Autonomous observations of VLBI radio telescopes

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([1]FESG Wettzell, TU of Munich; [2]BKG Wettzell; [3]JIVE ERIC)

Goal

Goal

Autonomous Observation

Local prioritization and planning

Fetching of session schedules

Local preparation (drudg)

Local adaption and recorder selection

Automatic startup

Observation status notification

Quality and alarm management

Post-processing

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Interaction →
← Feedback

Controlling →
← Feedback

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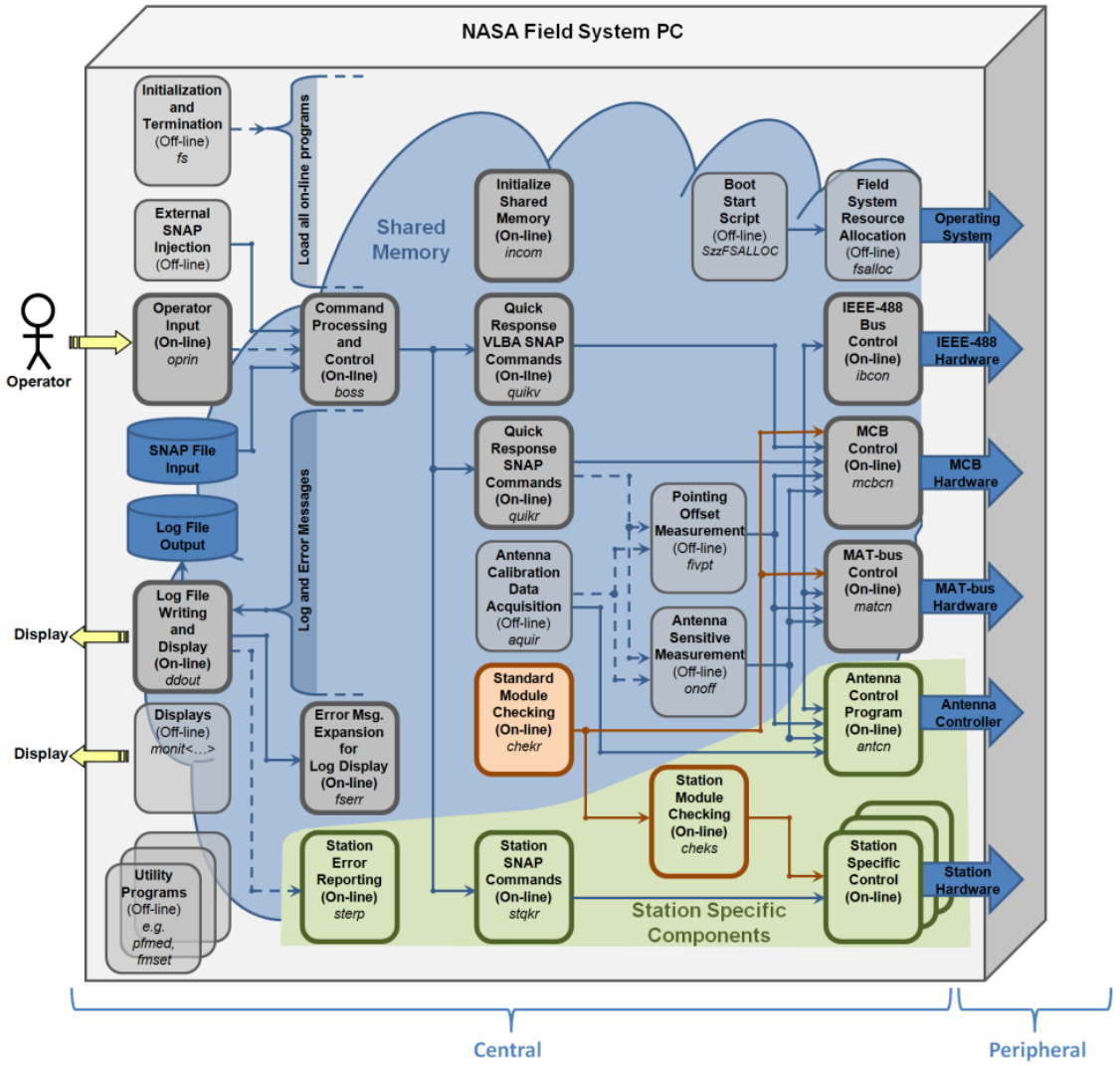
Controlling →
← Feedback

In a sense of a “Smart Observatory”

