



Multi-Mission Support with WARP

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German Space Operation Center (GSOC)

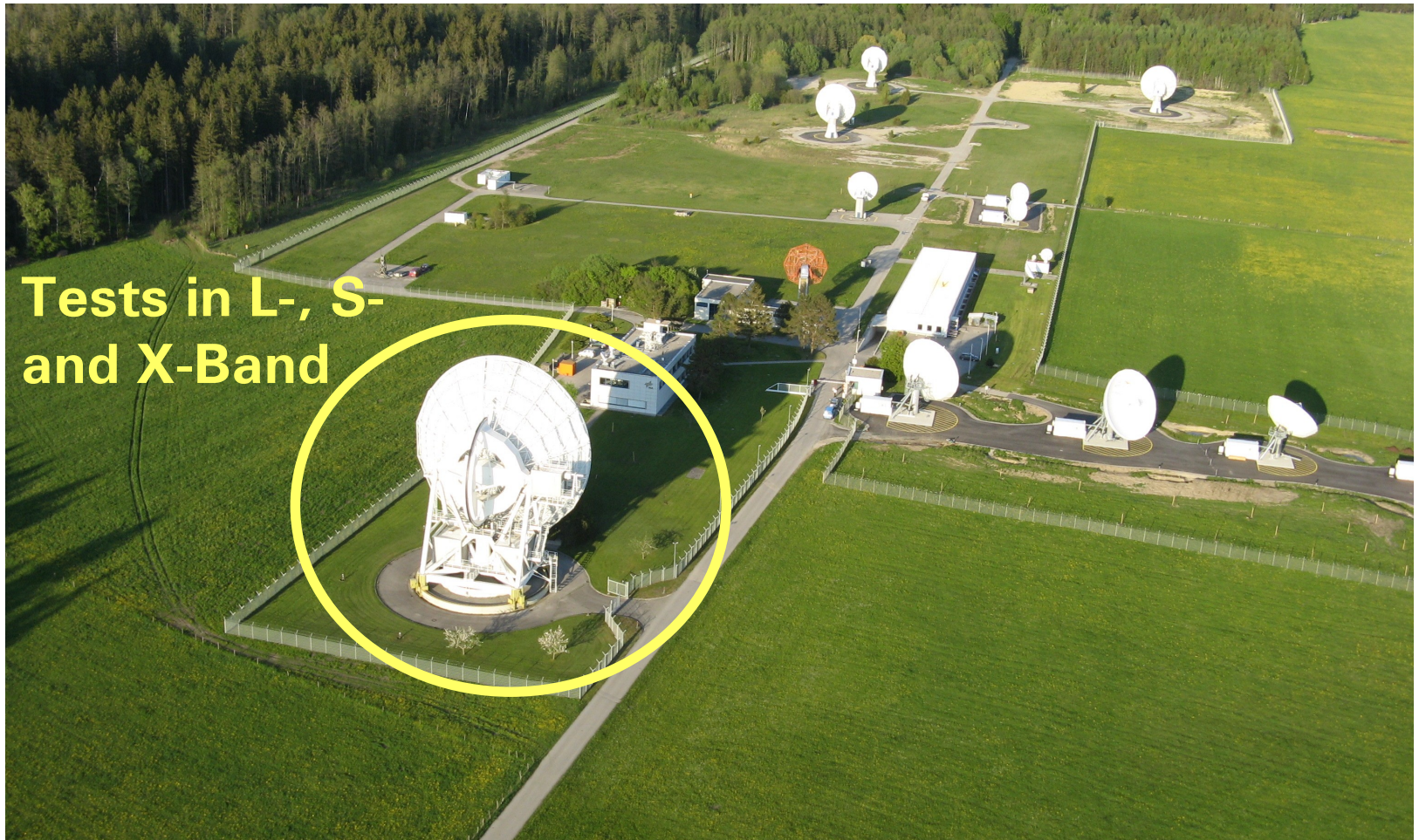
German Aerospace Center - DLR



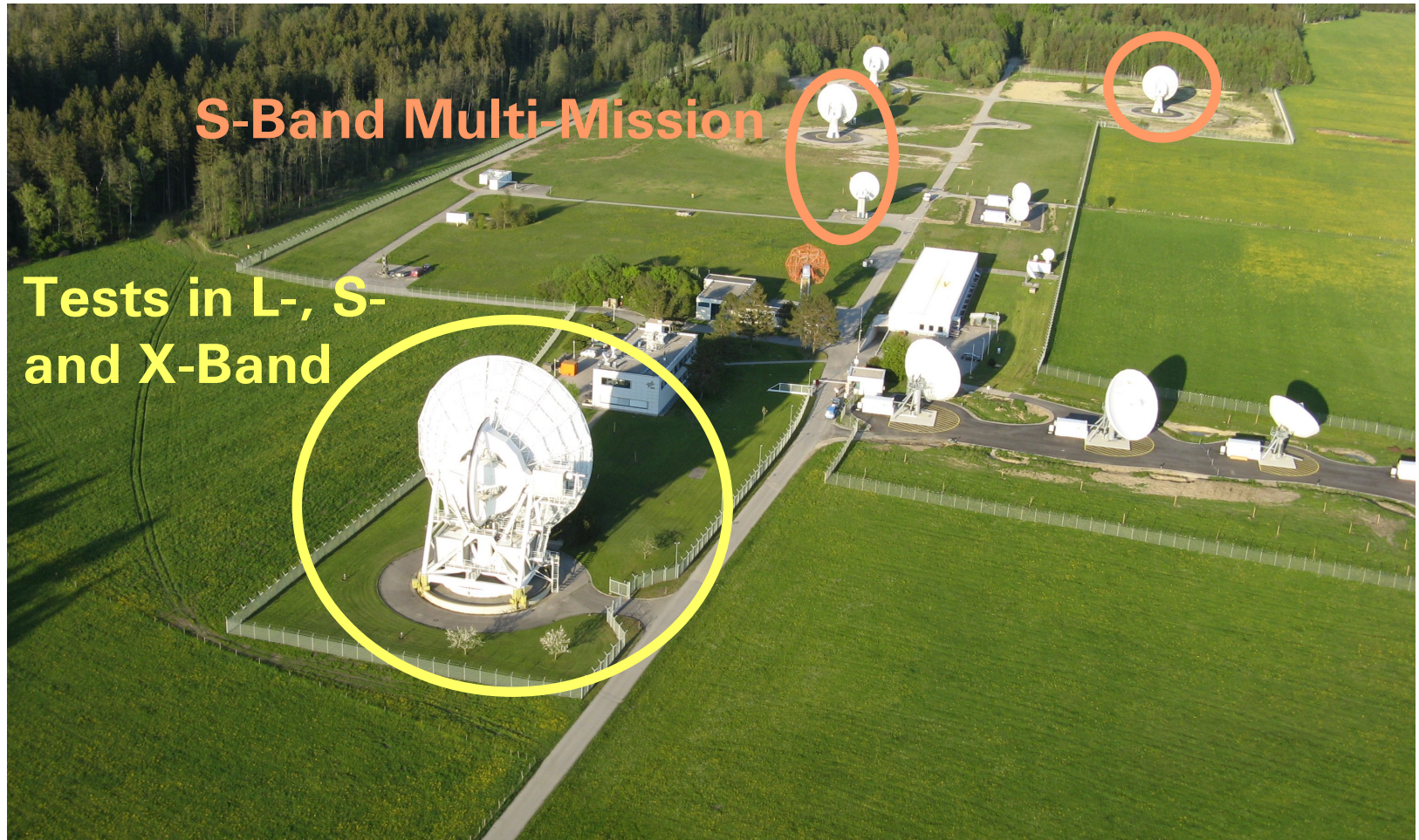
WARP – The Antenna M&C at Ground Station Weilheim



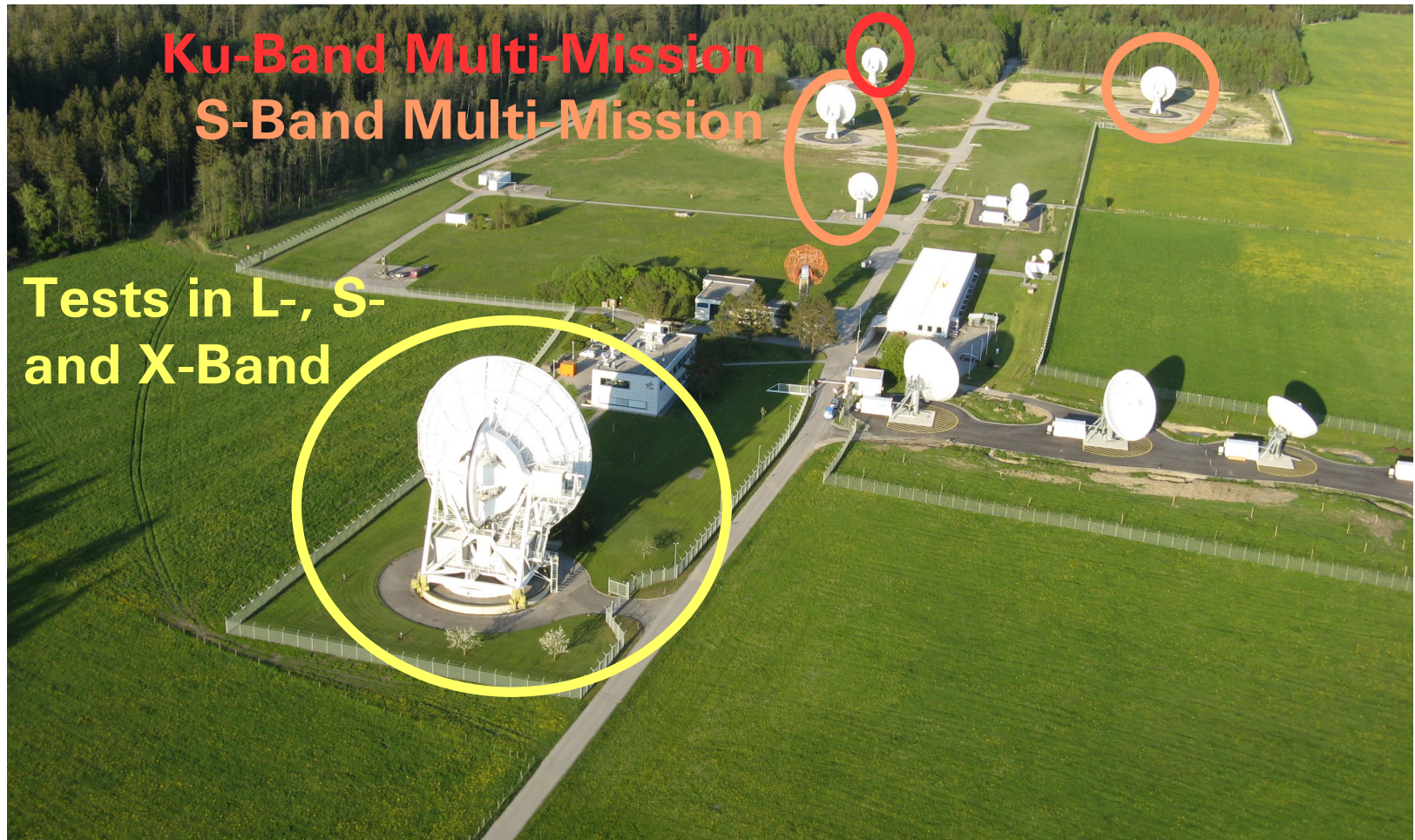
WARP – The Antenna M&C at Ground Station Weilheim



