



**ALMA Development Workshop**  
**Gothenburg, 26-28 May 2016**

# Integrated Alarm System for the ALMA Observatory

EU funded *small internal* ALMA development study

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# Overview



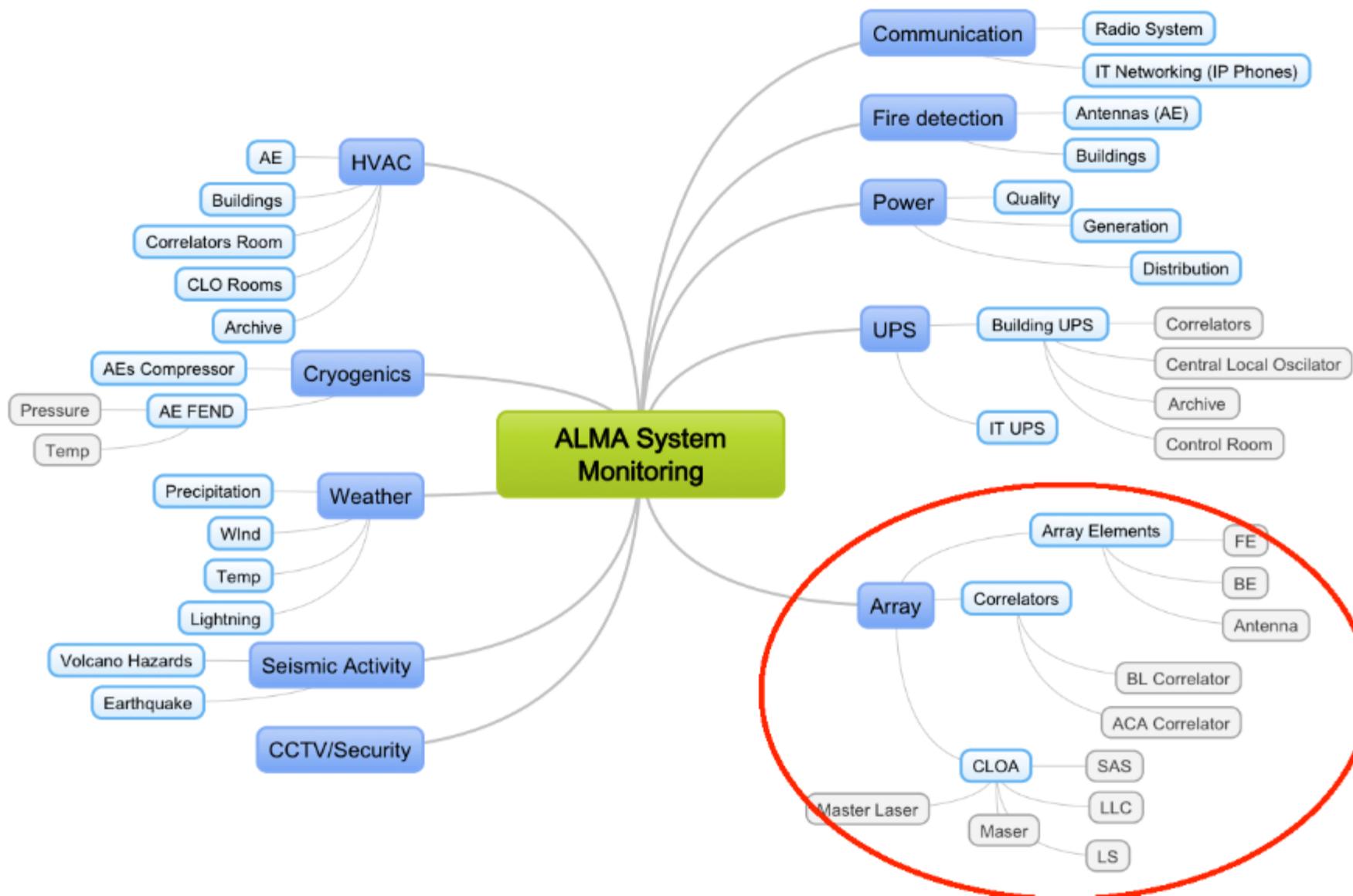
- Motivation – why do we need this?
- Approach – doing things the right way
- Status update – what has happened so far?
- Next steps – how do we bring this into production?