Goal

“Automating” the NASA Field System

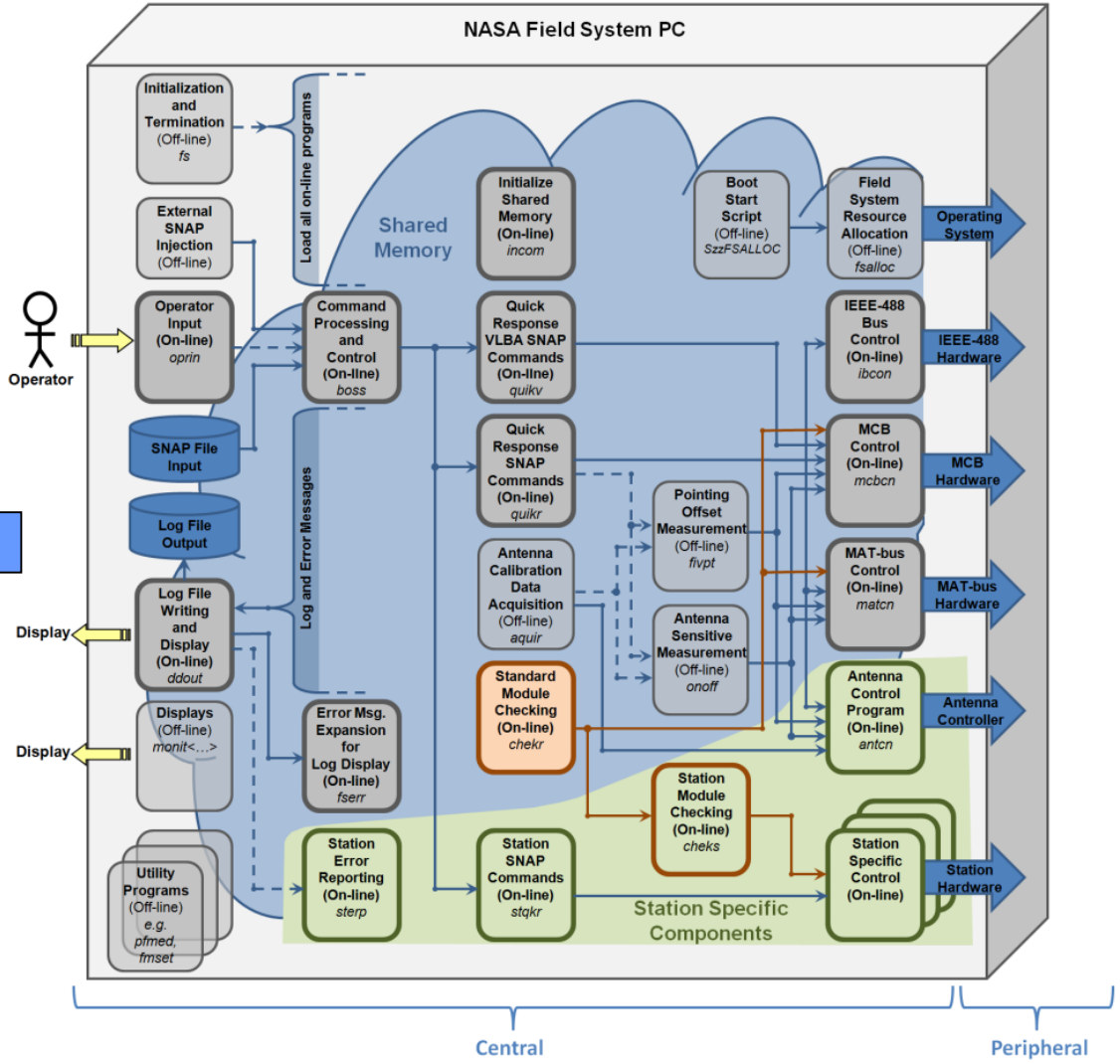
“Automating” the NASA Field System



“Automating” the NASA Field System

Show current status to the user

Shared mem. specific, local GUI



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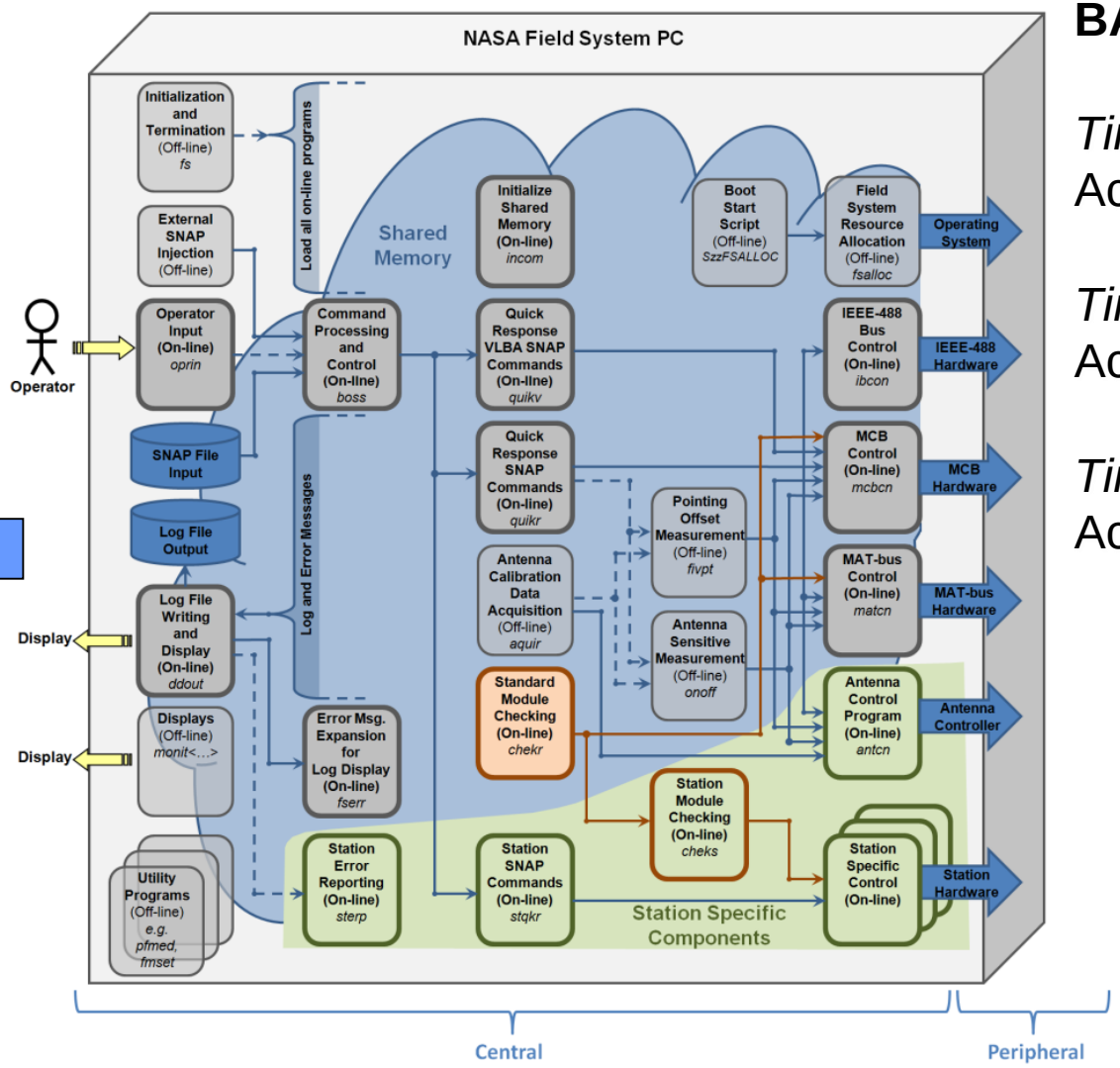

BATCH-Mode

Timestamp
Action =>
<=Reply
Timestamp
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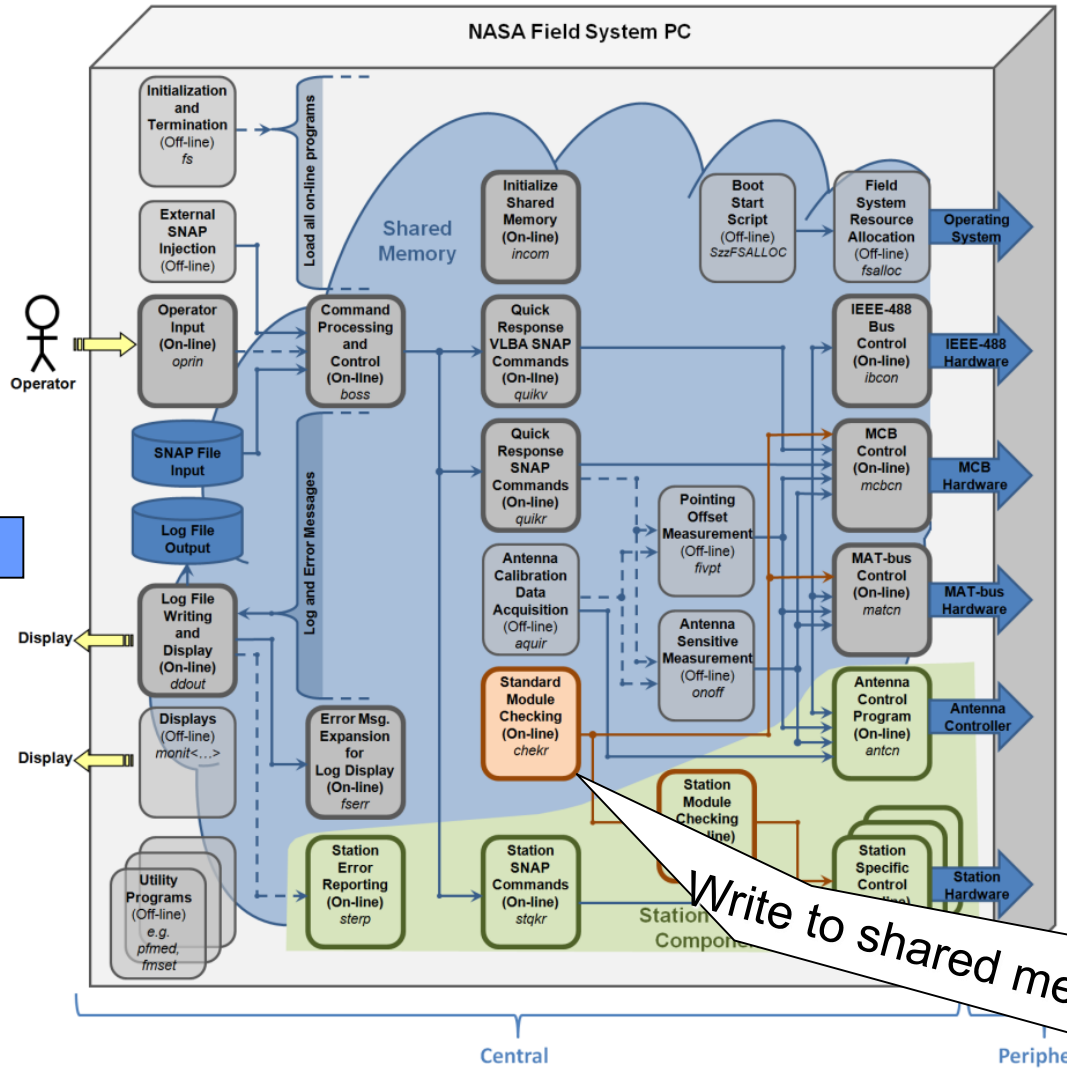
<=Reply
Timestamp
Action =>
<=Reply