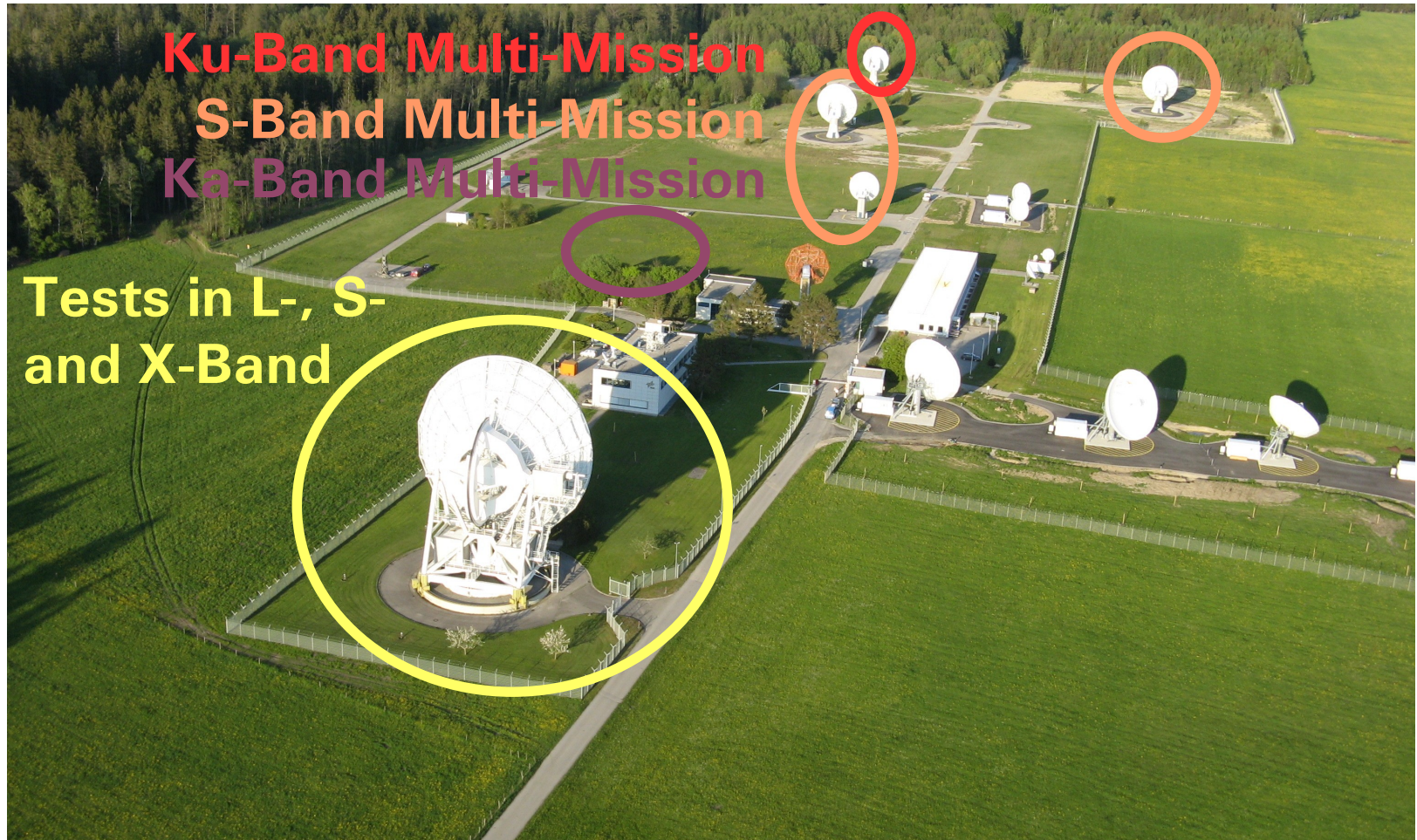
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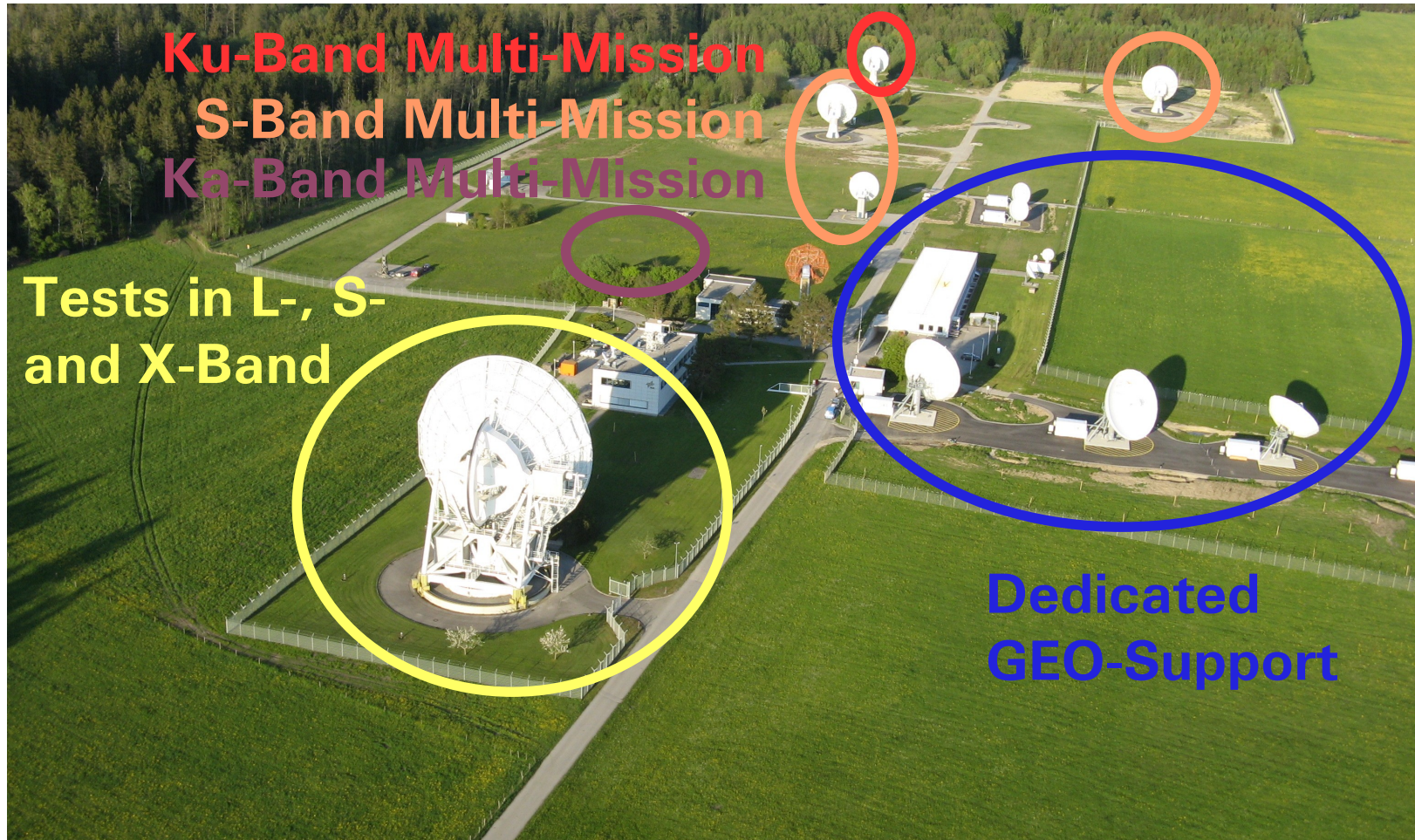
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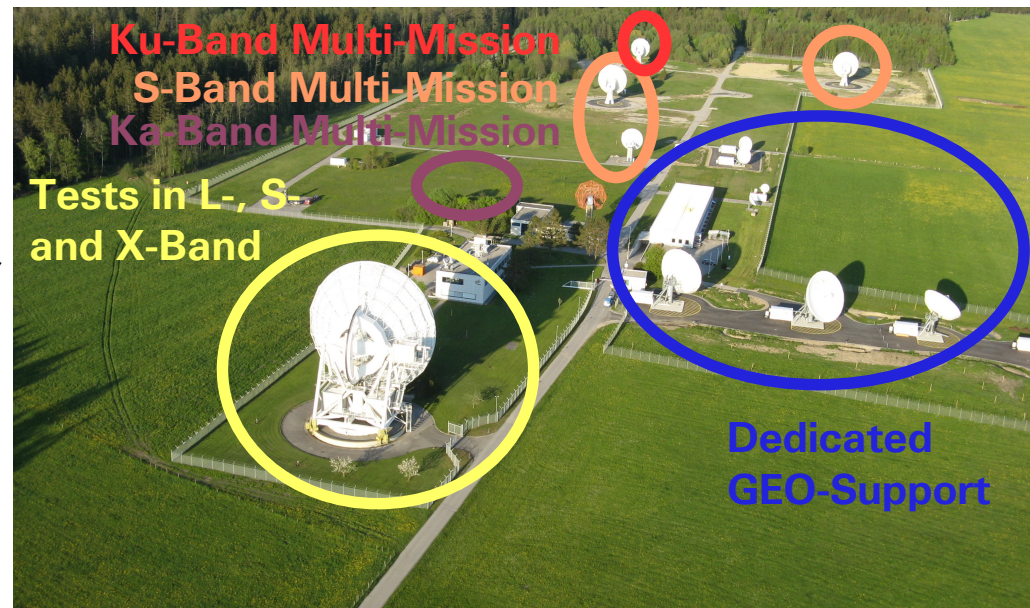


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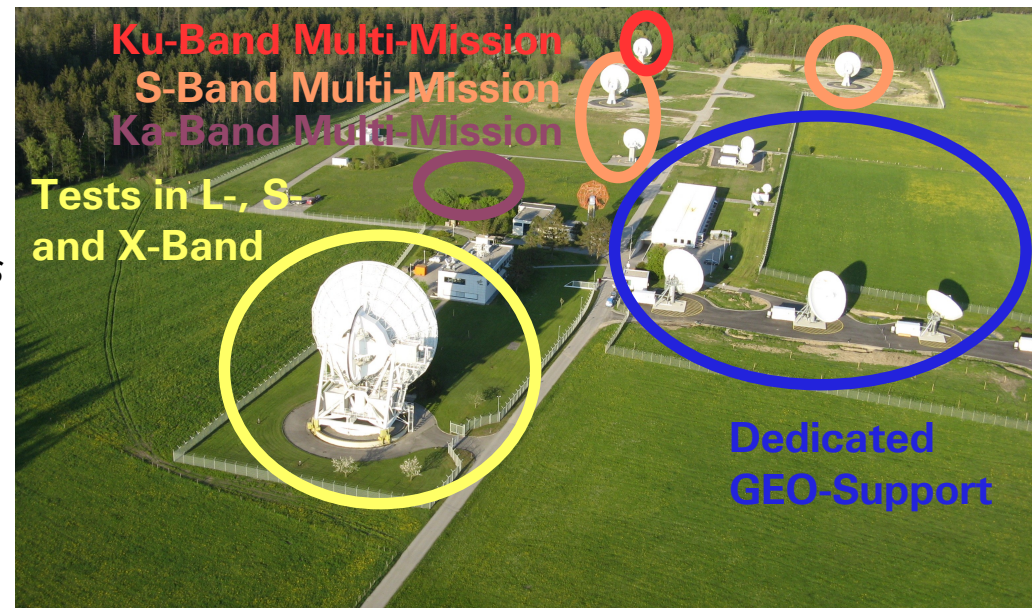
- Different antenna hardware
 - transparent to OPS
 - transparent I/F to GSOC
- Need to configure the station
 - reliably
 - quickly *typical slot of 20 minutes for configuration and internal tests*
 - frequently
- Hardware maintenance is done routinely between two passes