# Motivation

- ALMA is much more than 66 antennas, a correlator and a database
- Every component is important and must be monitored centrally 24/7
- Consistent representation of alarms to avoid misjudgements
- Increase system stability and hence operational efficiency

# Things to be monitored (not complete)





# What we have today

- The ACS alarm panel (red circle) is the only official source of alarm notifications to the array operators
  - Only tabular representation, no situational awareness
  - Can by design never cover everything
  - Only available when the online software is running
- Many prototype tools to cover the gaps – no consistency
- Many “blind spots”
- A good (bad) chance to miss out on important alarms or react too late



# ACS Alarm Panel



Time	Component	Family	Cause	Description	Action
08-25T21:40:...	da48-abm	SNMP	Computer not available	No access to the computer was pos...	Check and reboot computer
08-25T21:43:...	CONTROL/DA48/cppContai...	Manager		Container is Down	
08-25T21:11:...	CONTROL/PM04/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM03/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/PM02/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM07/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM04/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM05/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM01/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM10/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM02/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T21:11:...	CONTROL/CM11/DTSRBBpr0	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T20:34:...	CONTROL/DA43/CMPR	HardwareDevice	Hardware Device reached maximu...	Can-bus communication with the devi...	Contact the coresponding hardware...
08-25T20:26:...	CentralLO	ML	MilsNotLocked	The LS is unlocked.	Check the monitor points for errors.
08-25T20:54:...	CONTROL/DA45/WYR	WYR	Chopper wheel current out of range	(description)	
08-25T20:43:...	CONTROL/DA49/PSD	PSD	PSD is about to be shutdown due to...	PSD is about to be shutdown due to...	Check temperature before restart P...
08-25T20:37:...	CONTROL/DA51/PSD	PSD	PSD is about to be shutdown due to...	PSD is about to be shutdown due to...	Check temperature before restart P...
08-25T20:33:...	DA59	FLOOG	Glitches detected in Fine Tuning ...	Glitches detected in Fine Tuning S...	

Alarm details	
Field	
Component	DA59
Source timestamp	2015-08-25T20:33:...
Cause	Glitches detected
Priority	LOW
Description	Glitches detected
Action	
Consequence	Cannot produce
Status	Active
Host	da59-abm
Help page:	http://tempuri.o
Contact	OSF Support Tea
Email	
GSM	
Code	7
Family	FLOOG
Triplet	<FLOOG, DA59,
ID	FLOOG:DA59:7

1 0

Table not filtered

Session View Debug | Devices: Ack Alma OpServer MSG | Memory: 1.8GB | Kaps Queue: 18 GB | UT 13:07:22 LST 06:50:14

Alma

Antennas Software Alarms

OMC	OM2	OM3	OM4	OM5	OM6	OM7	OM8	OM9	OM10	OM11	OM12	OM13	OM14	OM15	OM16	OM17	OM18	OM19	OM20	OM21	OM22	OM23	OM24	OM25	OM26	OM27	OM28	OM29	OM30	OM31	OM32	OM33	OM34	OM35	OM36	OM37	OM38	OM39	OM40	OM41	OM42	OM43	OM44	OM45	OM46	OM47	OM48	OM49	OM50	OM51	OM52	OM53	OM54	OM55	OM56	OM57	OM58	OM59	OM60	OM61	OM62	OM63	OM64	OM65	OM66	OM67	OM68	OM69	OM70	OM71	OM72	OM73	OM74	OM75	OM76	OM77	OM78	OM79	OM80	OM81	OM82	OM83	OM84	OM85	OM86	OM87	OM88	OM89	OM90	OM91	OM92	OM93	OM94	OM95	OM96	OM97	OM98	OM99	OM100
0413	0411	0412	0413	0414	0415	0416	0417	0418	0419	0420	0421	0422	0423	0424	0425	0426	0427	0428	0429	0430	0431	0432	0433	0434	0435	0436	0437	0438	0439	0440	0441	0442	0443	0444	0445	0446	0447	0448	0449	0450	0451	0452	0453	0454	0455	0456	0457	0458	0459	0460	0461	0462	0463	0464	0465	0466	0467	0468	0469	0470	0471	0472	0473	0474	0475	0476	0477	0478	0479	0480	0481	0482	0483	0484	0485	0486	0487	0488	0489	0490	0491	0492	0493	0494	0495	0496	0497	0498	0499	0500									

