometric beam cuts for a range of environmental conditions (temperature, solar illumination, wind) and elevation. All bands and both polarizations. (b) One antenna continuously tracks an unpolarized point source whilst the antenna under test does beam cuts. (c) Long term repeatability (~ 180 days?) is verified by comparison between 2 beam maps measured 180 days apart.			
Links to procedure		AIV-224			
Status		Ongoing			
Links to status		(a) AIV team measured beam stability during Station-3. The results are included in AIV station-3 reports. 5 - 10 measurements / antenna. El range [20-60deg]. Jupiter/Mars. RX = B3, B6, B7. 1/4 Beam sampling. Measurements & Reduction are done by D. Barkats's scripts. Current conclusion: "Almost Pass" for B3 and B6. For higher frequencies (>= B7), interferometric beam measurements at AOS are desirable. CSV aims to do this systematically for all antennas and also every few months. Discussion with CSV-ANT team is needed. (b) and (c) have not been done yet.			
Assigned Team		AIV or CSV-ANT			
Person SE/SV		K-I. Morita / M. Sugimoto			
Person Others		K. Tachihara			

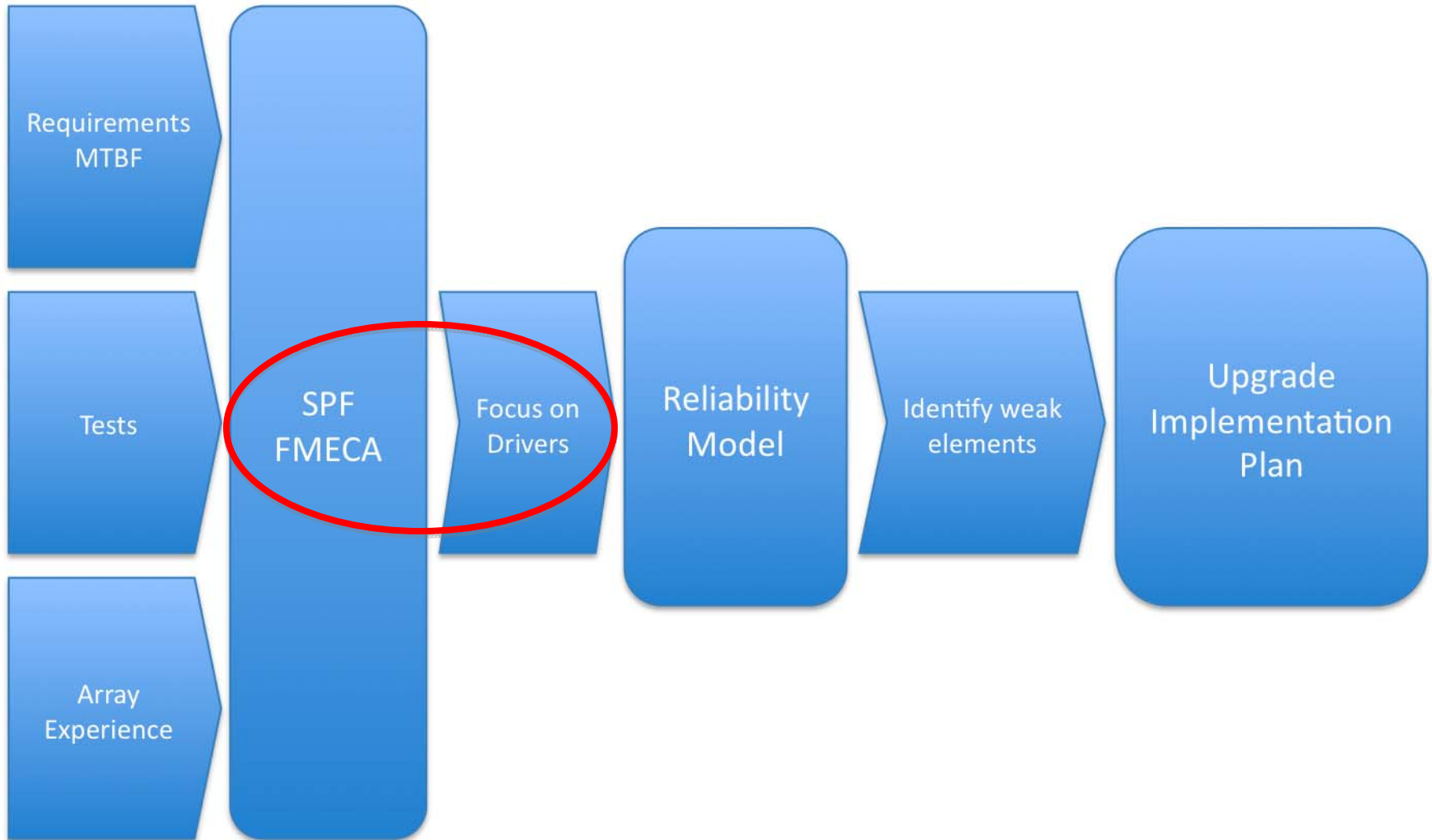


Reliability (1/2)

- Needs:
 - Lifetime Observatory 30+ yrs
 - 66 antennas each with more than 500 LRUs each
 - Thousands of electronic boards on two Correlators
 - Stable interaction Hardware – Software
- Still in an early integration phase
 - Infant mortality
 - Design flaws
 - Unexpected
 - Gaining experience



Reliability (2/2)





www.almaobservatory.org

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership among Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and in Japan by the National Institutes of Natural Sciences (NINS) in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI) and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.



Organization of SE