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Generalization

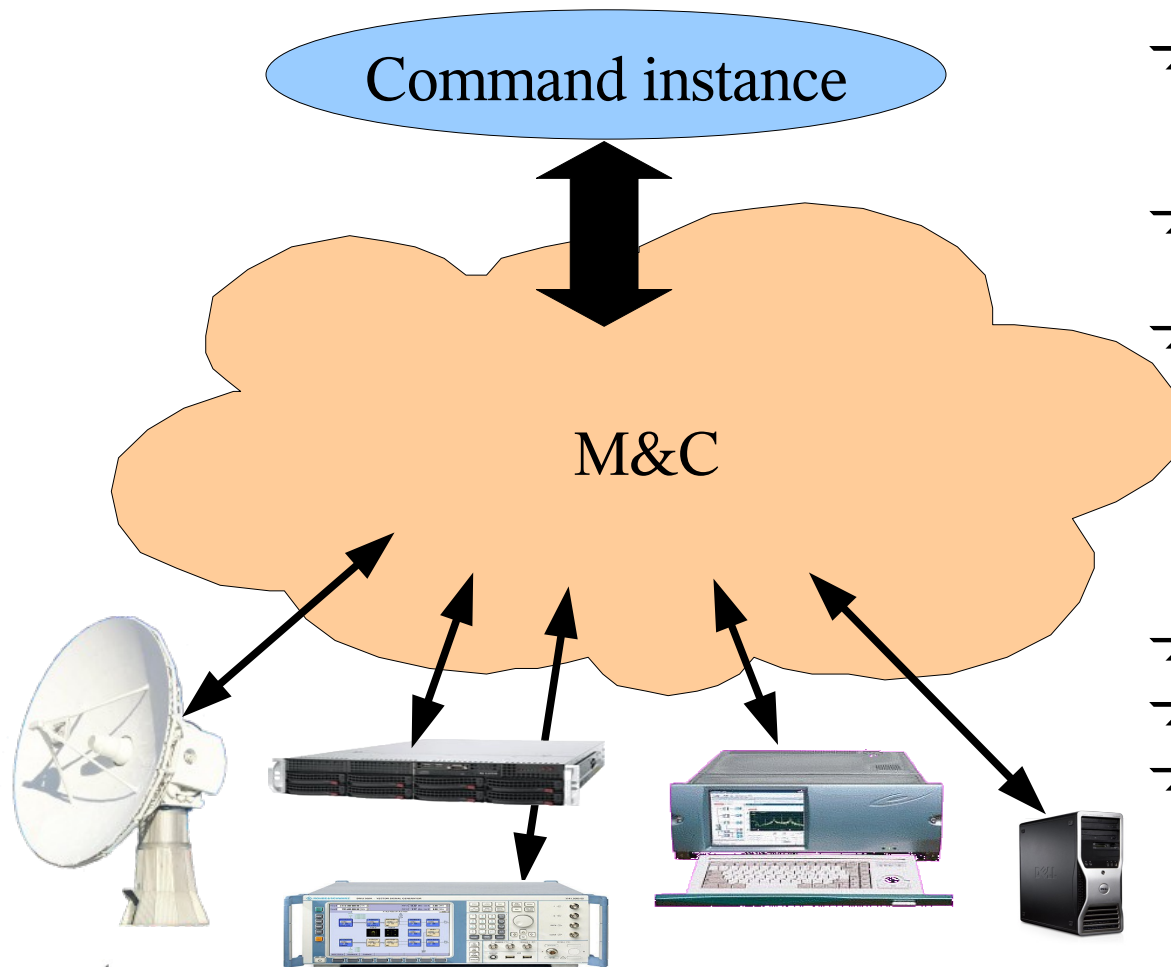




The WARP Software



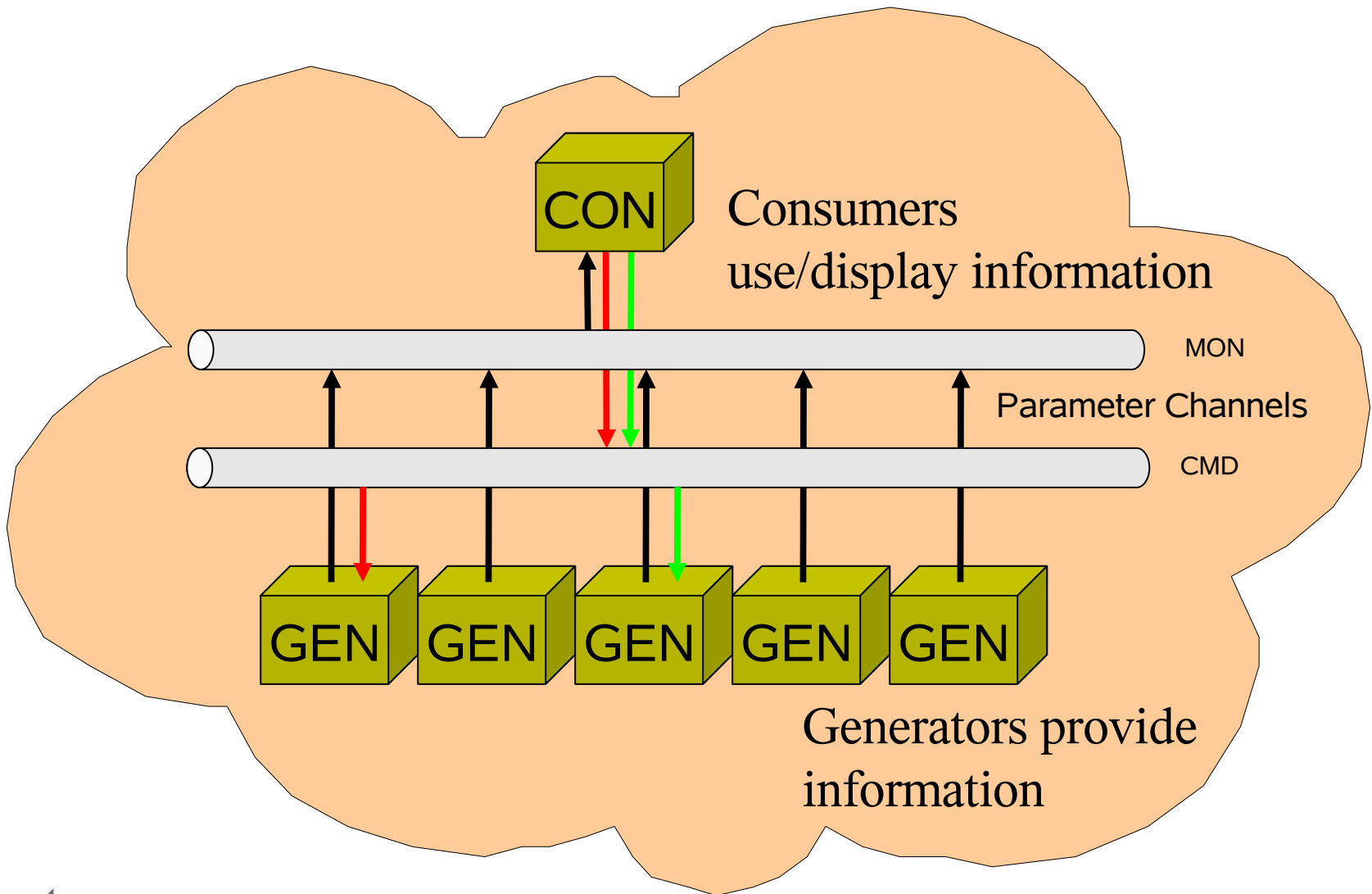
Requirements for a Generic M&C-System



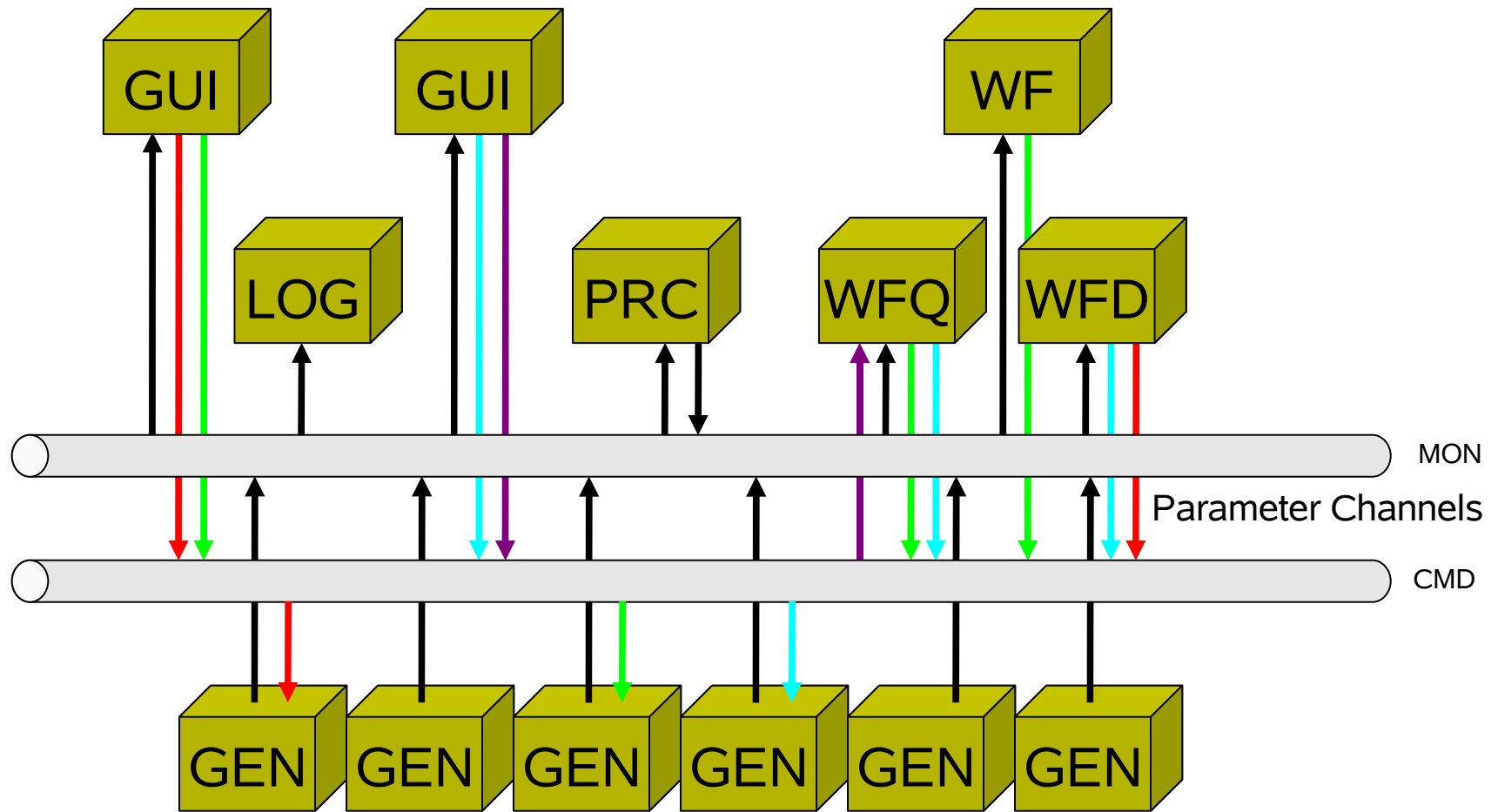
- Access to all hardware capabilities, especially all commands
- Hierarchical structure in monitoring and command
- Manually or automated

- Platform independent
- Scalable, distributed
- Fast and reliable

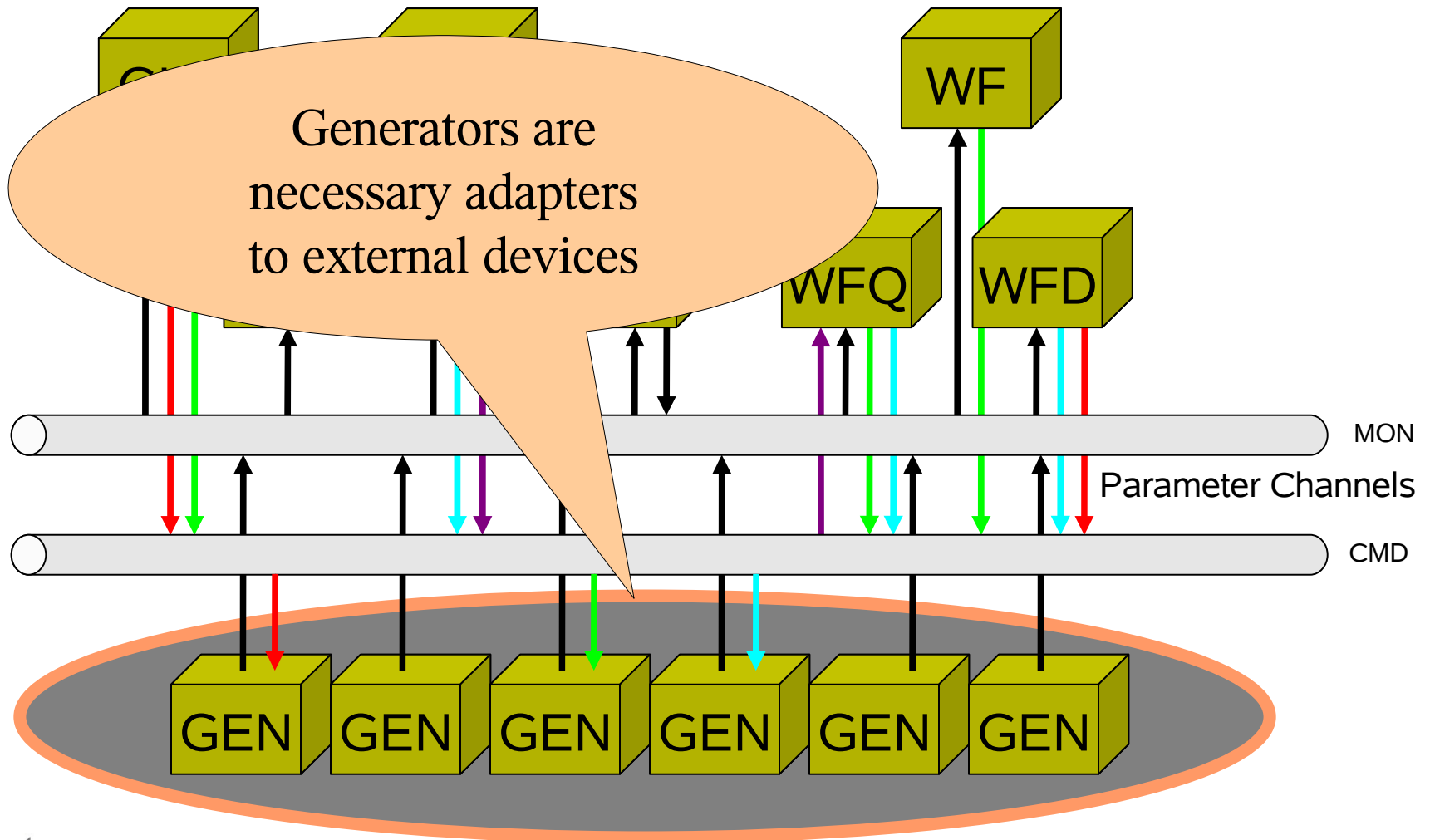
A Generic M&C-System - Design Principle (1)



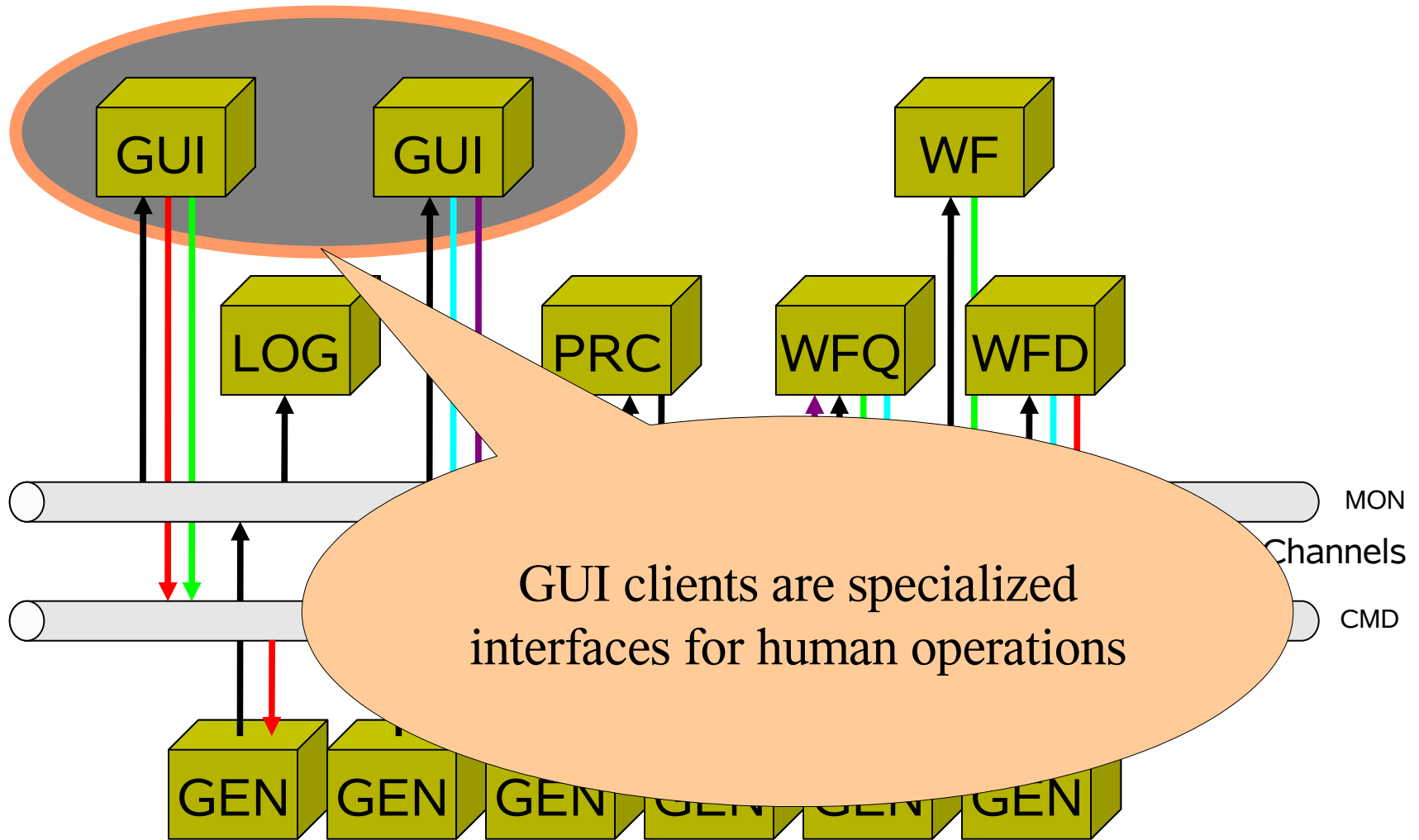
A Generic M&C-System - Design Principle (2)



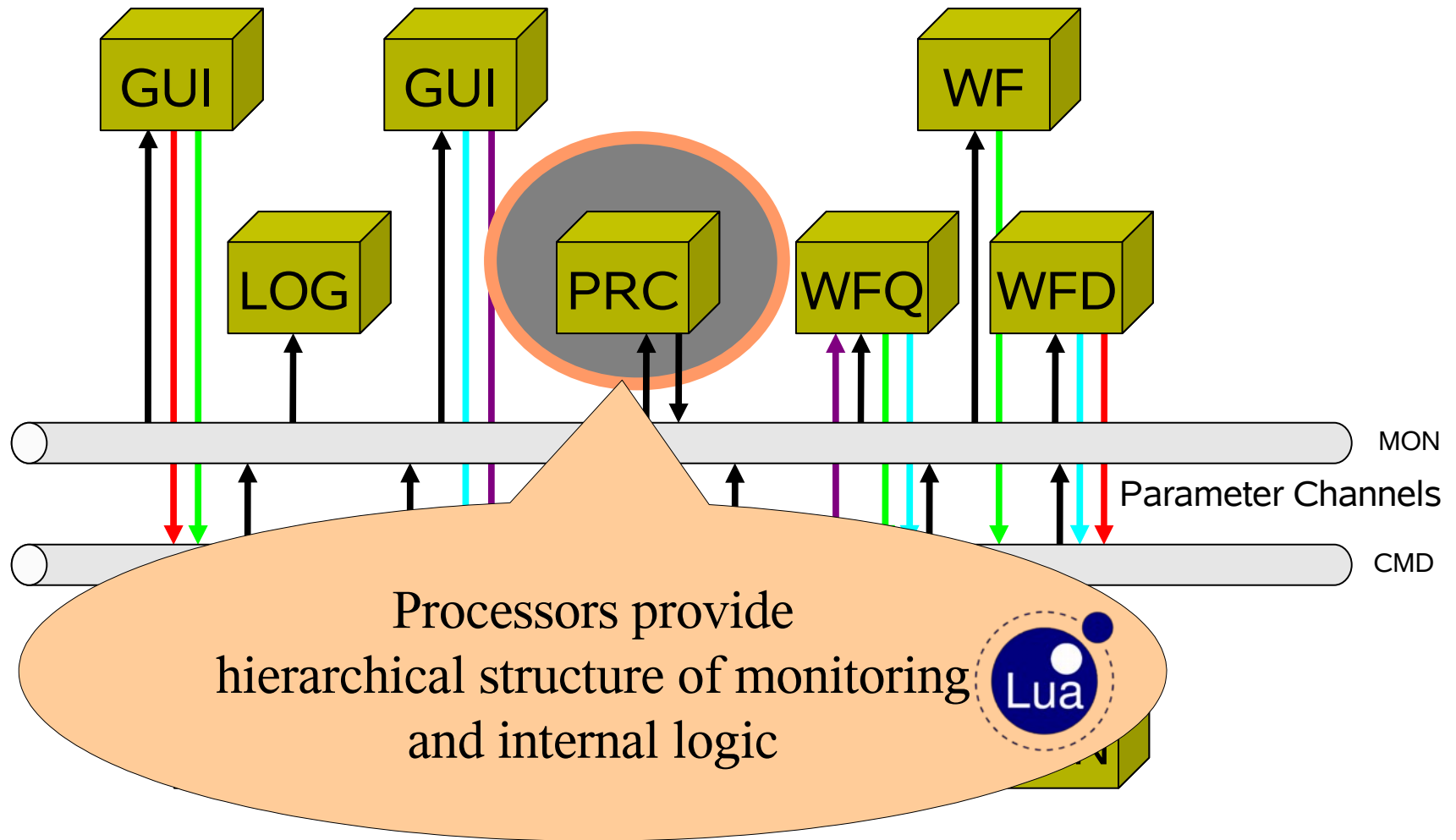
A Generic M&C-System - Design Principle (2)