Antennas Software Alarms

Alarms: Undocumented

Time	Component	Family	Cause	Description	Action	Priority
2015-08-25T...	CONTROL.DA.. Manager			Customer is D...		HIGH

Log

File View Search Drill-down Export

Log level: Info Discard level: Warning Pause Clear log Filter Full screen

Timestamp	Entry Type	Source Object	Log Message	Details info
13:00:18...	Warning	ARCHIVE/TIME/MONITOR.BUO	Exception caught while processing	Timestamp Entry Type Source Object File Line Routine Host Process Context Thread Log ID Priority URI Stack ID Stack Level Log Message Audience Array Antenna
13:00:19...	Warning	ARCHIVE/TIME/MONITOR.BUO	Exception caught while processing	
13:00:13...	Warning	ARCHIVE/TIME/MONITOR.BUO	Exception caught while processing	

100% Engine not filtered Table View Operator



# Critical Antenna Devices by AOG



	CM01	CM02	CM03	CM04	CM05	CM06	CM07	CM08	CM09	CM10	CM11	CM12	PM01	PM02	PM03	PM04
PSA	CM01 PSA	CM02 PSA	CM03 PSA	CM04 PSA	CM05 PSA	CM06 PSA	CM07 PSA	CM08 PSA	CM09 PSA	CM10 PSA	CM11 PSA	CM12 PSA	PM01 PSA	PM02 PSA	PM03 PSA	PM04 PSA
PSD	CM01 PSD	CM02 PSD	CM03 PSD	CM04 PSD	CM05 PSD	CM06 PSD	CM07 PSD	CM08 PSD	CM09 PSD	CM10 PSD	CM11 PSD	CM12 PSD	PM01 PSD	PM02 PSD	PM03 PSD	PM04 PSD
CMPR	CM01 CMPR	CM02 CMPR	CM03 CMPR	CM04 CMPR	CM05 CMPR	CM06 CMPR	CM07 CMPR	CM08 CMPR	CM09 CMPR	CM10 CMPR	CM11 CMPR	CM12 CMPR	PM01 CMPR	PM02 CMPR	PM03 CMPR	PM04 CMPR
Cryo	CM01 Cryo	CM02 Cryo	CM03 Cryo	CM04 Cryo	CM05 Cryo	CM06 Cryo	CM07 Cryo	CM08 Cryo	CM09 Cryo	CM10 Cryo	CM11 Cryo	CM12 Cryo	PM01 Cryo	PM02 Cryo	PM03 Cryo	PM04 Cryo
FEPS	CM01 FEPS	CM02 FEPS	CM03 FEPS	CM04 FEPS	CM05 FEPS	CM06 FEPS	CM07 FEPS	CM08 FEPS	CM09 FEPS	CM10 FEPS	CM11 FEPS	CM12 FEPS	PM01 FEPS	PM02 FEPS	PM03 FEPS	PM04 FEPS

	DA41	DA42	DA43	DA44	DA45	DA46	DA47	DA49	DA50	DA51	DA52	DA53	DA54	DA55	DA57	DA58	DA59	DA60	DA61	DA62	DA63	DA64
PSA	DA41 PSA	DA42 PSA	DA43 PSA	DA44 PSA	DA45 PSA	DA46 PSA	DA47 PSA	DA49 PSA	DA50 PSA	DA51 PSA	DA52 PSA	DA53 PSA	DA54 PSA	DA55 PSA	DA57 PSA	DA58 PSA	DA59 PSA	DA60 PSA	DA61 PSA	DA62 PSA	DA63 PSA	DA64 PSA
PSD	DA41 PSD	DA42 PSD	DA43 PSD	DA44 PSD	DA45 PSD	DA46 PSD	DA47 PSD	DA49 PSD	DA50 PSD	DA51 PSD	DA52 PSD	DA53 PSD	DA54 PSD	DA55 PSD	DA57 PSD	DA58 PSD	DA59 PSD	DA60 PSD	DA61 PSD	DA62 PSD	DA63 PSD	DA64 PSD
CMPR	DA41 CMPR	DA42 CMPR	DA43 CMPR	DA44 CMPR	DA45 CMPR	DA46 CMPR	DA47 CMPR	DA49 CMPR	DA50 CMPR	DA51 CMPR	DA52 CMPR	DA53 CMPR	DA54 CMPR	DA55 CMPR	DA57 CMPR	DA58 CMPR	DA59 CMPR	DA60 CMPR	DA61 CMPR	DA62 CMPR	DA63 CMPR	DA64 CMPR
Cryo	DA41 Cryo	DA42 Cryo	DA43 Cryo	DA44 Cryo	DA45 Cryo	DA46 Cryo	DA47 Cryo	DA49 Cryo	DA50 Cryo	DA51 Cryo	DA52 Cryo	DA53 Cryo	DA54 Cryo	DA55 Cryo	DA57 Cryo	DA58 Cryo	DA59 Cryo	DA60 Cryo	DA61 Cryo	DA62 Cryo	DA63 Cryo	DA64 Cryo