Only when commanded

“Automating” the NASA Field System



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Own programs

Program (int. Timing)

Action =>
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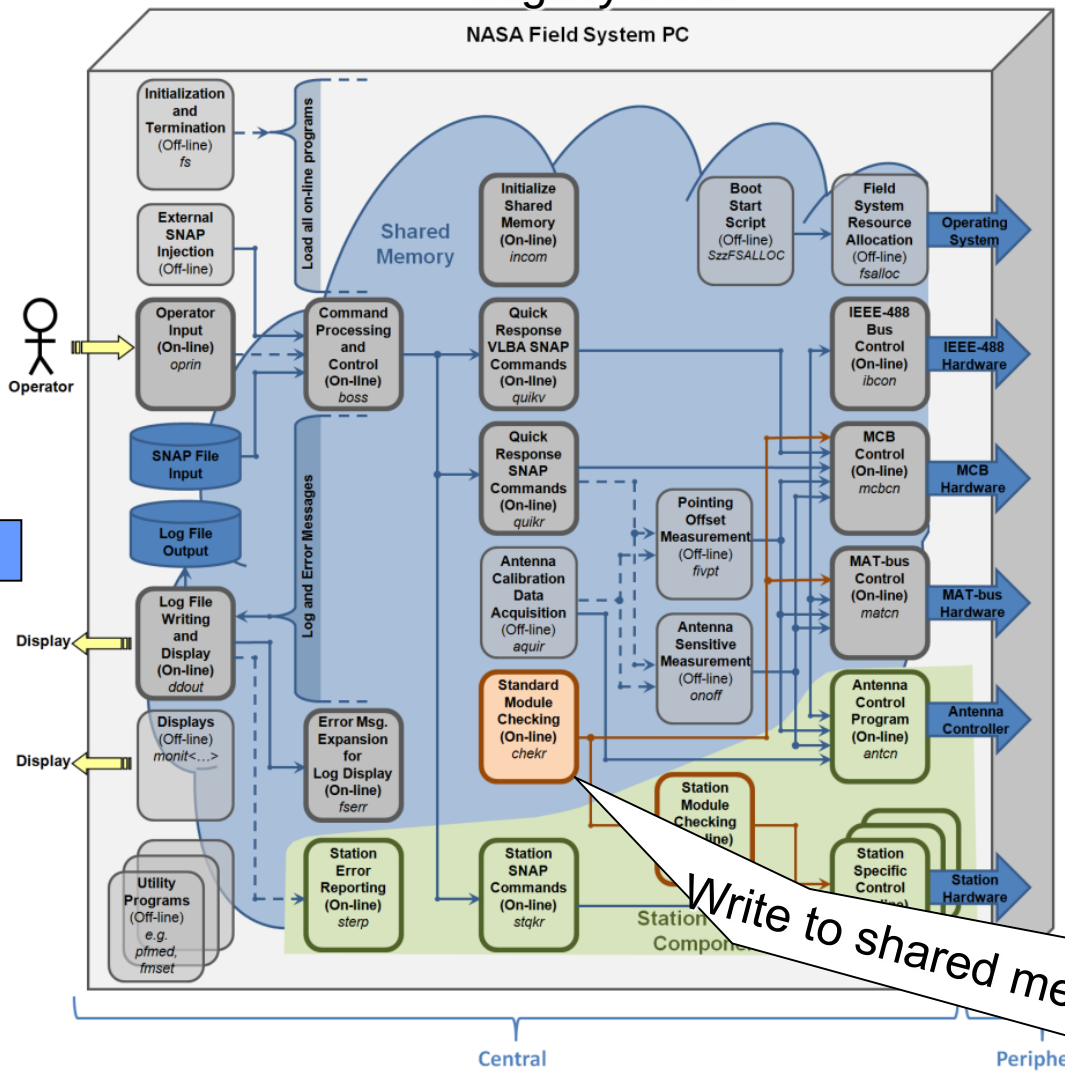
Specific, not monitored

“Automating” the NASA Field System

Legacy code



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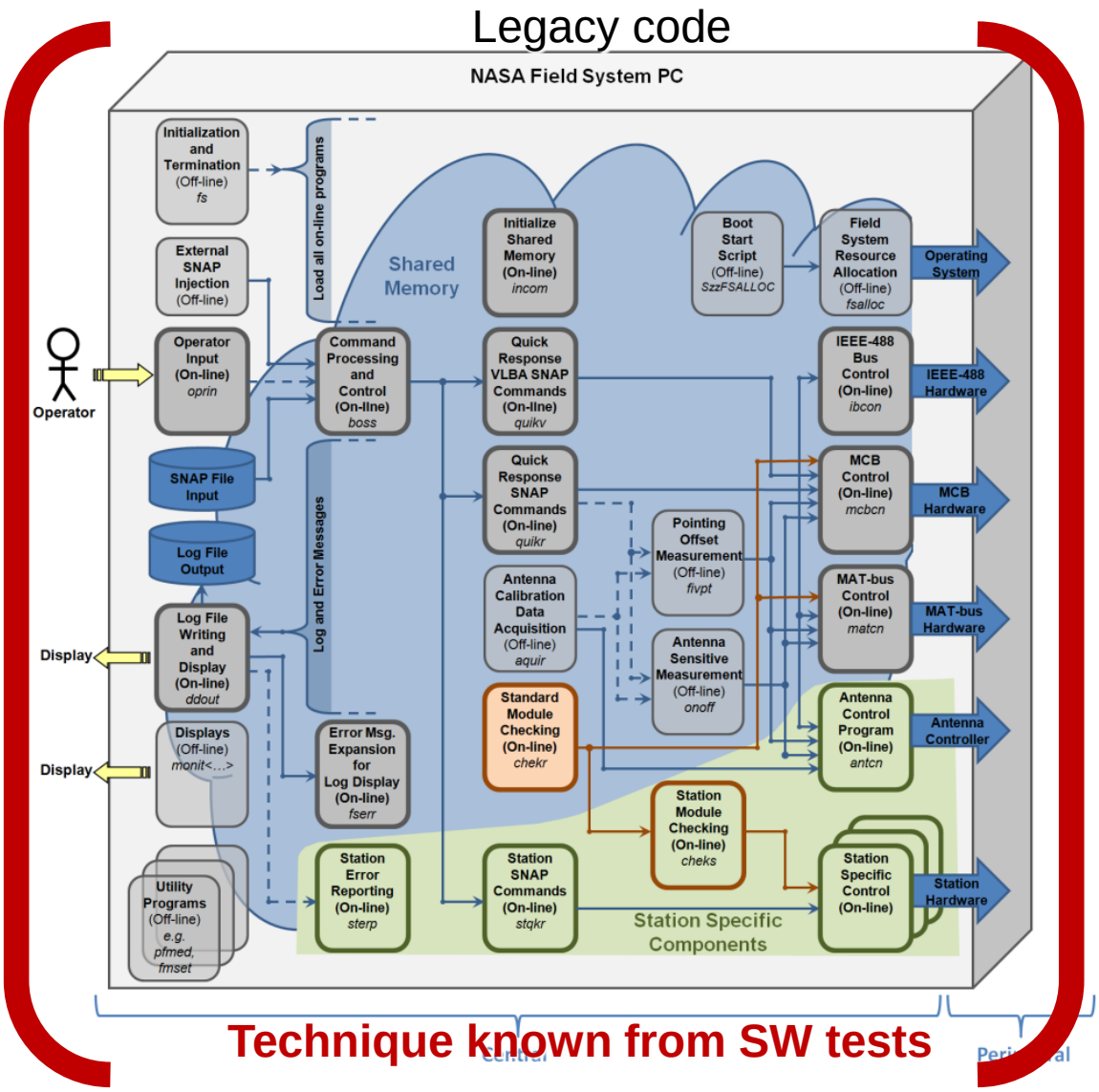