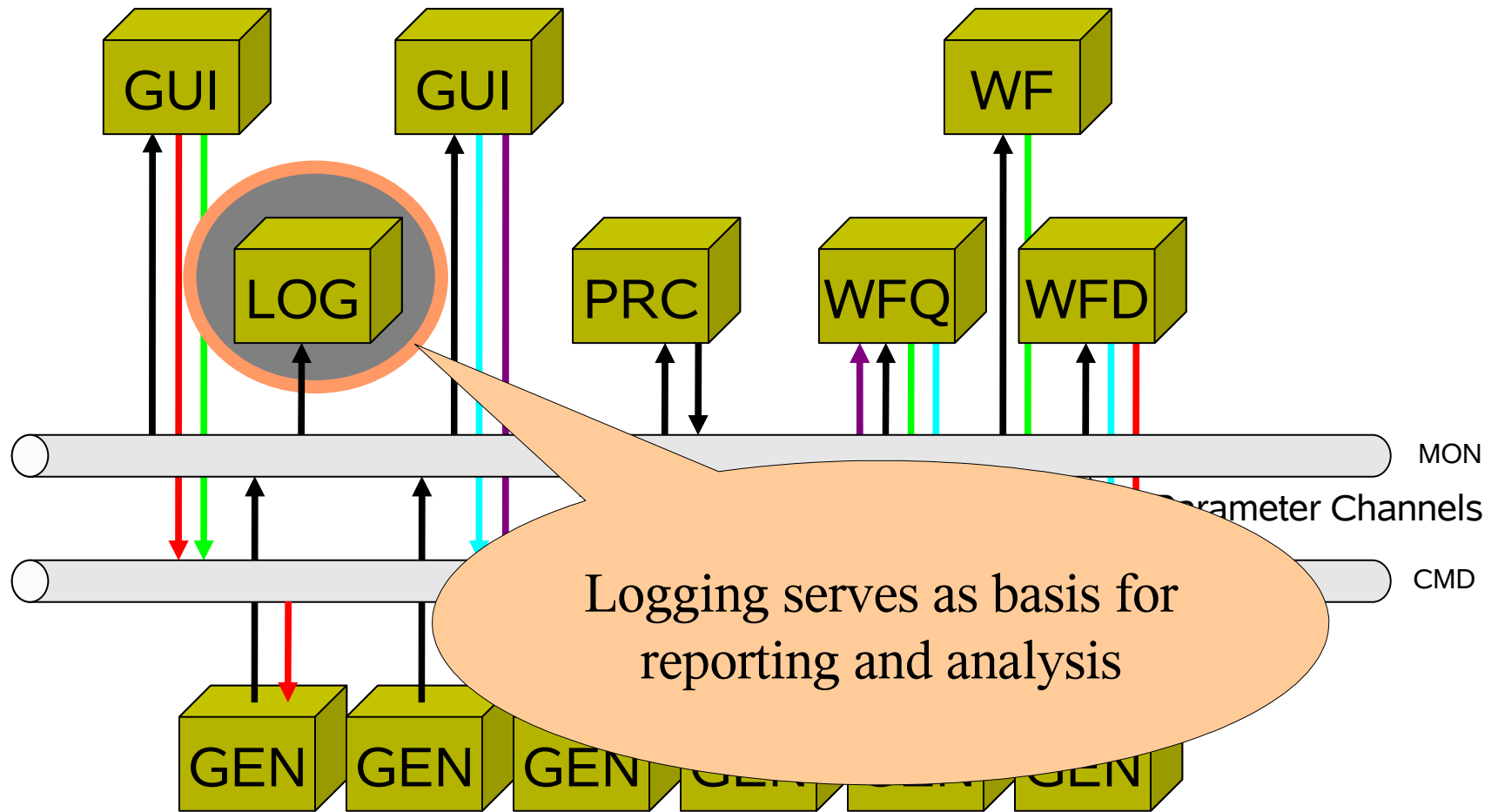
A Generic M&C-System - Design Principle (2)



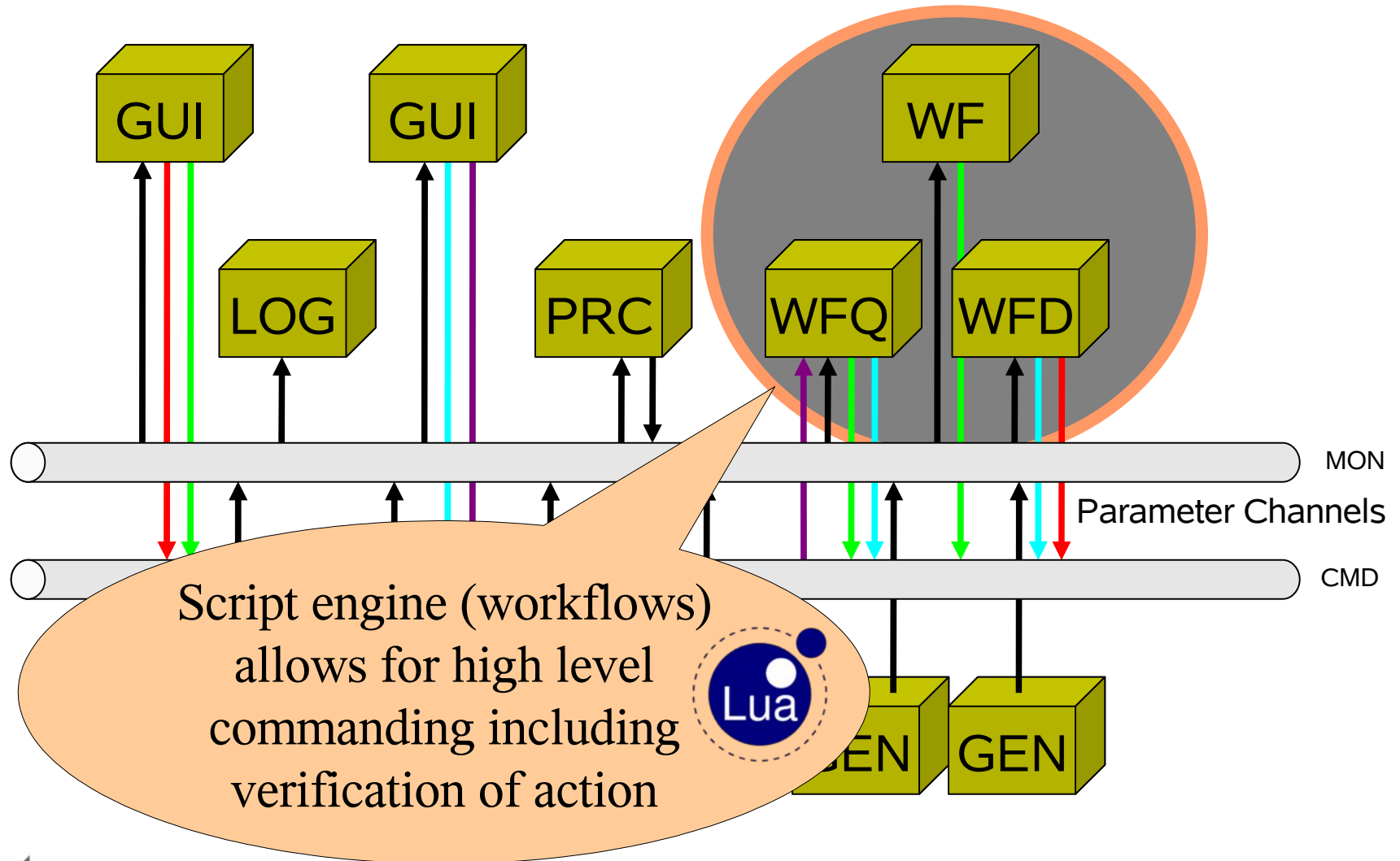
A Generic M&C-System - Design Principle (2)



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A Generic M&C-System - Design Principle (2)



WARP - Example: High Level Commanding

GSOC_DSI_WOF_Workflow_s67 - [Execute]

File Windows View Action Help

Missions: lro

ALARMS: 0

SysTime: 2012-02-25T14:03:02

Current Workflow: Mission Setup

Workflow

#	Progress	ID	Name	Message
@ 00001	100%		mission_setup_start	00004 ID:000-- --Script finished
@ 00002	100%		mission_setup_check_precond	00010 ID:000-- --Script finished
@ 00003	100%		store_mission_params	00107 ID:000-- --Script finished
@ 00004	100%		cortex_reset	01386 ID:001-- --Script finished
⊕ P-000			mission_primary_ctx_reset	
⊕ P-001			mission_backup_ctx_reset	
@ 00005	100%		mission_setup_check_CTXReset	00016 ID:000-- --Script finished
@ 00006	100%		mission_setup	00649 ID:000-- --Script finished
@ 00007	100%		mission_setup_set_COMMISSION	00009 ID:000-- --Script finished
@ 00008	100%		mission_setup_check_ULmission	00010 ID:000-- --Script finished
@ 00009	100%		mission_setup_uplink_setup	00029 ID:000-- --Script finished
00001			Starting script	
00002			OK--Starting script	
00003			ID:000--NTC--2012-02-25T14:00:32--Starting script	
00004			ID:000--DBG--2012-02-25T14:00:32--Class : lro	
00005			ID:000--DBG--2012-02-25T14:00:33--Instance: WOF	
00006			ID:000--DBG--2012-02-25T14:00:33--Antenna : S67	
00007			ID:000--DBG--2012-02-25T14:00:33--File : uplink_setup	
00008			ID:000--DBG--2012-02-25T14:00:33--Table : UPLINK	
00009			ID:000--INF--2012-02-25T14:00:33--Wof Class:execute_data_table: Check param S67_L2_ULSPS_MON	
00010			ID:000--NTC--2012-02-25T14:00:33-- [S67_L2_ULSPS_MON|txSignalDestination]: Success: set to	
00011			ID:000--INF--2012-02-25T14:00:33-- Wof Class:verifyGroup: Successfully set 1 params to the	
00012			ID:000--DBG--2012-02-25T14:00:33--Wof Class:execute_data_table: Operation on group S71_L2_H	
00013			ID:000--DBG--2012-02-25T14:00:33--Wof Class:execute_data_table: Set param S67_L2_CTX1_CMD|	
00014			ID:000--DBG--2012-02-25T14:00:33--Wof Class:execute_data_table: Set param S67_L2_CTX2_CMD|	
00015			ID:000--DBG--2012-02-25T14:00:33--Wof Class:execute_data_table: Set param S67_L2_CTX1_CMD|	
00016			ID:000--DBG--2012-02-25T14:00:33--Wof Class:execute_data_table: Set param S67_L2_CTX2_CMD|	
00017			ID:000--DBG--2012-02-25T14:00:34--Wof Class:execute_data_table: Set param S67_L2_UC1_CMD|	
00018			ID:000--DBG--2012-02-25T14:00:34--Wof Class:execute_data_table: Set param S67_L2_UC2_CMD|	
00019			ID:000--INF--2012-02-25T14:00:34-- Wof Class:execute_data_table: VERIFY params marked with	
00020			ID:000--NTC--2012-02-25T14:00:34-- [S67_L2_CTX1_MON|ifm1_ModulationEnable]: Success: set t	
00021			ID:000--NTC--2012-02-25T14:00:34-- [S67_L2_CTX2_MON|ifm1_ModulationEnable]: Success: set t	
00022			ID:000--NTC--2012-02-25T14:00:34-- [S67_L2_UC1_MON|carrier]: Success: set to ON (0 cycles)	
00023			ID:000--NTC--2012-02-25T14:00:34-- [S67_L2_UC2_MON|carrier]: Success: set to ON (0 cycles)	
00024			ID:000--NTC--2012-02-25T14:00:35-- [S67_L2_CTX1_MON|ifm1_CarrierEnable]: Success: set to 1	
00025			ID:000--NTC--2012-02-25T14:00:35-- [S67_L2_CTX2_MON|ifm1_CarrierEnable]: Success: set to 1	
00026			ID:000--INF--2012-02-25T14:00:36-- Wof Class:verifyGroup: Successfully set 6 params to the	
00027			ID:000--DBG--2012-02-25T14:00:36--Wof Class:include_data_table: File not found /opt/dsi/et	
00028			ID:000--NTC--2012-02-25T14:00:36--Exiting script	
00029			ID:000-- --Script finished	
00011			ID:000-- --Script finished	
00009			ID:000-- --Script finished	
00005			ID:000-- --Script finished	
@ 00010	100%		switch_vmx_default	
@ 00011	100%		mission_setup_set_ULmission	
@ 00012	100%		Cond001	
@ 00013	0%		mission_setup_check_DATAmission	
@ 00014	0%		sle_on	
@ 00015	0%		mission_setup_set_DATAmission	
@ 00016	100%		mission_setup_runSpec	00016 ID:000-- --Script finished
@ 00017	100%		mission_setup_finish	00004 ID:000-- --Script finished

Messages, command logging and monitoring checks

Parallel steps

WF overloaded for particular mission

Skipped steps

Apply

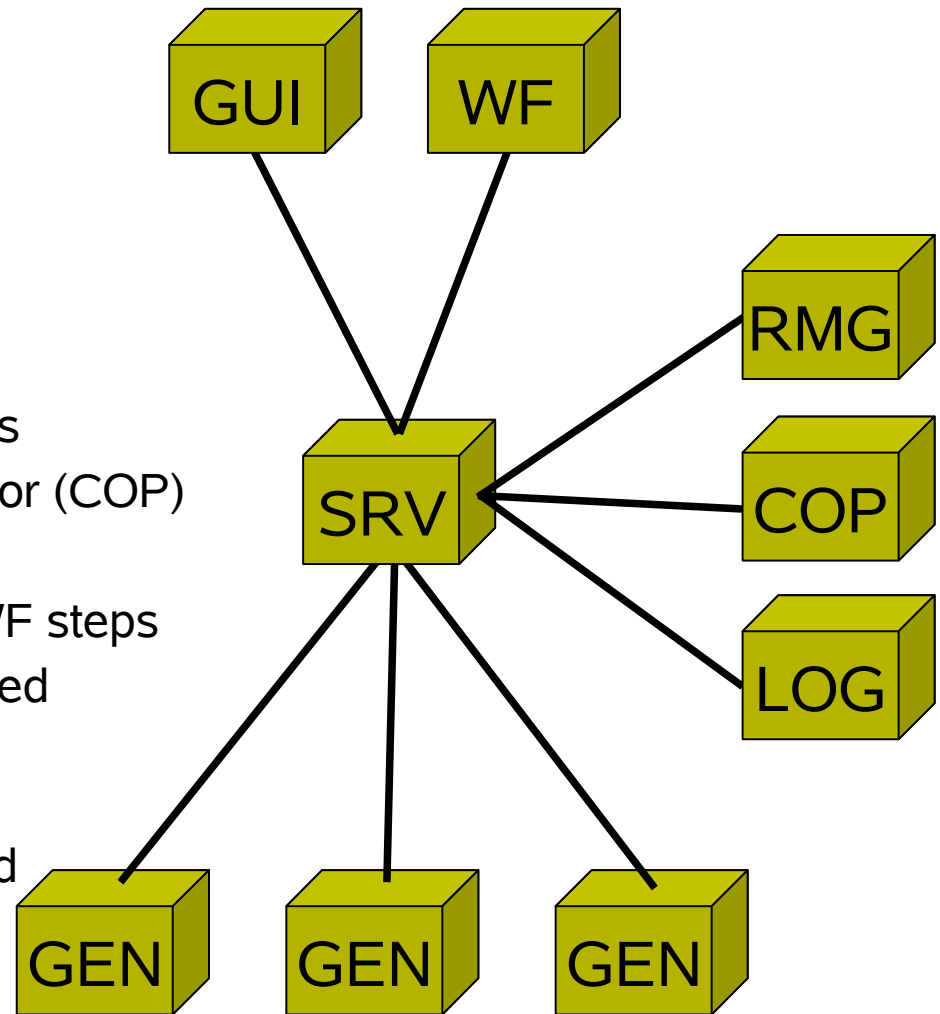
Activate Reset

Stop Start

Cmd: Mon: GEN: PDB:

WARP - Toolkit

- Resource Manager (RMG)
 - Declares devices as
 - present
 - maintained
 - faulty
 - Informs WFs to ignore devices
- Configuration Observation Processor (COP)
 - State machine
 - Allows/Forbids WFs and/or WF steps
 - Reports deviations from desired settings
- Reporting
 - Fills a template (LaTeX) based on parameter logging
 - Automatically generated



Configuration Observation Processor - State Machine

➤ Keeps track on actions and provide antenna state

➤ globally

- ◆ setup
- ◆ pass
- ◆ ...

➤ functionally

- ◆ UL/DL
- ◆ ...