	DV01	DV02	DV03	DV04	DV05	DV06	DV07	DV08	DV09	DV10	DV11	DV12	DV13	DV14	DV15	DV16	DV17	DV18	DV19	DV20	DV21	DV22	DV23	DV24	DV25
PSA	DV01 PSA	DV02 PSA	DV03 PSA	DV04 PSA	DV05 PSA	DV06 PSA	DV07 PSA	DV08 PSA	DV09 PSA	DV10 PSA	DV11 PSA	DV12 PSA	DV13 PSA	DV14 PSA	DV15 PSA	DV16 PSA	DV17 PSA	DV18 PSA	DV19 PSA	DV20 PSA	DV21 PSA	DV22 PSA	DV23 PSA	DV24 PSA	DV25 PSA
PSD	DV01 PSD	DV02 PSD	DV03 PSD	DV04 PSD	DV05 PSD	DV06 PSD	DV07 PSD	DV08 PSD	DV09 PSD	DV10 PSD	DV11 PSD	DV12 PSD	DV13 PSD	DV14 PSD	DV15 PSD	DV16 PSD	DV17 PSD	DV18 PSD	DV19 PSD	DV20 PSD	DV21 PSD	DV22 PSD	DV23 PSD	DV24 PSD	DV25 PSD
CMPR	DV01 CMPR	DV02 CMPR	DV03 CMPR	DV04 CMPR	DV05 CMPR	DV06 CMPR	DV07 CMPR	DV08 CMPR	DV09 CMPR	DV10 CMPR	DV11 CMPR	DV12 CMPR	DV13 CMPR	DV14 CMPR	DV15 CMPR	DV16 CMPR	DV17 CMPR	DV18 CMPR	DV19 CMPR	DV20 CMPR	DV21 CMPR	DV22 CMPR	DV23 CMPR	DV24 CMPR	DV25 CMPR
Cryo	DV01 Cryo	DV02 Cryo	DV03 Cryo	DV04 Cryo	DV05 Cryo	DV06 Cryo	DV07 Cryo	DV08 Cryo	DV09 Cryo	DV10 Cryo	DV11 Cryo	DV12 Cryo	DV13 Cryo	DV14 Cryo	DV15 Cryo	DV16 Cryo	DV17 Cryo	DV18 Cryo	DV19 Cryo	DV20 Cryo	DV21 Cryo	DV22 Cryo	DV23 Cryo	DV24 Cryo	DV25 Cryo
FEPS	DV01 FEPS	DV02 FEPS	DV03 FEPS	DV04 FEPS	DV05 FEPS	DV06 FEPS	DV07 FEPS	DV08 FEPS	DV09 FEPS	DV10 FEPS	DV11 FEPS	DV12 FEPS	DV13 FEPS	DV14 FEPS	DV15 FEPS	DV16 FEPS	DV17 FEPS	DV18 FEPS	DV19 FEPS	DV20 FEPS	DV21 FEPS	DV22 FEPS	DV23 FEPS	DV24 FEPS	DV25 FEPS

# Device Map by OMC+HCI





# AOG Alarm Panel

HVAC

Cryogenics

Weather

Array

Fire Detection

Power

UPS

Last update: 12:14:09 UTC

Refresh Exit

### Alarms activated

- DA44 HVAC Alarm activated
- DA54 HVAC Alarm activated
- DA57 HVAC Alarm activated
- DV01 HVAC Alarm activated
- DV20 HVAC Alarm activated