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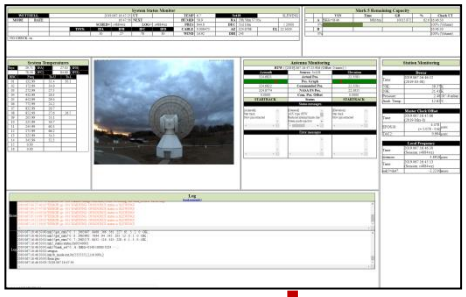
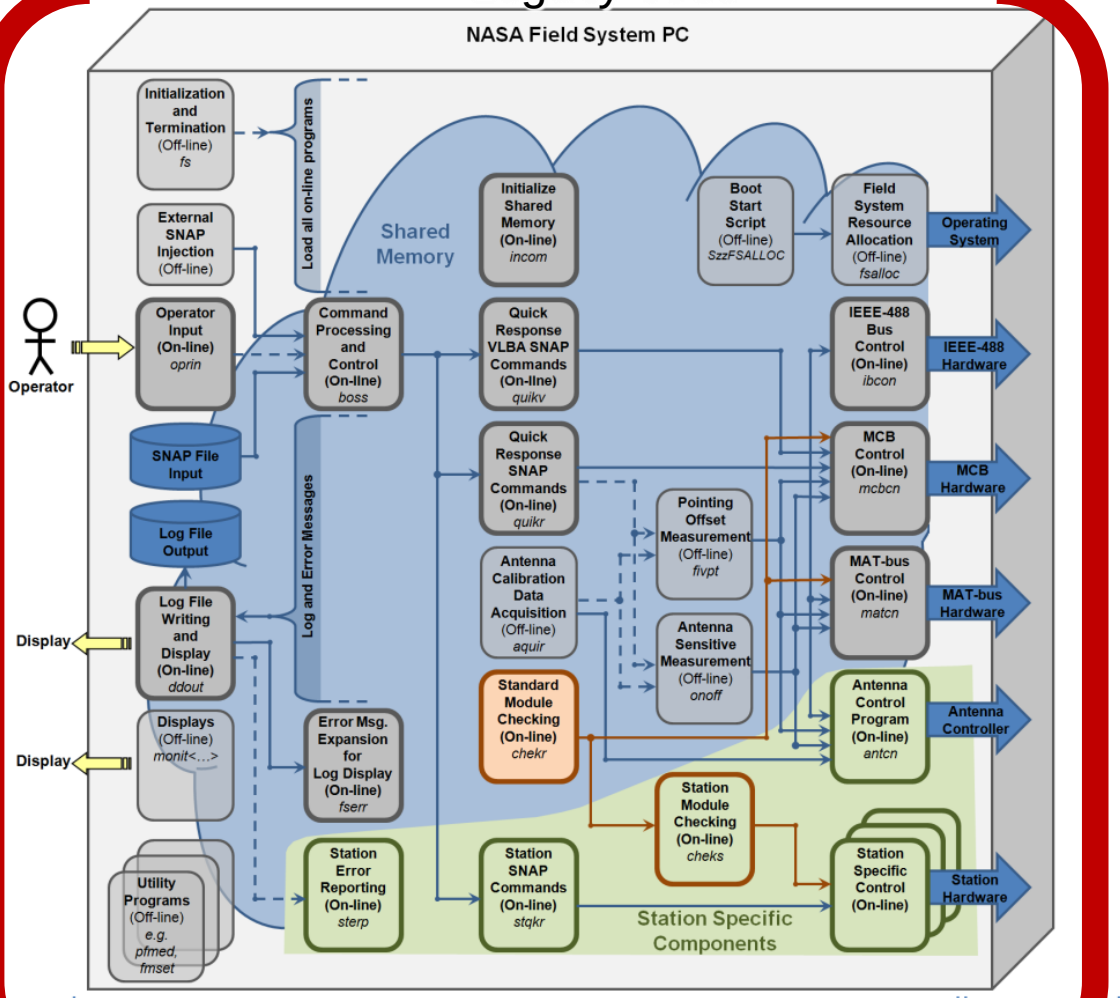