➤ Prevents action if necessary preconditions are not fulfilled

➤ Allows to initiate error-correction if needed/execution failed

➤ Continuously checks configuration

#	Progress	ID	Name	Message
00001	100%		start_uplink_start	00004 ID:000-- --Script finished
00002	100%		start_uplink_check_state	00011 ID:000-- --Script finished
00003	100%		start_uplink_init	00010 ID:000-- --Script finished
00004	100%		start_uplink_activate_hpa	00011 ID:000-- --Script finished
00005	100%		start_uplink_sweep_ctx	00010 ID:000-- --Script finished
00006	100%		start_uplink_term	00010 ID:000-- --Script finished
00007	100%		start_uplink_set_state	00010 ID:000-- --Script finished
00008	100%		start_uplink_finish	00004 ID:000-- --Script finished

#	Progress	ID	Name	Message
00001	100%		connect_start	00004 ID:000-- --Script finished
00002	100%		connect	00077 ID:000-- --Script finished
00003	STEP		connect_emulators	
00004	100%		connect_antConnect	00010 ID:000-- --Script finished
00005	100%		Cond001	00005 ID:000-- --Script finished
00006	100%		connect_repair	00032 ID:000-- --Script finished
00007	100%		connect_antReConnect	00009 ID:000-- --Script finished
00008	100%		connect_finish	00004 ID:000-- --Script finished

Workflow: "Antenna Connect"

=== FINISHED SUCCESSFULLY === OCCURED ERRORS WERE CORRECTED ===
(Duration: 9.520 seconds)



Configuration Observation Processor - State Machine (2)

gsoc - WOF GUI (S67) <3>

File Windows View Action Help

LRO DOY: 25 13:51:59 ALARMS: 0

Antenna state: configuration okay?

Antenna State: SETUP FOR MISSION

Antenna Operations Mode: UPLINK

Antenna Config

Source	Severity	ParGroup	ParName	Desired	Range	Value
1	RESconnect	COH_ALARM	S67_L2_CTY1_MON	deviceNonConnected	Link	Link
2	RESconnect	COH_ALARM	S67_L2_CTY1_MON	deviceCtrlConnected	Link	Link
3	RESconnect	COH_ALARM	S67_L2_CTY1_MON	deviceTsubConnected	Link	Link
4	RESconnect	COH_ALARM	S67_L2_CTY1_MON	deviceNonConnected	Link	Link
5	RESconnect	COH_ALARM	S67_L2_CTY2_MON	deviceNonConnected	Link	Link
6	RESconnect	COH_ALARM	S67_L2_CTY2_MON	deviceCtrlConnected	Link	Link
7	RESconnect	COH_ALARM	S67_L2_CTY2_MON	deviceTsubConnected	Link	Link
8	RESconnect	COH_ALARM	S67_L2_CTY2_MON	deviceNonConnected	Link	Link
9	RESconnect	COH_ALARM	S67_L2_ACU_MON	deviceConnected	LINK	LINK
10	RESconnect	COH_ALARM	S67_L2_RTC_MON	deviceNonConnected	LINK	LINK
11	RESconnect	COH_ALARM	S67_L2_ULSPS_MON	deviceNonConnected	LINK	LINK
12	RESconnect	COH_ALARM	S67_L2_ULSPS_MON	deviceNonConnected	LINK	LINK
13	RESconnect	COH_ALARM	S67_L2_DLSPS_MON	deviceNonConnected	LINK	LINK
14	RESconnect	COH_ALARM	S67_L2_DLSPS_MON	deviceCadConnected	LINK	LINK
15	RESconnect	COH_ALARM	S67_L2_HPA_MON	deviceConnected	LINK	LINK
16	RESconnect	COH_ALARM	S67_L2_DC1_MON	deviceConnected	LINK	LINK
17	RESconnect	COH_ALARM	S67_L2_DC2_MON	deviceConnected	LINK	LINK
18	RESconnect	COH_ALARM	S67_L2_UC1_MON	deviceConnected	LINK	LINK
19	RESconnect	COH_ALARM	S67_L2_UC2_MON	deviceConnected	LINK	LINK
20	RESconnect	COH_ALARM	S67_L2_UCT_MON	deviceConnected	LINK	LINK
21	RESconnect	COH_ALARM	S67_L2_TRK_MON	deviceConnected	LINK	LINK
22	RESconnect	COH_ALARM	S67_L2_RSY1_MON	deviceConnected	LINK	LINK
23	RESconnect	COH_ALARM	S67_L2_RSY2_MON	deviceConnected	LINK	LINK
24	RESconnect	COH_ALARM	S67_L2_WSP1_MON	deviceConnected	LINK	LINK
25	RESconnect	COH_ALARM	S67_L2_WSP2_MON	deviceConnected	LINK	LINK
26	RESmission	ERROR	S67_L2_SYS_MON	gen_Mission	---	---
27	Dlreset	WARNING	S67_L2_DLSPS_MON	testNode	UCT	UCT
28	Dlreset	ERROR	S67_L2_DLSPS_MON	testChain1Noise	OFF	OFF
29	Dlreset	ERROR	S67_L2_DLSPS_MON	testChain2Noise	OFF	OFF
30	Dlreset	ERROR	S67_L2_UCT_MON	carrier	OFF	OFF
31	Dlreset	ERROR	S67_L2_RSY1_MON	outputActive	no	no
32	Dlreset	ERROR	S67_L2_RSY2_MON	outputActive	no	no
33	ACUreset	ERROR	S67_L2_ACU_MON	powerOn	1	1
34	ACUreset	ERROR	S67_L2_ACU_MON	mode	Preset	Preset
35	ACUreset	ALARM	S67_L2_ACU_MON	targetEL	20	0.01
36	ACUreset	ALARM	S67_L2_ACU_MON	targetAZ	80	0.01
37	ACUreset	WARNING	S67_L2_ACU_MON	actualEL	20	0.1
38	ACUreset	WARNING	S67_L2_ACU_MON	actualAZ	80	0.1
39	ACUreset	ERROR	S67_L2_ACU_MON	actualEL	20	1
40	ACUreset	ERROR	S67_L2_ACU_MON	actualAZ	80	1

Sort Key: RESULT RESULT Refresh Table Reset Statistics

Last Response: Section of updated param (S67_L2_ACU_MON)targetEL done

PDB System: 2012-025T13:51:59;input Buffer: 0 # Clients: 35 # Consumer: 11 # Generator: 24 # Updates last sec(abs): 51

Cmd: Mon GEN PDB

L4 - Summary

MISSION: lro SC-MODE: 293120 bit/s

TAF WSP

UL 1 UL 2

Tower

ULMx

Complex 2 Complex 1

TC TC

RNG-DOP RNG-DOP

TM TM

DL

DLMx

SC RCV: UNKNOWN

L3 - RFG

TX Pol Ant Dummy HPA 1 HPA 2 JCHPA UC3 UC1 UC2

REFCON

Test In 1 Test In 2

SYNH 1 UCT

Comp.

SYNH 2

LNA 1 LNA 2 LNA 3

DC 2 DC 1

ULMx DLMx

Device state:
hardware okay?

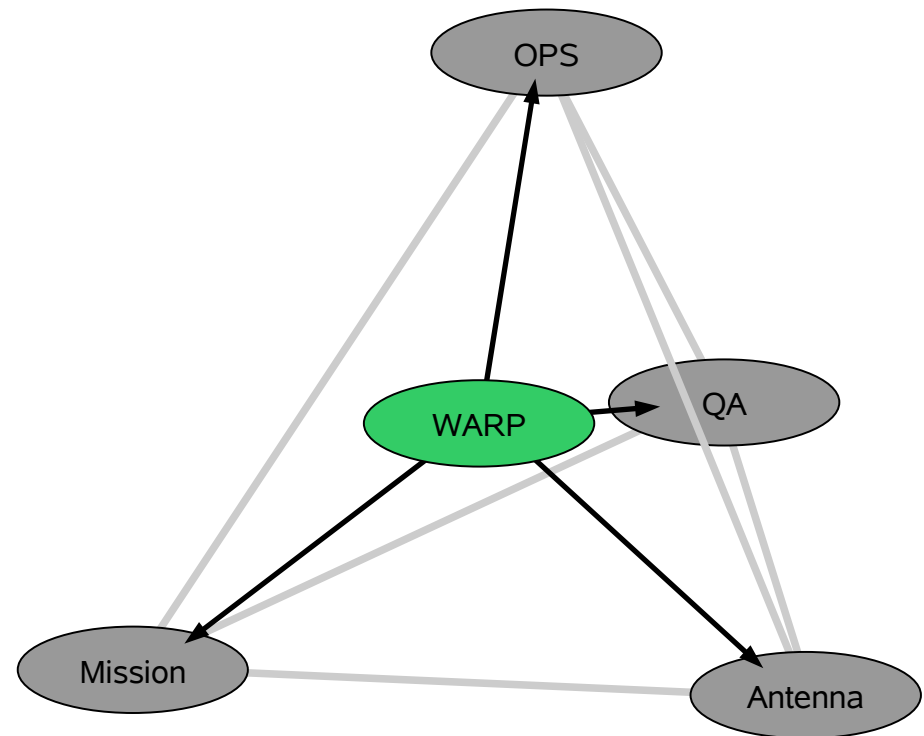


Multi-Mission Support with WARP



WARP - An Object Oriented Design for Operations

- Mission Definition
 - Abstract parameters like
 - Frequencies
 - Bitrates
- Antenna Definition
 - Applicable devices
 - Do's and dont's
 - Calibrations
 - Parameter ranges
- Operations Concept
 - Unified procedures for
 - ✓ Various antennas
 - ✓ Various missions
- QA
 - Few inputs
 - Checkable against settings



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Antenna Specific Settings

File Help

Antenna Settings Fixed Positions Clystron Settings TRK Phase Calibration

Desc.	S67	S69	S71
1 LAT	47.88006944	47.88119889	47.88232834
2 LONG	11.08530250	11.08361889	11.08193528
3 H	663.392	663.374	663.356
4 FD ID	3267	3271	3275
5 FD MNE	WHM1	WHM2	WHM3
6 MNE	S67	S69	S71
7 GAIN	46.40	47.20	48.00
8 GAIN COR	0.00	0.00	0.00
9 CableLoss	0.00	0.00	0.00
10 HPA1 CableLoss	0.00	0.00	0.00
11 HPA2 CableLoss	0.00	0.00	0.00
12 HPA1 EIRP MIN	46.40	47.20	48.00
13 HPA1 EIRP MAX	69.41	70.21	71.01
14 HPA1 UC Attenuation	7	7	7
15 HPA2 EIRP MIN	46.40	47.20	48.00
16 HPA2 EIRP MAX	79.41	80.21	81.01
17 HPA2 UC Attenuation	7	7	7
18 UC1 CableLoss	3	3	3
19 UC2 CableLoss	0	0	0
20 UC3 CableLoss	3	3	3
21 Channel1 DL1 GAIN	55.40	58.00	60.60
22 Channel2 DL1 GAIN	55.40	58.00	60.60
23 Channel3 DL1 GAIN	55.40	58.00	60.60
24 Channel1 DL2 GAIN	55.40	58.00	60.60
25 Channel2 DL2 GAIN	55.40	58.00	60.60
26 Channel3 DL2 GAIN	55.40	58.00	60.60
27 LEO DC Attenuation	7.0	7.0	7.0
28 GEO DC Attenuation	2.0	2.0	2.0
29 RINGSYN LEVEL	10.00	-10.00	0.00
30 UCT Attenuation	2.0	2.0	2.0
31 PRD POINTS MAX	2900	2900	2900
32 AZ MIN	0.00	0.00	0.00
33 AZ MAX	360.00	360.00	360.00
34 EL MIN	6.00	2.00	0.00
35 EL MAX	174.00	177.00	180.00
36 EL PRD MIN	6.30	3.00	0.00
37 EL PRD MAX	173.70	176.00	178.00

Mission Editor

File Edit Help

Mission: **BIR** ...

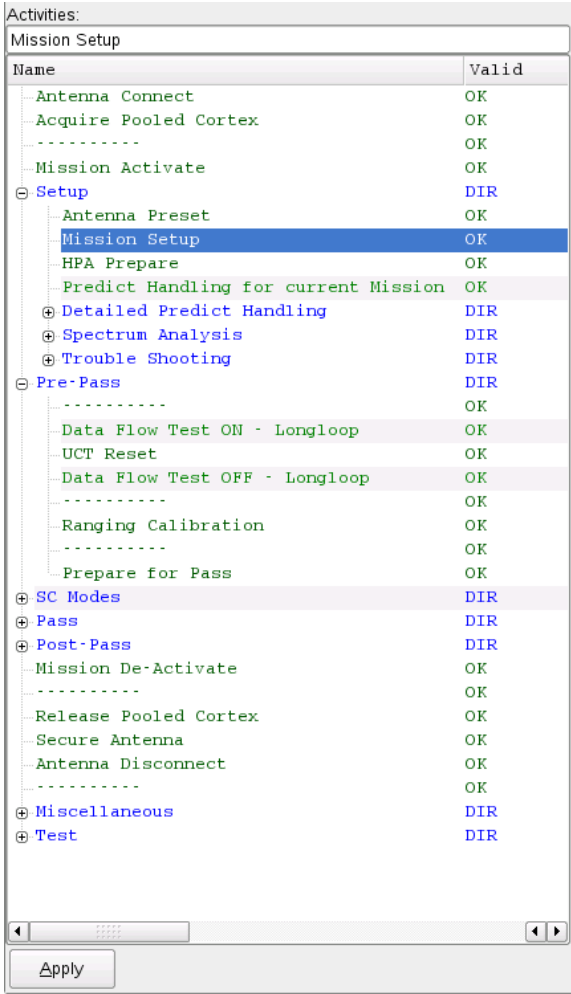
Parameter

Default
 Lowrate
 Highrate
 Default @ S67
 ...