Additional info (comments, PR or IR associated):

Shelve Alarm

### Alarms Shelved

Activate Alarm

Apply Close



# Email Alarm Notification



Inbox for Alma-aog@alma.cl - Thunderbird

File Edit View Go Message Tools Help

Send Mail Write Address Book Mark Tag Back Forward

Search: Subject or Sender

Subject: ALARM HVAC COR From: metasy@alma.cl 08/23/2015 03:53

Date	Subject	Sender
<b>Today</b>		
12:25 PM	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
06:18 AM	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
05:02 AM	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule HVAC Alarm Activated	zenoss@freia.osf.alma.cl
02:46 AM	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
<b>Yesterday</b>		
08/24/2015	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/24/2015	[zenoss] CONTROL_DA64_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/24/2015	[zenoss] CONTROL_DA64_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/24/2015	AOS TB ALARM EVENT	metasy@alma.cl
08/24/2015	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
08/24/2015	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
08/24/2015	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
<b>Last Week</b>		
08/23/2015	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DA65_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DA65_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DA65_CNPR is turn off	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule HVAC Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule HVAC Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	Re: [Ada-Ig-correlator] ALARM HVAC CORRELATOR ROOM 139	Oscar Riveros
08/23/2015	Re: ALARM HVAC CORRELATOR ROOM 139	Oscar Riveros
08/23/2015	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	Re: [Ada-Ig-correlator] ALARM HVAC CORRELATOR ROOM 139	Lorenzo Martinez Conde
08/23/2015	[zenoss] CONTROL_DA45_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DA45_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DA45_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	ALARM HVAC CORRELATOR ROOM 139	metasy@alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA47_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_PM03_UtilityModule UPS Power Alar...	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	CRYO CNPR Report	alma-aog@alma.cl
08/23/2015	[zenoss] CONTROL_DV12_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/23/2015	[zenoss] CONTROL_DV12_CNPR is turn off	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/23/2015	[Utility-modules] [zenoss] CONTROL_DA65_UtilityModule Fire Alarm Activated	zenoss@freia.osf.alma.cl
08/22/2015	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/22/2015	[zenoss] CONTROL_DV21_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl
08/22/2015	[zenoss] CONTROL_DV11_FrontEnd_Cryostat temperature alert	zenoss@freia.osf.alma.cl

Unread: 0 Total: 1226



# Approach



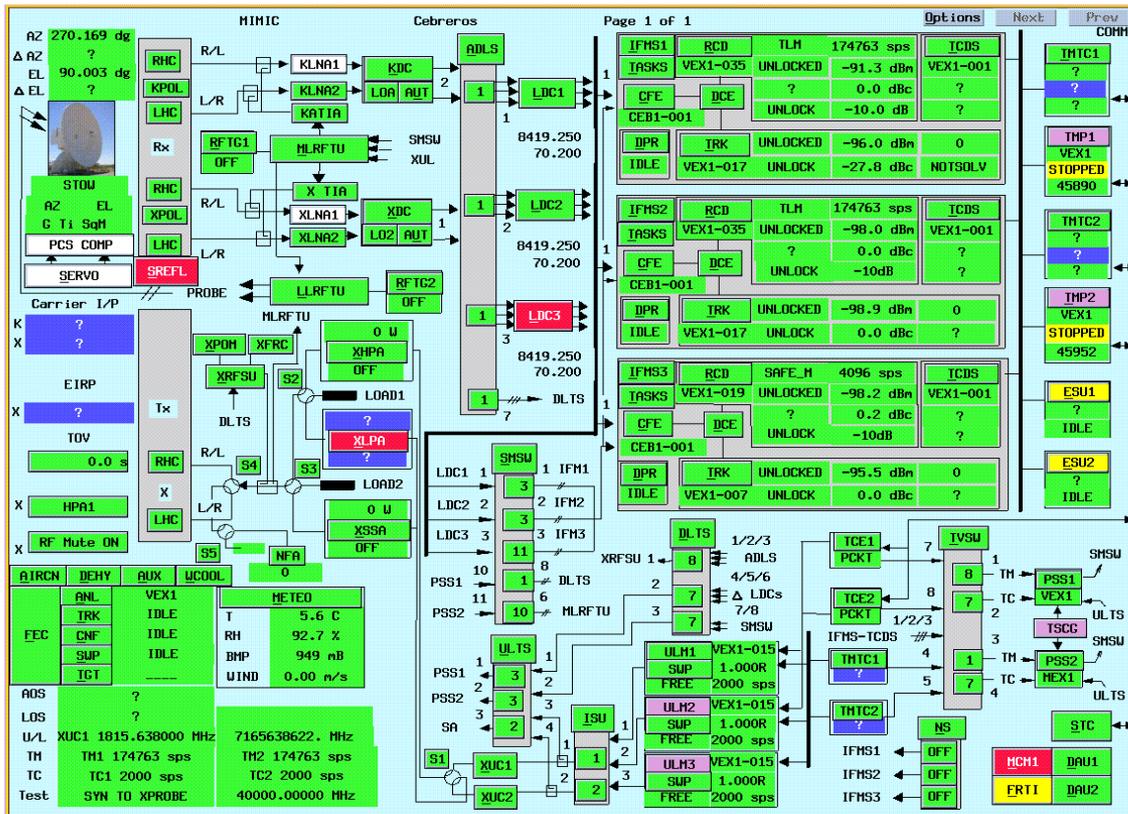
- Small internal study to determine requirements
  - Funds from ESO to cover travel and contracts
  - Collaboration of all ALMA partners
  - Started in October 2015, to be completed in June 2016