NASA FS Output remotely accessable

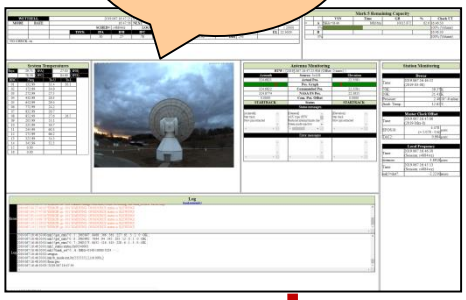
e.g. Logs Errors …

Legacy code



“Automating” the NASA Field System

Poster P107



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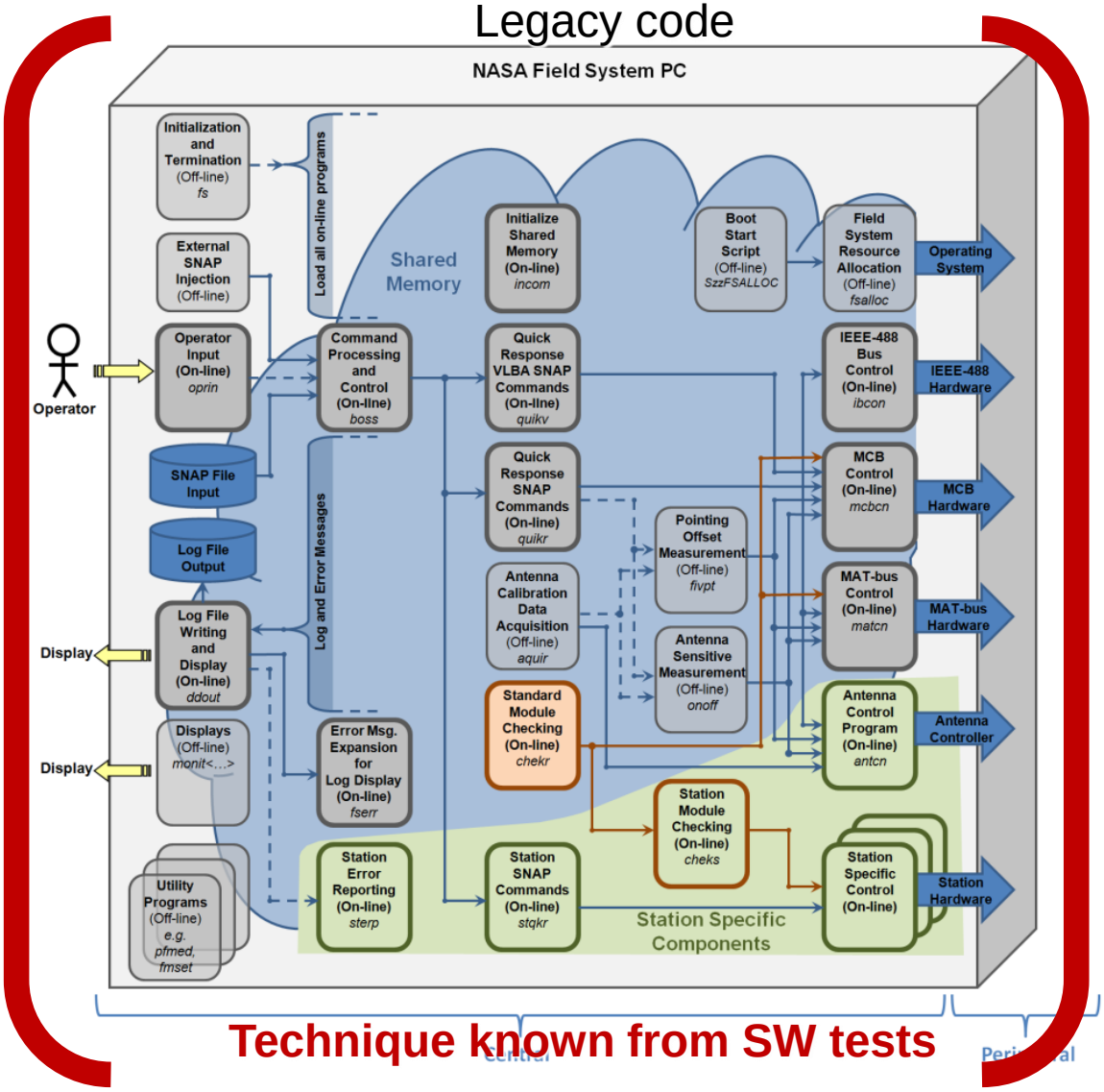

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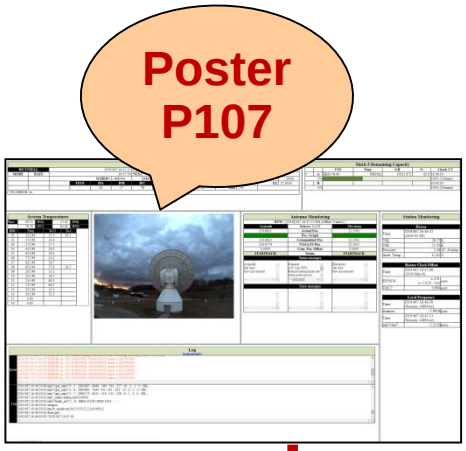
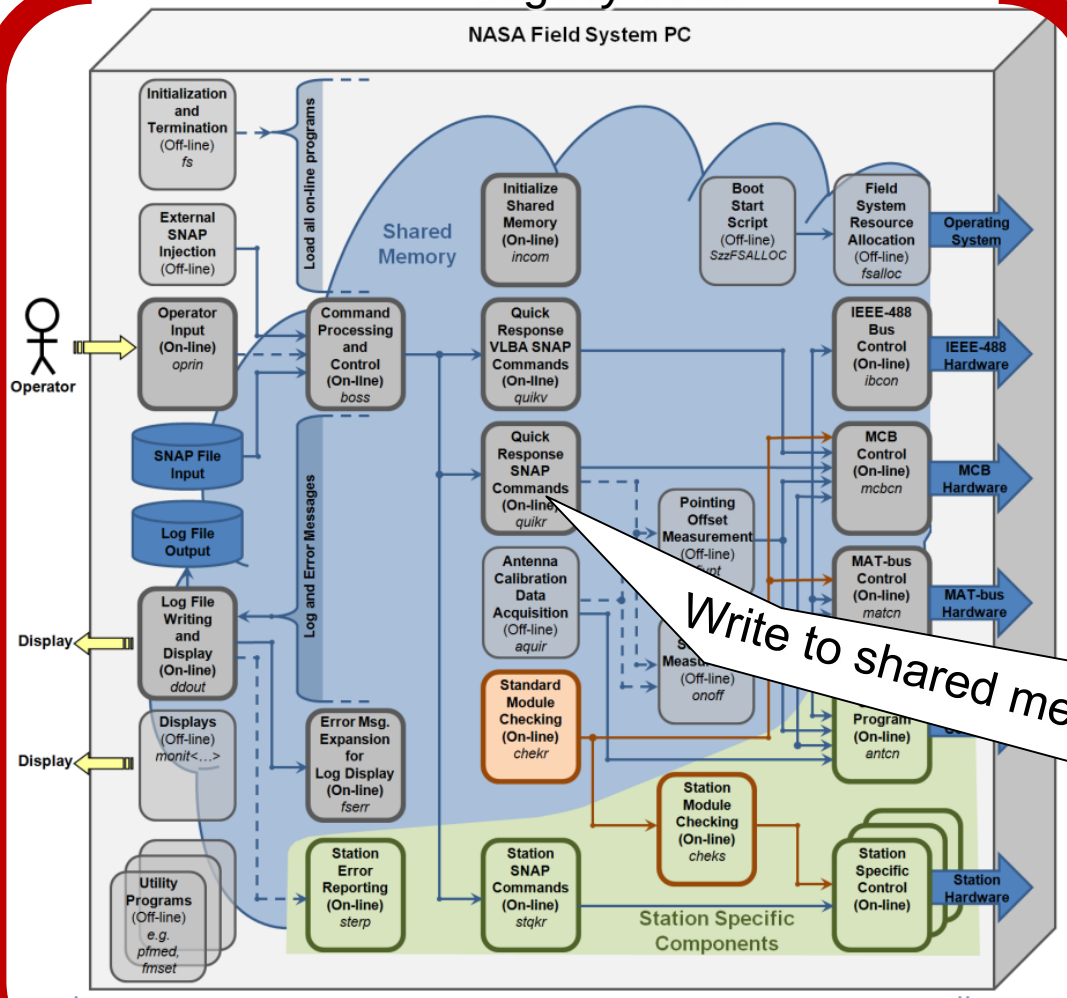