Name	Value
27 r_LoopFilterBandwidth	2
28 r_AcquisitionRange	100000
29 r_AGCTimeConstant	0
30 r_SubcarrierFrequency	0
31 r_SubcarrierDemodulationType	0
32 r_PSKDemodulatorLoopBandwidth	1
33 r_PCCode	0
34 r_HRdirectPCMMatchFilter	0
35 r_HRdirectPCMrollOffFactor	0.1
36 r_Bitrate	137500.000
37 r_ConvolutionalCoding	0
38 r_TMFormat	1
39 r_AttachedSyncMarker	1ACFFCID
40 r_AttachedSyncMarkerLength	32
41 r_FrameLength	508
42 r_FrameChecking	0
43 r_Randomization	0
44 r_FrameEncoding	0
45 r_ReedSolomonInterleavingDepth	0
46 r_DiversityCombining	1
47 r_DiversityCombiningMode	1
48 r_DiversityCombiningOut1	2
49 r_DiversityCombiningOut2	0
50 r_ChannelAPort	0
51 r_ChannelBPort	1
52 r_FrameECFpresent	1
53 r_FrameOCFpresent	1
54 r_spectralBandwidth	2500
55 f_EIRP	68.0
56 f_ModulatingSignal	6
57 f_Polarization	1
58 f_HPPrime	0
59 f_UplinkFrequency	2032.5
60 f_UplinkIntermediateFrequency	70.000000
61 f_Sweep	0
62 f_SweepRange	50
63 f_SweepRate	50
64 f_ModulationType	1
65 f_ModulationIndex	1.6
66 f_FrequencyDeviation	0.0
67 f_PulseShapingFilterRC	0
68 f_PulseShapingFilterRCrollOffFactor	0.1

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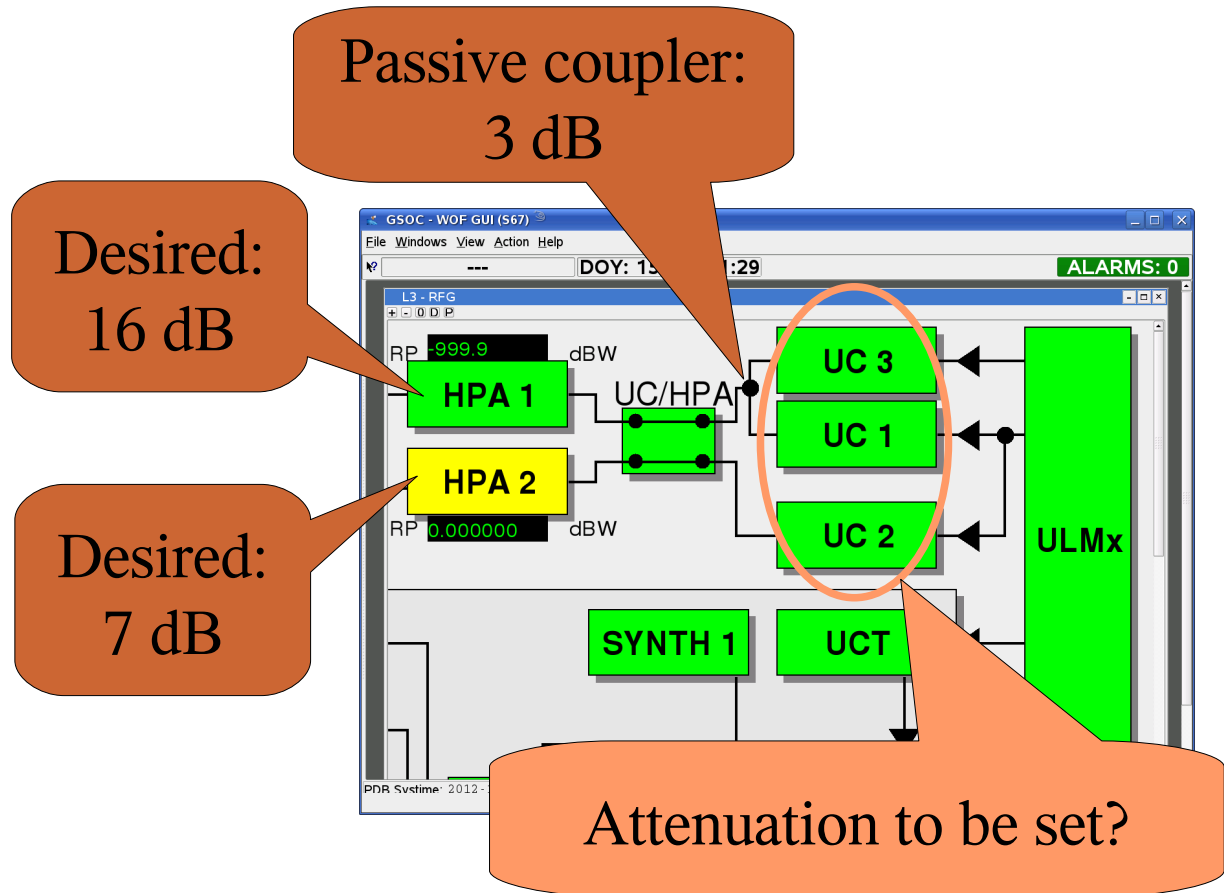
Activities:

Mission Setup	
Name	Valid
Antenna Connect	OK
Acquire Pooled Cortex	OK
-----	OK
Mission Activate	OK
⊖ Setup	DIR
Antenna Preset	OK
Mission Setup	OK
HPA Prepare	OK
Predict Handling for current Mission	OK
⊕ Detailed Predict Handling	DIR
⊕ Spectrum Analysis	DIR
⊕ Trouble Shooting	DIR
⊖ Pre-Pass	DIR
-----	OK
Data Flow Test ON - Longloop	OK
UCT Reset	OK
Data Flow Test OFF - Longloop	OK
-----	OK
Ranging Calibration	OK
-----	OK
Prepare for Pass	OK
⊕ SC Modes	DIR
⊕ Pass	DIR
⊕ Post-Pass	DIR
Mission De-Activate	OK
-----	OK
Release Pooled Cortex	OK
Secure Antenna	OK
Antenna Disconnect	OK
-----	OK
⊕ Miscellaneous	DIR
⊕ Test	DIR

Apply

Functional Dependencies - Antenna Parameters

- Different HPA have different working points
- Different signal paths have different losses
- Dynamic assignment UC/HPA must be possible



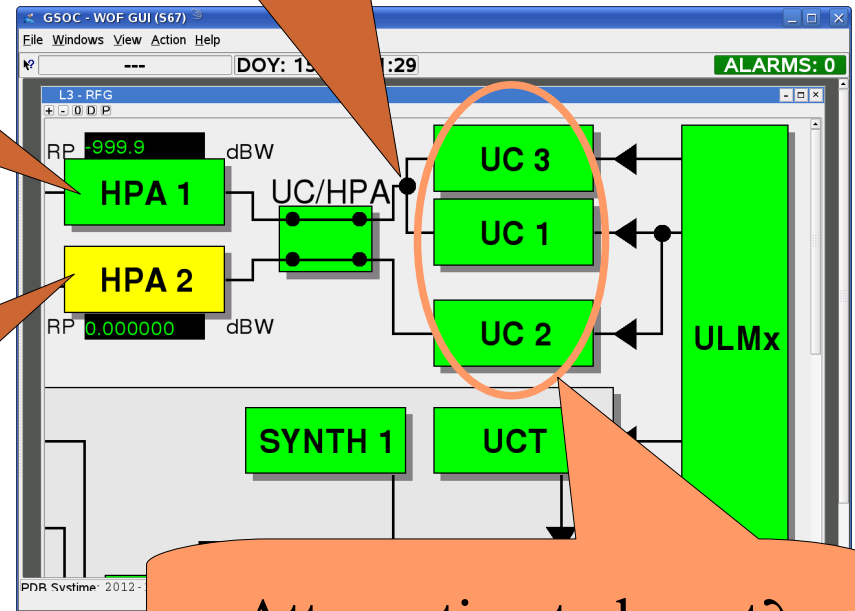
Functional Dependencies - Antenna Parameters

- Different HPA have different working points
- Different signal paths have different losses
- Dynamic assignment UC/HPA must be possible

Desired:
16 dB

Desired:
7 dB

Passive coupler:
3 dB



function
`UC_Attenuation(a_hpa, a_uc)`

Functional Dependencies - Mission Parameters

TD1 - Mission-Parameter
DL-Frequency = 2268.0 MHz

Workflow Mission-Setup

```
Function DL-Frequency(2268.0)
{
  Set DC: Frequency = 2268.0
  Set TRK: Phase = Calib(2268.0)
  Set TRK: GainX = Calib(2268.0)
  Set TRK: GainY = Calib(2268.0)
}
```

GEN
DC1

GEN
DC2

GEN
TRK

S67 - Antenna-Parameter
TRK-Calibration

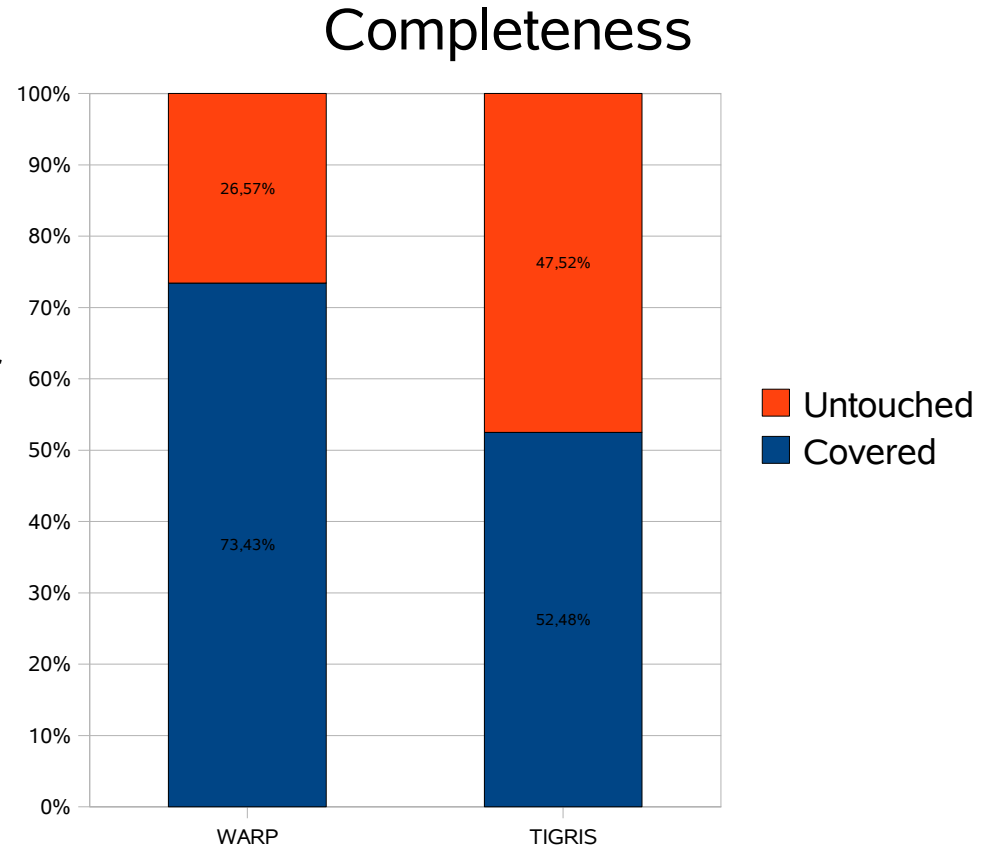


Operation-Procedures within WARP



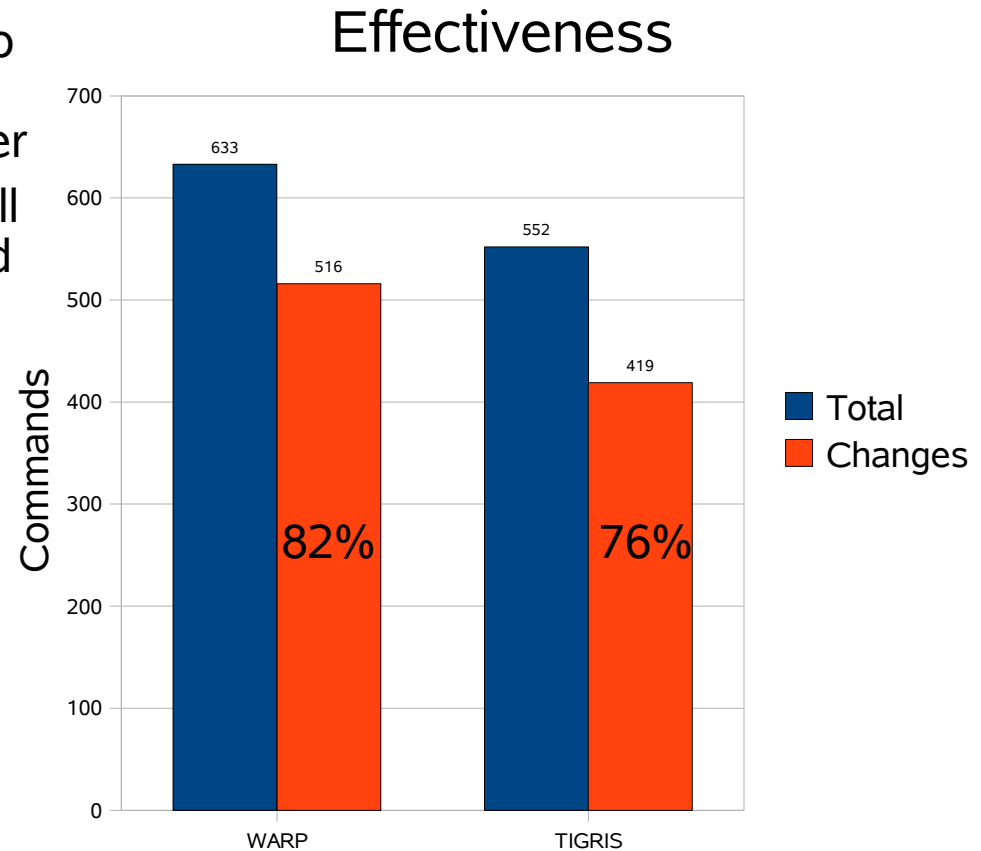
Statistical Analysis of Procedures - Completeness

- Relates existing command parameters (1189) to the ones actually used
 - Untouched parameters give room for potential misconfiguration
 - Total number corrected for static parameters like TCP/IP configuration
- Some (trigger-)commands not used on purpose
- Same hardware in test assures compatible results



Statistical Analysis of Procedures - Effectiveness

- Compares commanded values to the ones sent with the last command on the same parameter
 - Keeping the antenna in well defined states should avoid commanding identical values multiple times
 - Requirements are met, not established
- Some (trigger-)commands have no meaningful value at all
- Same hardware in test assures compatible results



Statistical Analysis of Procedures - Cunningness

- Relates number of send commands to the number of changed parameters for several configurations
 - Reach the desired state with the least possible commands
 - Prefer switch $A \rightarrow C$ over sequence $A \rightarrow B \rightarrow C$
- Temporary states may be needed ($A \rightarrow B \rightarrow A$)
- Starting with a global "reset" contradicts the idea of cunningness

Considered states:

(1) Setup

Antenna is configured to support a given mission or perform end-to-end testing

(2) Prepass

Antenna points to the ascending point of the spacecraft, data recordings are activated, uplink is ready to be set

(3) Uplink

Antenna is "green for command", spacecraft receivers are locked to idling (PLOP-2)

(4) Stop

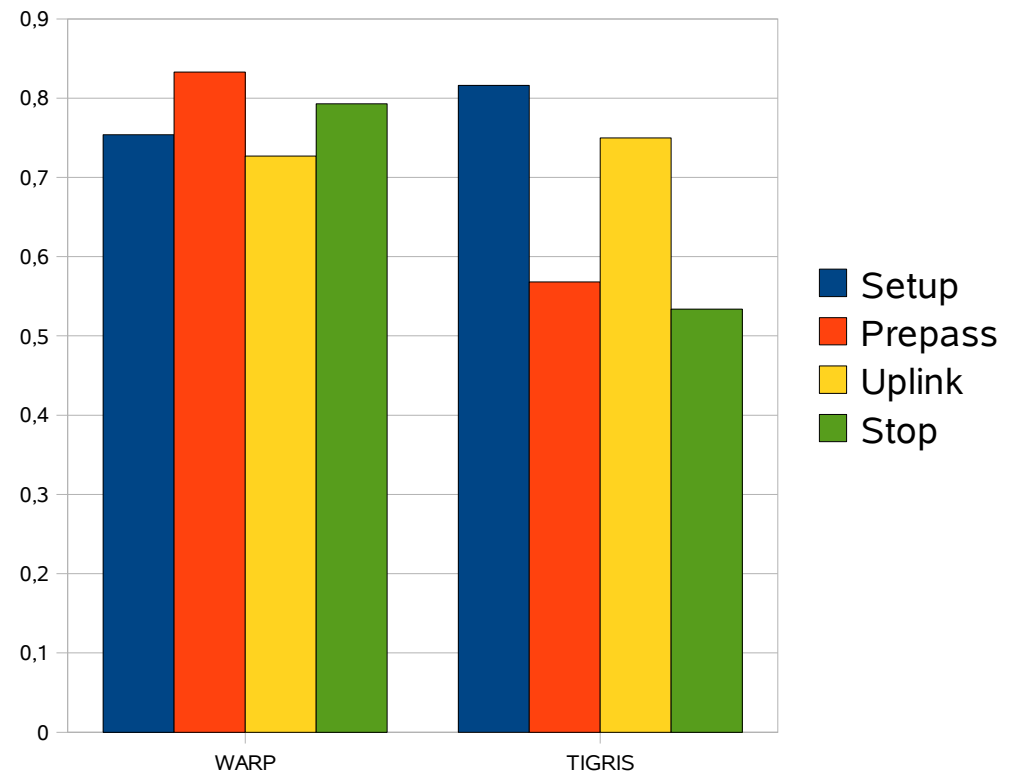
Support is completed, antenna is secured (HPA off, ACU park etc.)