# Status update

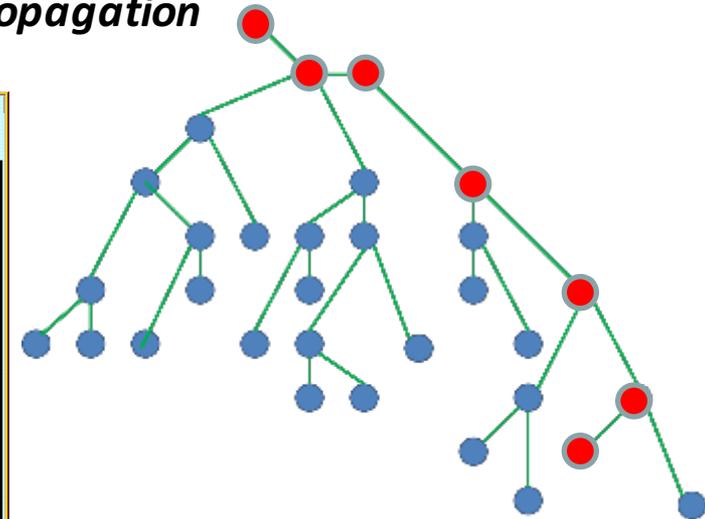
1. Identify all the relevant hardware and software systems. ✓
2. Document the existing alarm systems and available interfaces to access relevant data. ✓
3. Engage an external alarm system expert (ESA) ✓
4. Engage a human-computer interface expert (INRIA) ✓
5. Compile a report to stipulate the requirements for an integrated alarm system. ⌚
6. Write a proposal for the upcoming call for ALMA development projects to design, implement and deploy an integrated alarm system. ✗

# Overview of ESA model

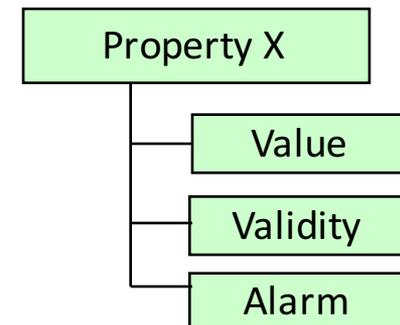
*Intuitive overview of the monitored information*