Poster P107

NASA FS Output remotely accessable

e.g. Logs Errors …



Watch dog

Controller task

Com. tasks

…

Action =>
<=Reply

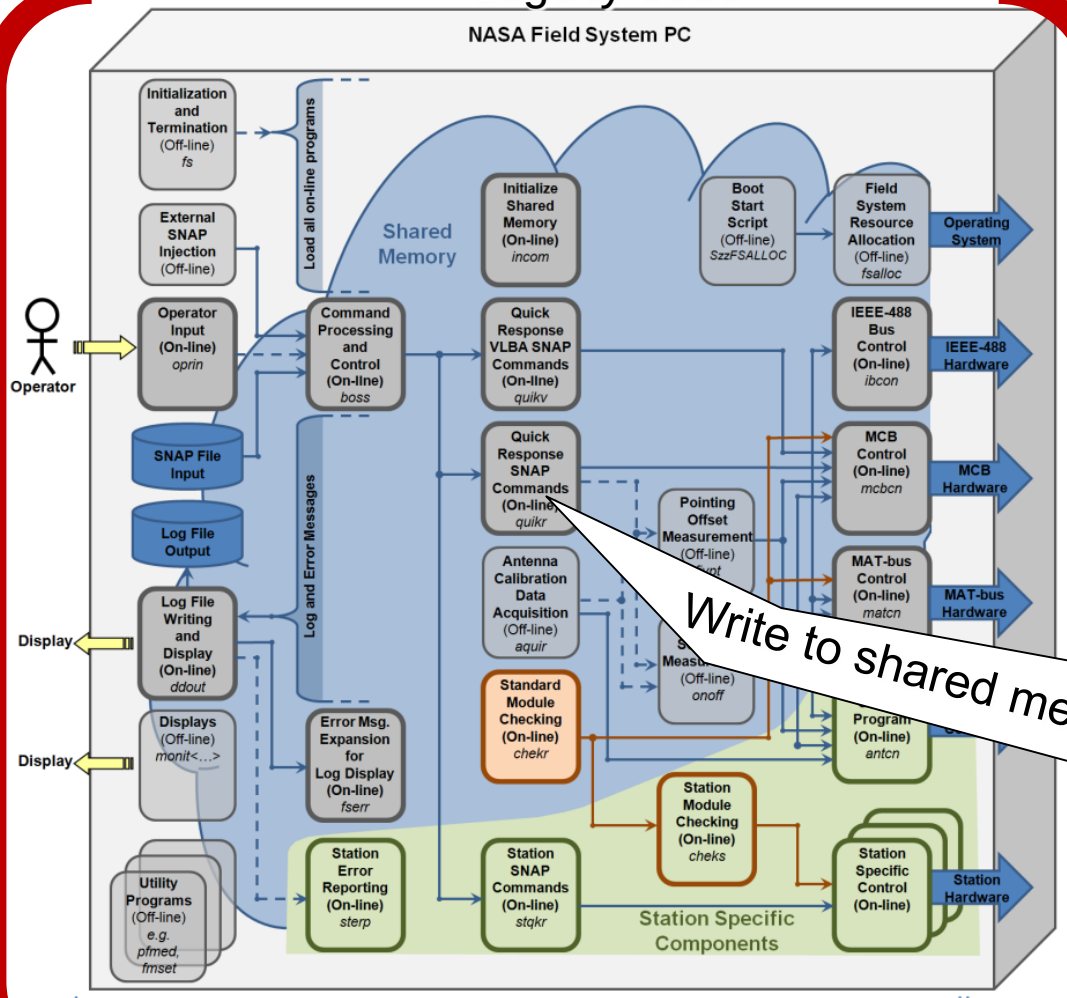
Add. safety

e.g. Antenna Timing Meteo Mark6 …

Monitoring-Bypass

“Automating” the NASA Field System

Legacy code



Human Safety is implemented in HW device

…

Watch dog

Controller task

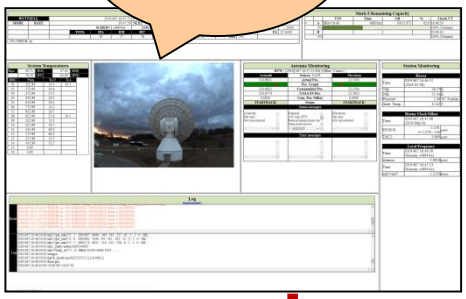
Com. tasks

Action =>

<=Reply

Add. safety

Poster P107



NASA FS Output remotely accessable

e.g. Logs Errors …

e.g. Antenna Timing Meteo Mark6 …

Monitoring-Bypass

Goal

“Automating” the NASA Field System

Using the data from the monitored (NASA Field) System

Using the data from the monitored (NASA Field) System

NASA FS Output remotely accessable

Monitoring-Bypass

Additional Site Monitoring-Data

UPS SNMP

Using the data from the monitored (NASA Field) System

Pattern extraction
e.g.
"941.9"
is extracted from
"<!—ERC::PRESSURE--> 941.9<!-- -->"

NASA FS Output remotely accessable

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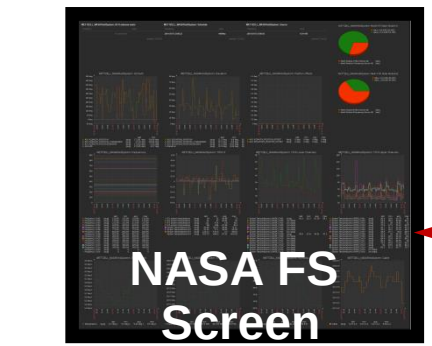

ZABBIX
Server

Pattern extraction
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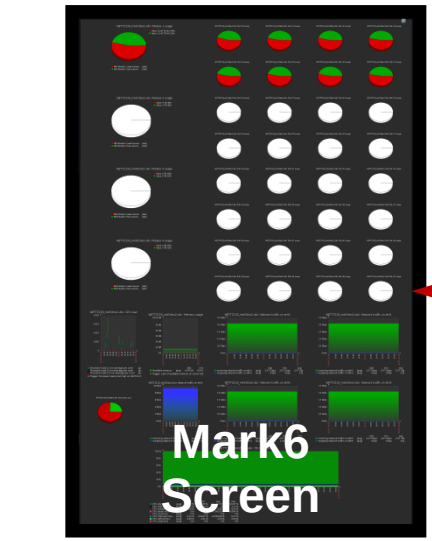
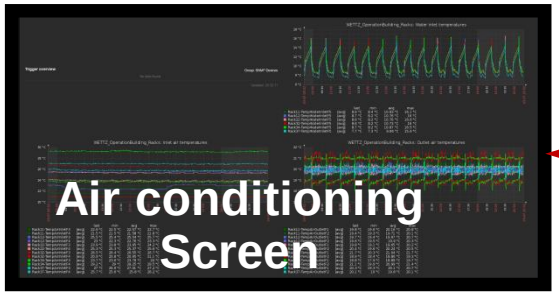
NASA FS Output remotely accessable