Statistical Analysis of Procedures - Cunningness

- Relates number of send commands to the number of changed parameters for several configurations
 - Reach the desired state with the least possible commands
 - Prefer switch $A \rightarrow C$ over sequence $A \rightarrow B \rightarrow C$
- Temporary states may be needed ($A \rightarrow B \rightarrow A$)
- Starting with a global "reset" contradicts the idea of cunningness

Cunningness

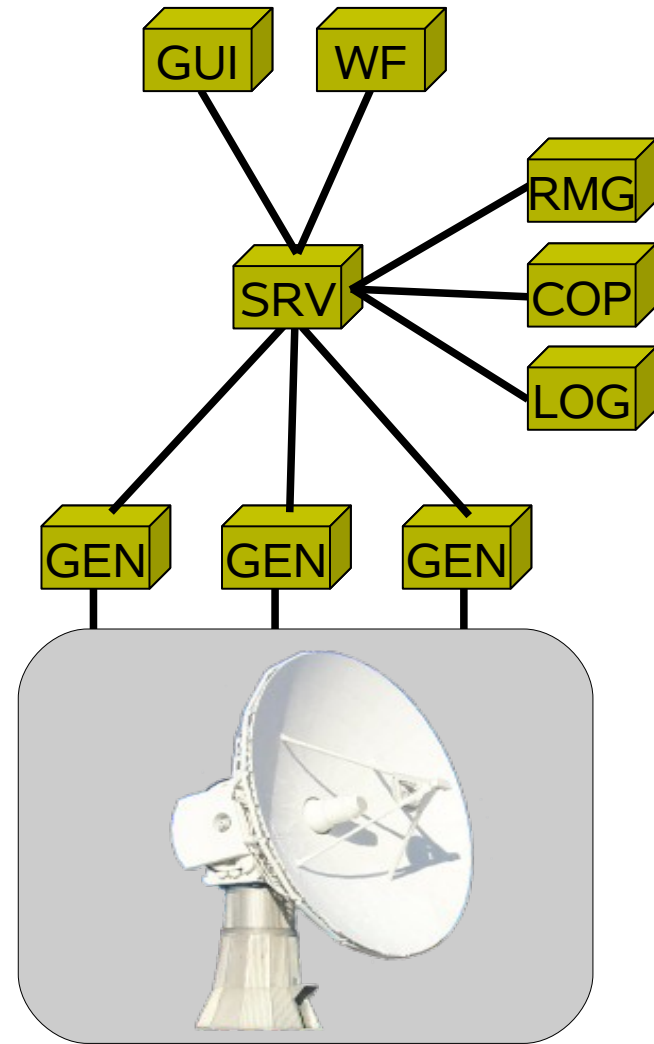
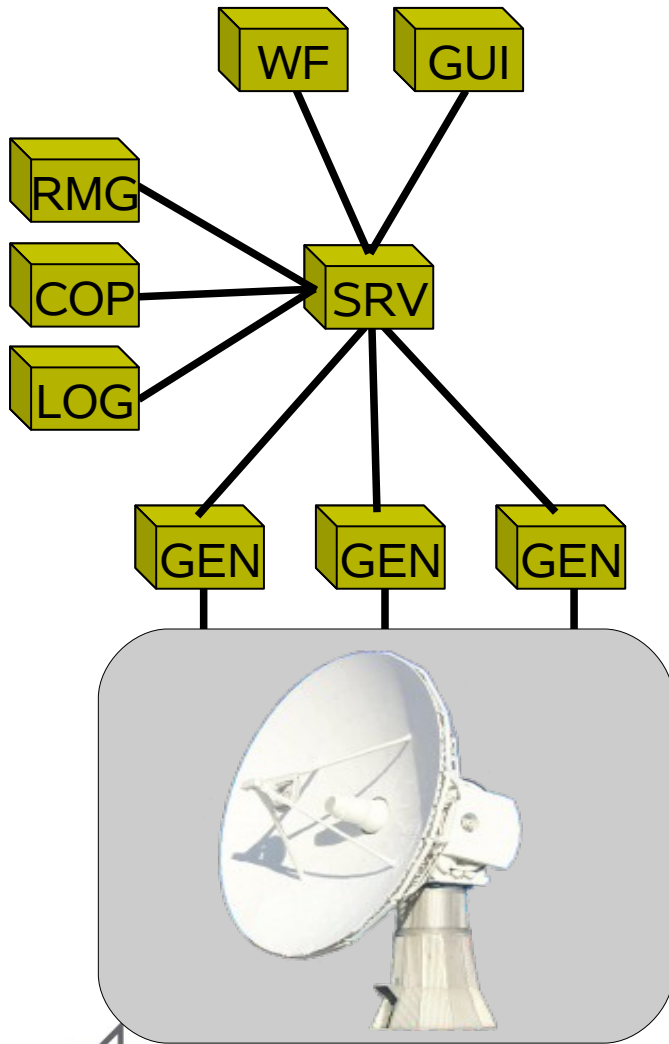




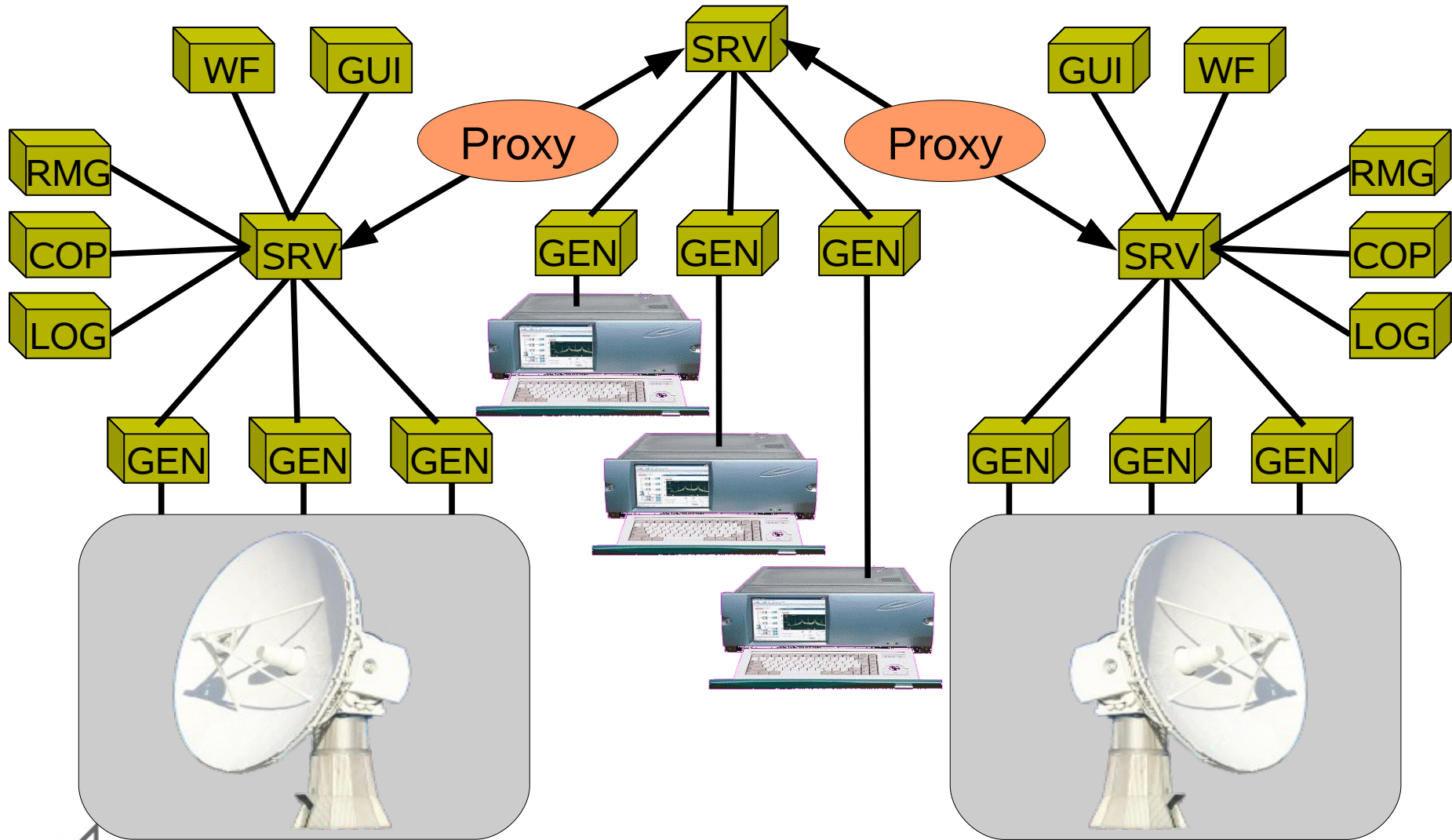
Multiple Antennas



Connecting WARP Instances - The Grand Picture



Connecting WARP Instances - The Grand Picture



Connecting WARP Instances - The Grand Picture

The screenshot displays the GSOC - WOP GUI (S00) interface. At the top, the system time is DOY: 25 14:56:21 and the alarm count is 0. The main window is divided into several sections:

- Station Summary (S00):** Shows a tree view of station components including S00-L4, S00-L2, and various subsystems like Logger, Sys Info, Cop Info, ULS, DLS, DLS_NOV, VMX, and TAF.
- ULS (Ultraviolet Line Scanning) Summary:**
 - Monitoring:** Shows 'Remote Control Enabled' and 'Power Supply #1 Alarm'.
 - Matrix:** A grid showing the status of various components (S67U1, S67U2, S69U1, S69U2, S70UL, TOWER, S71UL, SFE) across BB001 to BB005.
 - Station Resources (L4 - Summary):**
 - S71:** State: PASS, DOWNLINK. BB prime: Cortex 8, BB backup: Cortex 7.
 - S69:** State: STANDBY FOR PASS, UP/DOWNLINK. BB prime: Cortex 4, BB backup: Cortex 3.
 - S70:** State: UNKNOWN.
 - S67:** State: SETUP FOR MISSION, DOWNLINK. BB prime: Cortex 2, BB backup: Cortex 1.
- DLS [Novotronik]:** Shows 'Manual Control Alarm' and a matrix for components like S67R1, S67L1, S69R1, S69L1, S70RC, S70LC, S71RC, S71LC, S67R2, S67L2, S69R2, S69L2, Spare, S73C1, S73C2, S73E1, and Spare.
- Station Resources Table:**

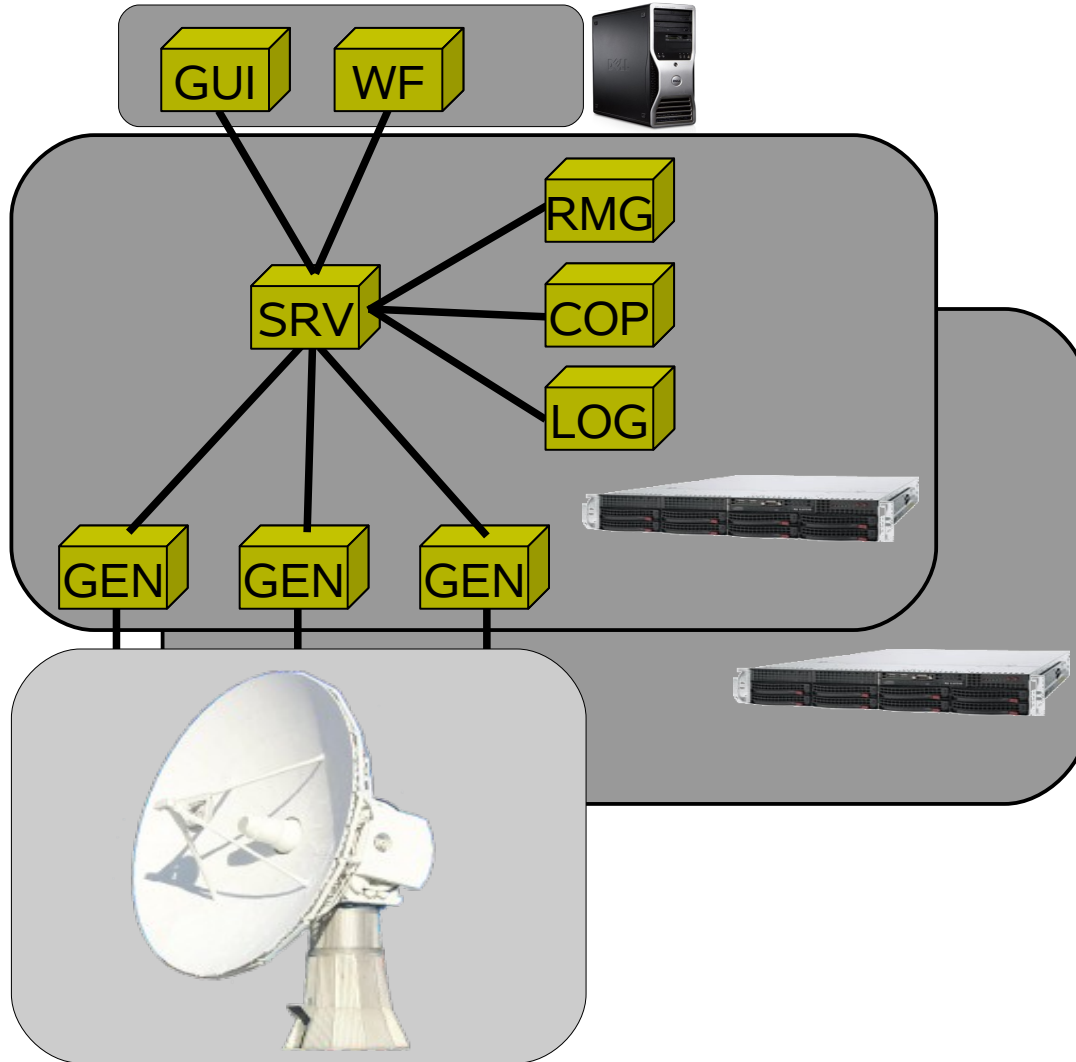
Class	Resource	State	Owner	Task	Start	Stop	Desc.	ID
CTX	129.247.245.53 POOL_LOCKED	S67	BACKUP	2012-025T14:55:54.882011Z	3000-001T00:00:00.000000Z	Cortex 1	1, 1	
CTX	129.247.245.54 POOL_LOCKED	S67	PRIME	2012-025T14:55:54.884074Z	3000-001T00:00:00.000000Z	Cortex 2	1, 2	
CTX	129.247.245.55 POOL_LOCKED	S69	BACKUP	2012-025T14:55:54.885446Z	3000-001T00:00:00.000000Z	Cortex 3	1, 3	
CTX	129.247.245.56 POOL_LOCKED	S69	PRIME	2012-025T14:55:54.887010Z	3000-001T00:00:00.000000Z	Cortex 4	1, 4	
CTX	129.247.245.57 POOL_FREE	SYSTEM POOLED	2012-025T14:55:54.892561Z	3000-001T00:00:00.000000Z	Cortex 5	1, 5		
CTX	129.247.245.58 POOL_FREE	SYSTEM POOLED	2012-025T14:55:54.894876Z	3000-001T00:00:00.000000Z	Cortex 6	1, 6		
CTX	129.247.245.59 POOL_LOCKED	S71	BACKUP	2012-025T14:55:54.895335Z	3000-001T00:00:00.000000Z	Cortex 7	1, 7	
CTX	129.247.245.77 POOL_LOCKED	S71	PRIME	2012-025T14:55:54.895665Z	3000-001T00:00:00.000000Z	Cortex 8	1, 8	
CTX	129.247.245.67 POOL_FREE	SYSTEM POOLED	2012-025T14:55:54.898840Z	3000-001T00:00:00.000000Z	Cortex 10	1, 9		
ULS	129.247.245.38	PRESENT	SYSTEM	2012-025T14:55:54.902319Z	3000-001T00:00:00.000000Z	U/L Switch Matrix	2, 1	
DLS	10.21.2.174	PRESENT	SYSTEM	2012-025T14:55:54.906739Z	3000-001T00:00:00.000000Z	Z/L Switch Matrix	3, 1	
VMX	129.247.245.71	PRESENT	SYSTEM	2012-025T14:55:54.90679Z	3000-001T00:00:00.000000Z	Video Matrix	4, 1	
TAF	129.247.245.27	PRESENT	SYSTEM	2012-025T14:55:54.90740Z	3000-001T00:00:00.000000Z	Time and Frequency	5, 1	
TUC	129.247.245.17	POOL_FREE	SYSTEM	2012-025T14:55:54.90850Z	3000-001T00:00:00.000000Z	Tower Upconverter	6, 1	