*Hierarchical model with alarm propagation*



*Qualified values*



# Alarm panel mock-ups

## ■ Observatory Overview Panel



# Alarm panel mock-ups

■ Array elements



# Alarm panel mock-ups

## ■ Visualization techniques



# Alarm panel mock-ups

## ■ Weather reporting



# Alarm panel mock-ups

## ■ Power generation

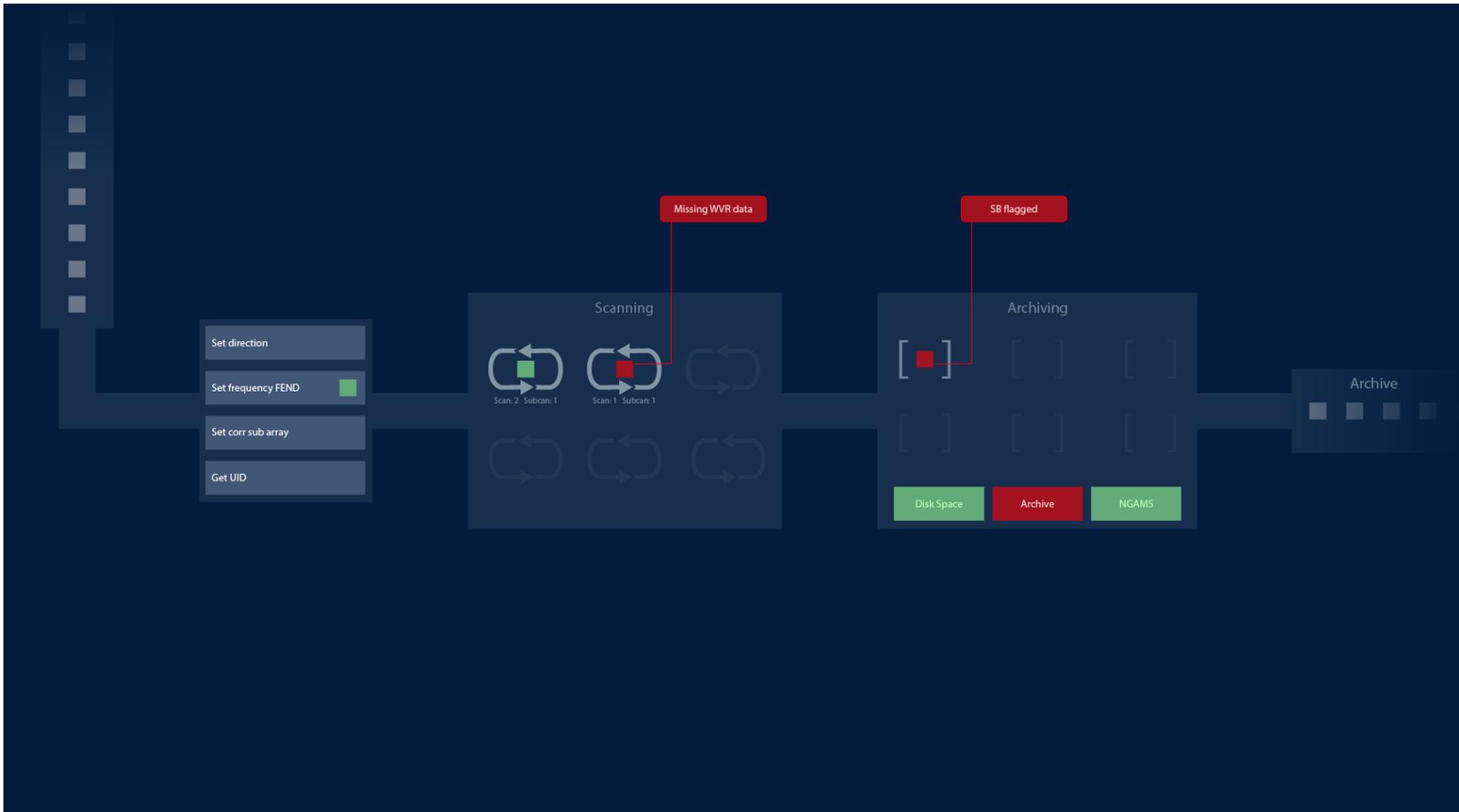


# Alarm panel mock-ups

## ■ Buildings



## ■ Observations





# Next steps

- Complete study by 30 June 2016
- Write proposal for ALMA development funding
  - Need FTE estimate
  - Cost for software licensing or additional hardware
  - Where should the work be done? ESO or JAO?
  - Requires frequent collaboration with all groups at JAO
- Delivery of first version in late 2017?
- Maintenance must be factored in



**That's all!**



**???**