Monitoring-Bypass

Database

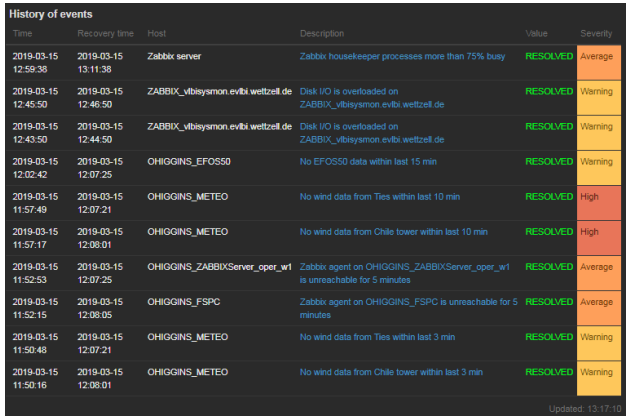
Additional Site Monitoring-Data

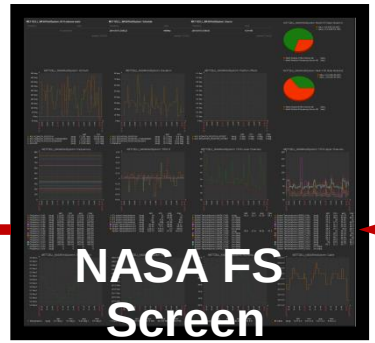


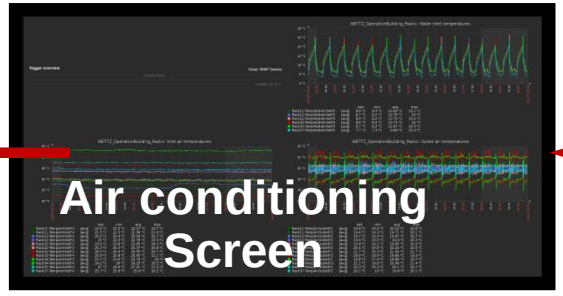
UPS SNMP

Using the data from the monitored (NASA Field) System

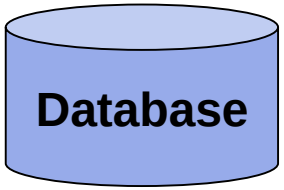
Global Network Status







ZABBIX Server



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Monitoring-Bypass

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730884 - JUMPING JIVE

Using the data from the monitored (NASA Field) System

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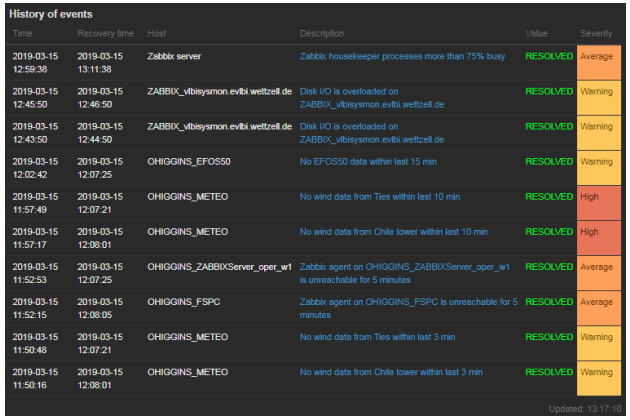
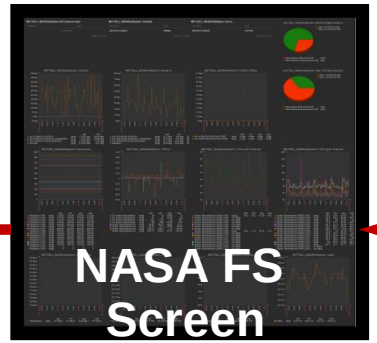
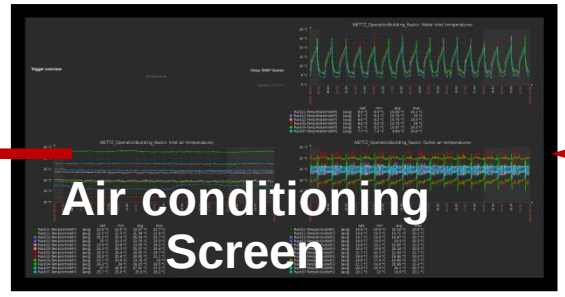


Poster P106





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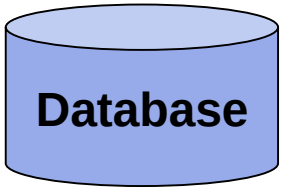

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Towards a data achive for seamless auxiliary data

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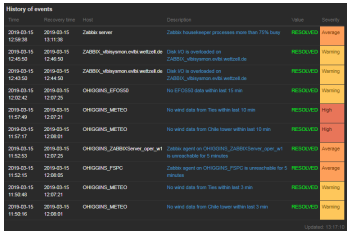
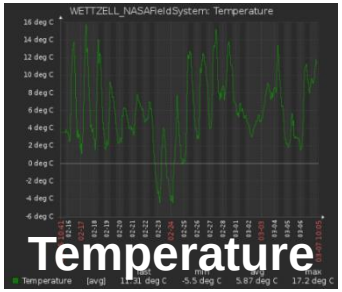
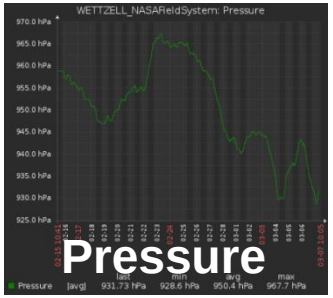
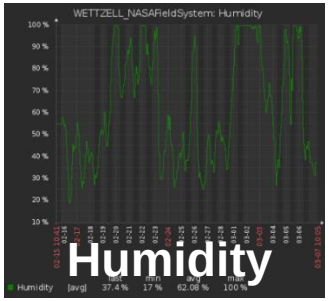


Towards a data achive for seamless auxiliary data

Data Archive for Seamless Auxiliary Data





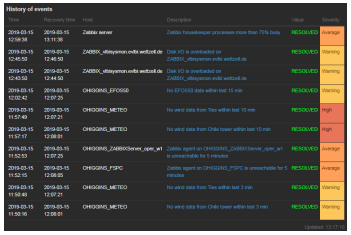


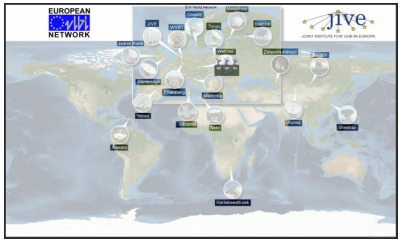
ITEM	CLOCK	DATETIME (UTC)	VALUE
26733	1551996101	2019-03-07 22:01:41	5.8000
26733	1551995801	2019-03-07 21:56:41	6.1000
26733	1551995501	2019-03-07 21:51:41	5.9000
26733	1551995201	2019-03-07 21:46:41	5.7000
26733	1551994902	2019-03-07 21:41:42	5.7000
26733	1551994602	2019-03-07 21:36:42	5.8000
26733	1551994301	2019-03-07 21:31:41	5.6000
26733	1551994002	2019-03-07 21:26:42	5.6000
26733	1551993700	2019-03-07 21:21:40	5.5000
26733	1551993401	2019-03-07 21:16:41	5.5000

Extraction

Python Script

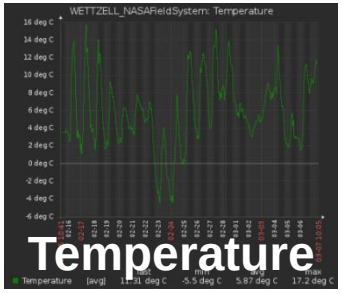
Global Network Status

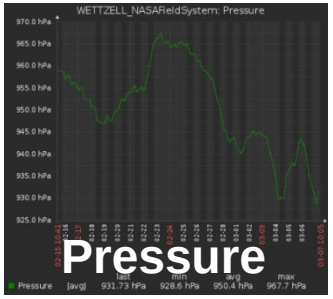


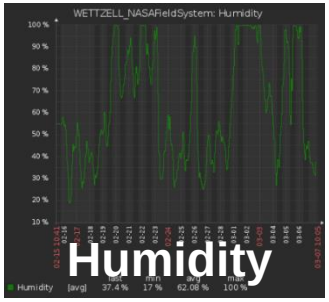


Towards a data achive for seamless auxiliary data

Data Archive for Seamless Auxiliary Data







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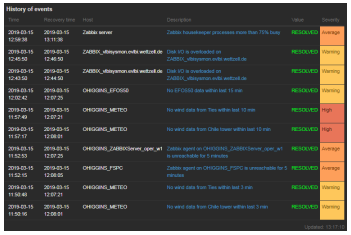
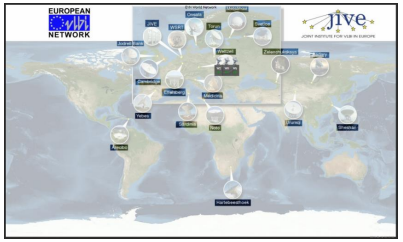
26733	1551993401	2019-03-07 21:16:41	

Extraction **Python Script**

Global Network Status





IVS Task Force

A first technical solution for continuous data acquisition is now available. Now is the time to start a discussion about:

- which parameters are required by analysis
- which time intervals are required
- which format is required in best case
- which stations can and will participate
- which station log books with meta-data are useful
- …

Interested? Join!