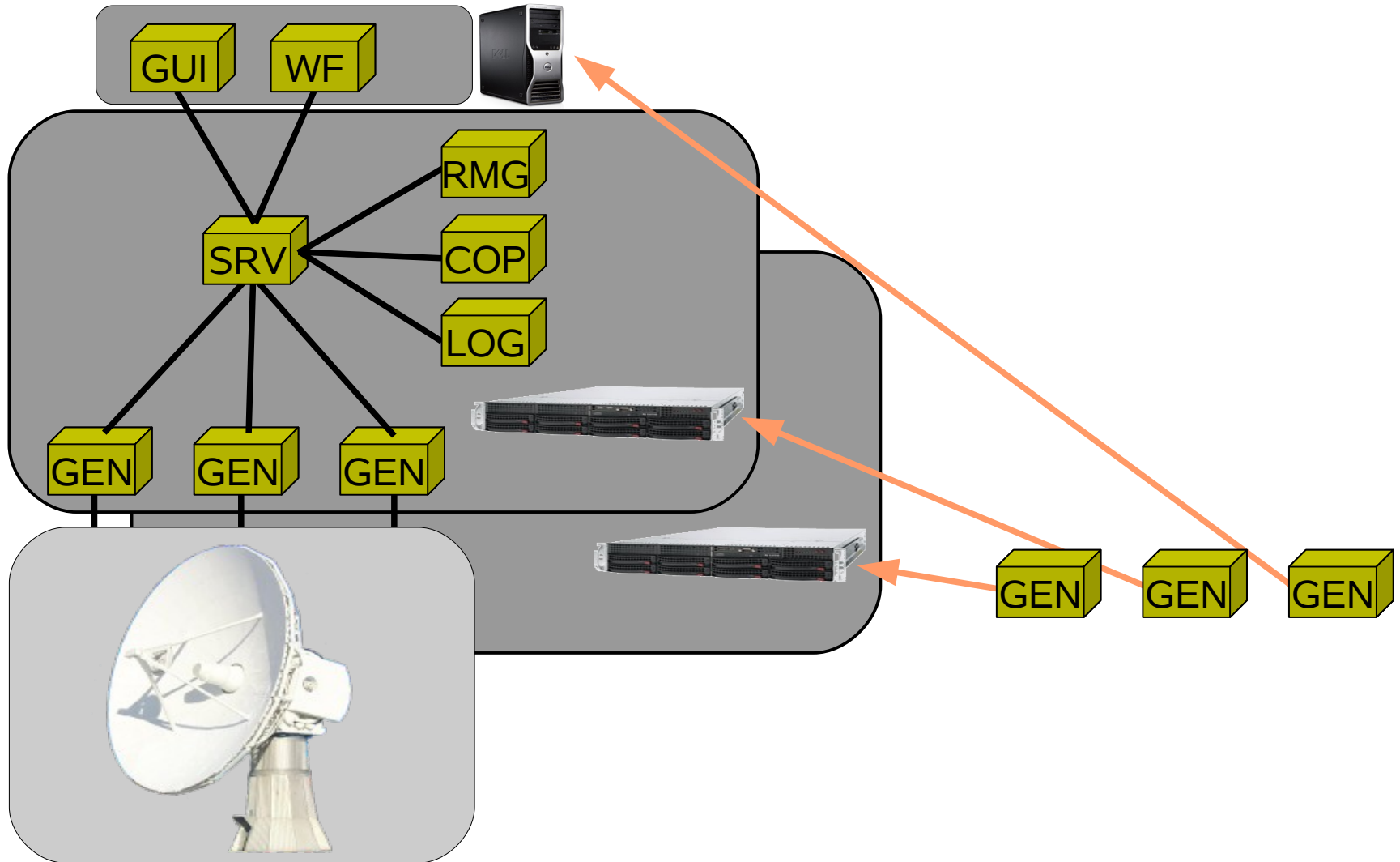
Beyond Antenna-Control "Trans-WARP"



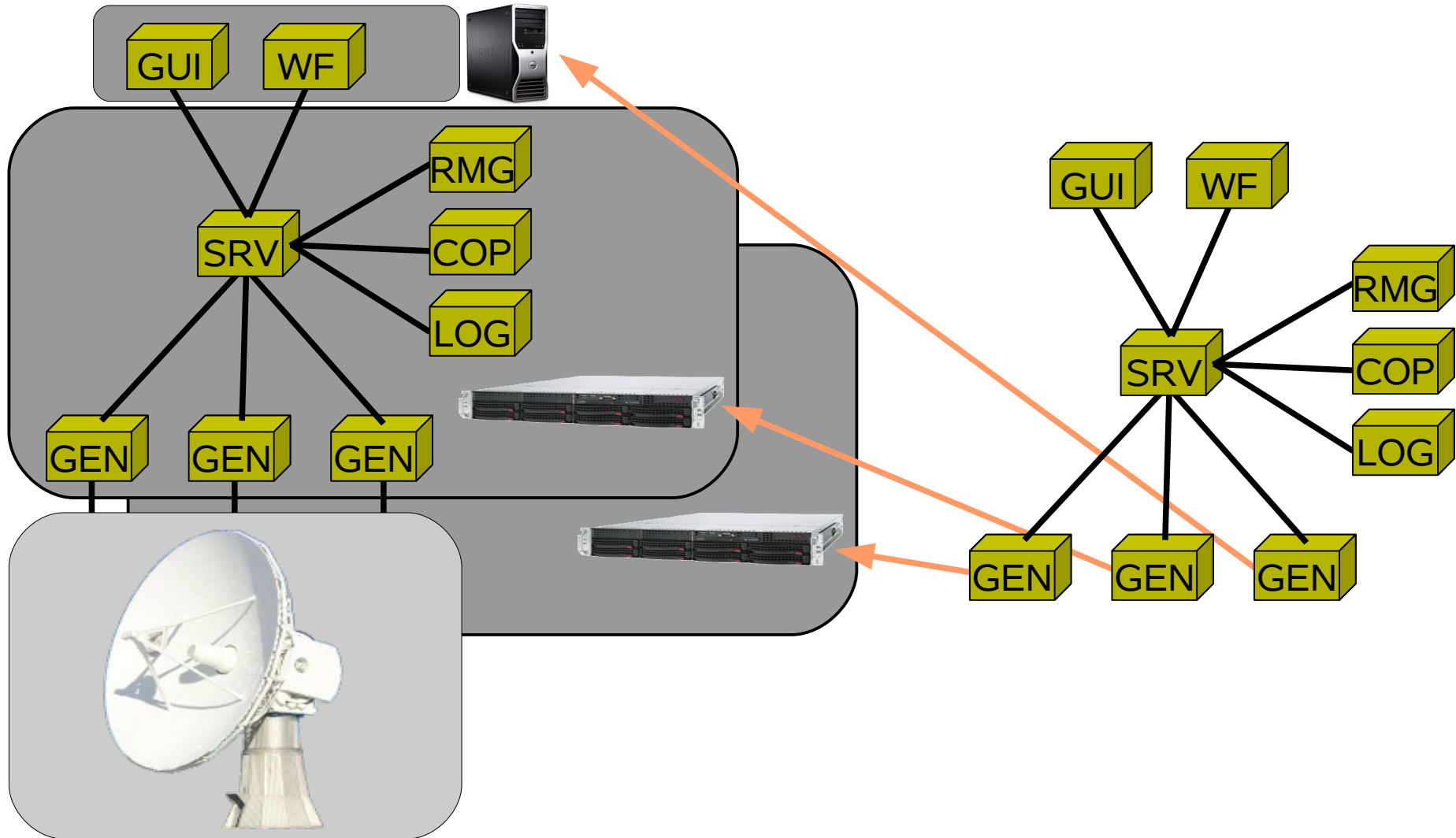
Process Monitoring and Control - "Trans-WARP"



Process Monitoring and Control - "Trans-WARP"



Process Monitoring and Control - "Trans-WARP"



Process Monitoring and Control - "Trans-WARP"

The screenshot displays the GSOC - DSI: WHM Nemo interface. The main window shows a summary of the system S67 b, with a date and time of 25.01.2012 13:50:39. The interface is divided into several sections:

- Summary:** A central area with status indicators for various components:
 - wm-mcs-01:** OK, with values for root (20.00), dsi_share (78.00), and dsi_local (22.00).
 - wm-mcs-02:** OK, with values for root (35.00), dsi_share (78.00), and dsi_local (23.00).
 - wm-mcs-03:** OK, with values for root (48.00), dsi_share (78.00), and dsi_local (22.00).
 - GUI Frontends:** Includes Client 1a, 3a, 5a, 0a, 1b, and 5b.
 - NAS01:** 84.00
 - NAS02:** (empty)
- Probe List (Right Panel):** A table showing the status of various probes.

Desc.	State	Last Check	Message	Value	EC	Commanding
1 S67B_L2_MONI check_vip	OK	14:50:14.104	bond0:67 present (10.21.2.105)	...	1	0
2 ...	...	...	...	...	...	...
3 S67B_L2_MONI check_pdb_cop	OK	14:50:19.133	Process running (17483:pdb_proc2)	...	17483	0
4 S67B_L2_MONI check_pdb_log	OK	14:50:20.133	Process running (17475:pdb_log5)	...	17475	0
5 S67B_L2_MONI check_pdb_prc	OK	14:50:17.133	Process running (17469:pdb_proc2)	...	17469	0
6 S67B_L2_MONI check_pdb_prc	OK	14:50:21.133	Process running (17481:pdb_proxy3)	...	17481	0
7 S67B_L2_MONI check_pdb_pcx	OK	14:50:22.133	Process running (20528:pdb_pcx)	...	20528	0
8 S67B_L2_MONI check_pdb_rep	OK	14:50:15.133	Process running (17462:pdb_rep)	...	17462	0
9 S67B_L2_MONI check_pdb_rep	OK	14:50:19.133	Process running (17472:pdb_proc2)	...	17472	0
10 S67B_L2_MONI check_pdb_srv	OK	14:50:16.133	Process running (17464:pdb_srv)	...	17464	0
11 ...	...	...	...	...	...	...
12 S67B_L2_MONI check_wof_gen_acu	OK	14:50:24.133	Process running (17494:wof_s67_acu_dev)	17494	0	OK
13 S67B_L2_MONI check_wof_gen_btc	OK	14:50:19.162	Process running (17560:wof_s67_btc_dev)	17560	0	OK
14 S67B_L2_MONI check_wof_gen_ctx1	OK	14:50:25.133	Process running (17502:wof_s67_ctx1_de)	17502	0	OK
15 S67B_L2_MONI check_wof_gen_ctx2	OK	14:50:26.134	Process running (17516:wof_s67_ctx2_de)	17516	0	OK
16 S67B_L2_MONI check_wof_gen_dc1	OK	14:50:37.133	Process running (17528:wof_s67_dc1_dev)	17528	0	OK
17 S67B_L2_MONI check_wof_gen_dc2	OK	14:50:38.134	Process running (17565:wof_s67_dc2_dev)	17565	0	OK
18 S67B_L2_MONI check_wof_gen_dtps	OK	14:50:34.133	Process running (17580:wof_s67_dtps_d)	17580	0	OK
19 S67B_L2_MONI check_wof_gen_hpa	OK	14:50:36.133	Process running (17659:wof_s67_hpa_dev)	17659	0	OK
20 S67B_L2_MONI check_wof_gen_rsy1	OK	14:50:15.162	Process running (17536:wof_s67_rsy1_de)	17536	0	OK
21 S67B_L2_MONI check_wof_gen_rsy2	OK	14:50:16.163	Process running (17572:wof_s67_rsy2_de)	17572	0	OK
22 S67B_L2_MONI check_wof_gen_trk	OK	14:50:13.140	Process running (17618:wof_s67_trk_dev)	17618	0	OK
23 S67B_L2_MONI check_wof_gen_uc1	OK	14:50:09.126	Process running (17543:wof_s67_uc1_dev)	17543	0	OK
24 S67B_L2_MONI check_wof_gen_uc2	OK	14:50:10.126	Process running (17595:wof_s67_uc2_dev)	17595	0	OK
25 S67B_L2_MONI check_wof_gen_uct	OK	14:50:12.134	Process running (17611:wof_s67_uct_dev)	17611	0	OK
26 S67B_L2_MONI check_wof_gen_ulaps	OK	14:50:33.133	Process running (17586:wof_s67_ulaps_d)	17586	0	OK
27 ...	...	...	...	...	...	...
28 S67B_L2_MONI devicePktTime	(OK)	14:50:38.104	2012-025T13:50:38.104	...	0	0
29 S67B_L2_MONI deviceResponse	(OK)	01:00:00.000	2012-025T13:50:23:WHM_S67B-Probe cycle completed	...	0	0
- Status Bar (Bottom):** PDB System: 2012-025T14:50:38 Input Buffer. 0 # Clients: 31 # Consumer: 3 # Generator: 28 # Updates last sec(abs): 102. Cmd: | Mon: | GEN: | PDB: |



Conclusions



Conclusions - Our Goals for WARP

- Detection of errors before they become relevant
 - ✓ Commands are immediately verified within workflows
 - ✓ Discrepancies from desired state are detected and reported

- Errors are real errors
 - ✓ Break if verification fails
 - ✓ The system communicates with the operator
 - ➔ Clear definition how to proceed

- No implicit assumptions
 - ✓ All possible command parameters are set to a default first

- Clearly and uniquely defined conditions of all antennas
 - ✓ Shifting switches at well defined points

- Commanding antenna hardware and M&C-software redundancies with the same tools

Conclusions - Our Goals for Operation with WARP

- Standardizing Procedures
 - ✓ Actions do look alike on different hardware
 - ✓ Mission specifics are handled in generic or overloaded workflows
- Apply changes at single points only
 - ✓ Separation between
 - ◆ Antenna description
 - ◆ Abstract mission definition
 - ✓ Define actual values by functions of all relevant variables
- Sources of trouble shall be located easily
 - ✓ Failure indications can be traced down to device level
 - ✓ Distinction between hardware state and configuration helps to identify reason of failure
- New missions can be included with minimal effort

Conclusions - Outlook

- WARP is well prepared for automation
 - ◆ Slowly change the role of Weilheim's operations personal

- WARP enables summarized monitoring of
 - ✓ Several antennas
 - ✓ Antenna hardware, M&C software and IT-hardware
 - ◆ Ground station and control center (end-to-end service)

- Promising features maybe need to be applied more consequently
 - ◆ Improvements in mission parameter definition
 - ◆ Standardization of mission description

Helm, Maximum Warp! Engage!