Goal

“Automating” the NASA Field System

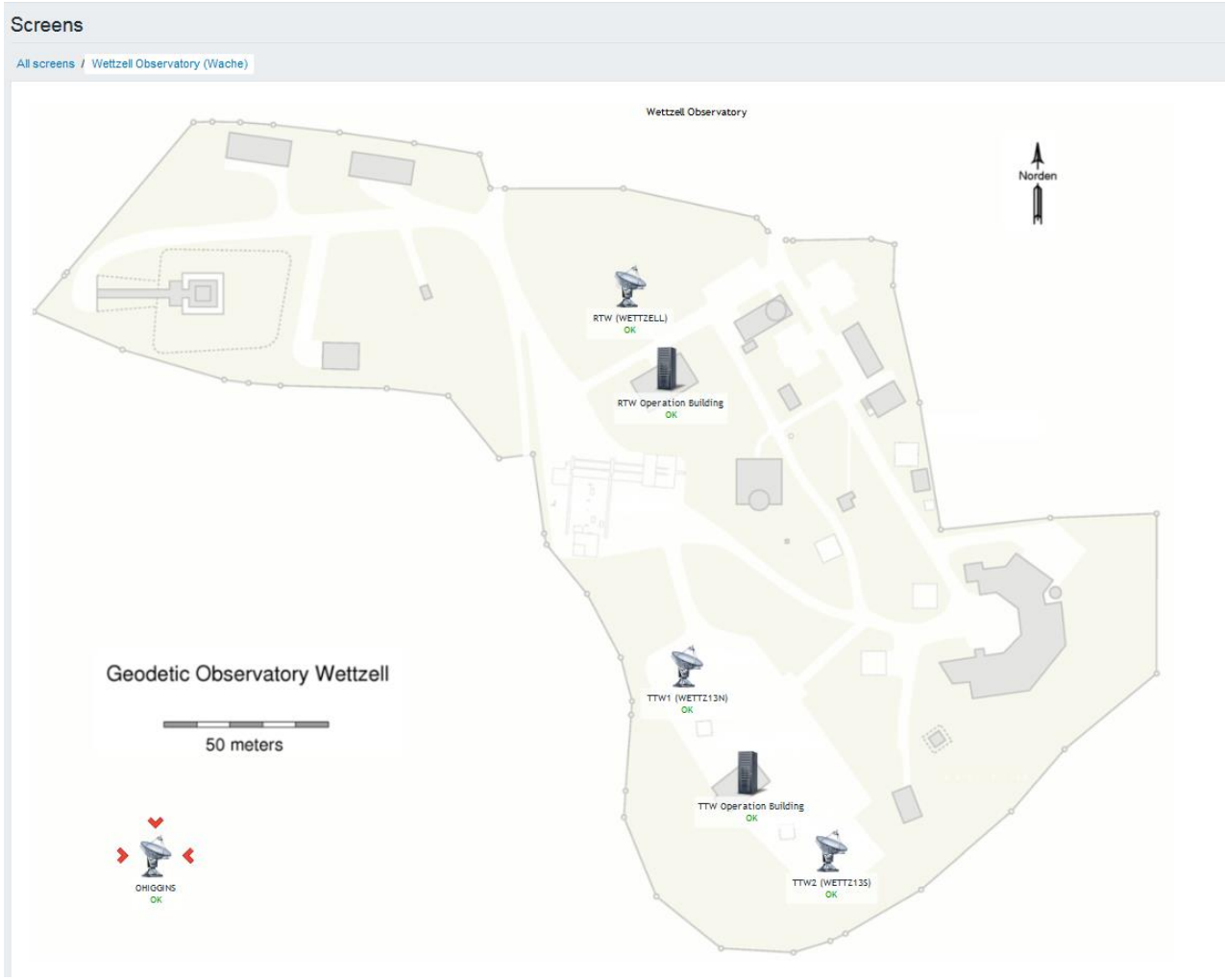
Using the data from the monitored (NASA Field) System

Towards a data achive for seamless auxiliary data

Benefit: Central alerting at the guard of the Wettzell observatory

Benefit: Central alerting at the guard of the Wettzell observatory

Idea of an
atonomous safety,
but with human control,
and on-call service



Improving the visibility of error situations while reducing the complexity of error feedbacks

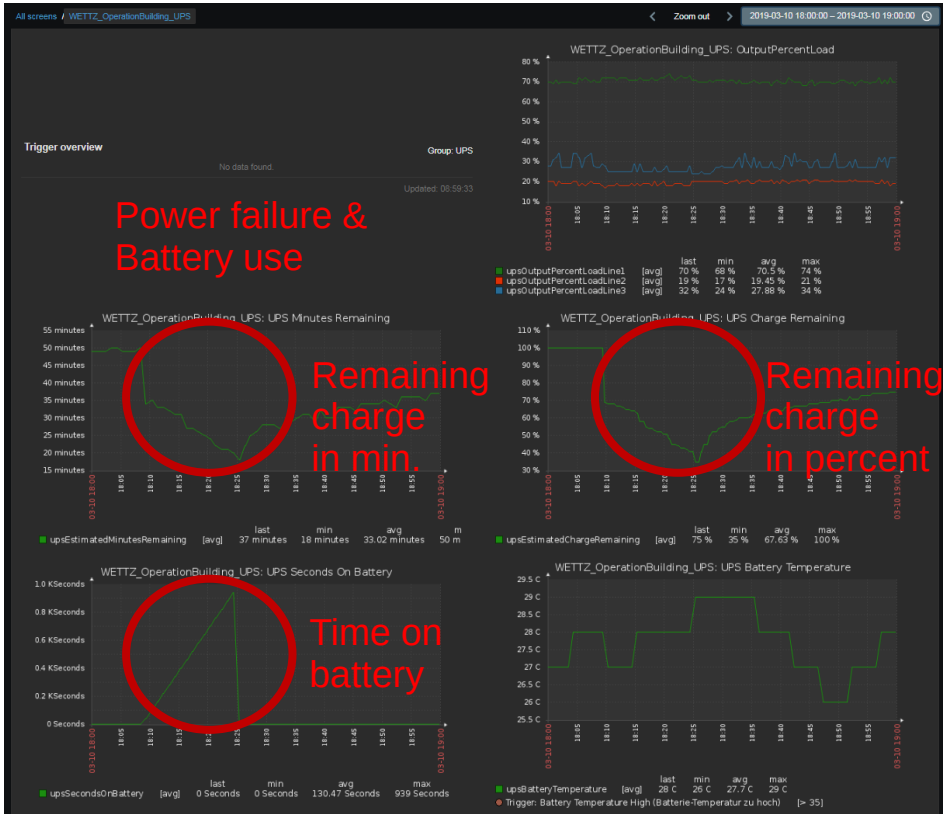
Benefit: Central alerting - Real alert scenario I (reconstruction)

Partial power blackout during storm “Eberhard” on March 10th, 2019
from 18:09 til 18:30 local time

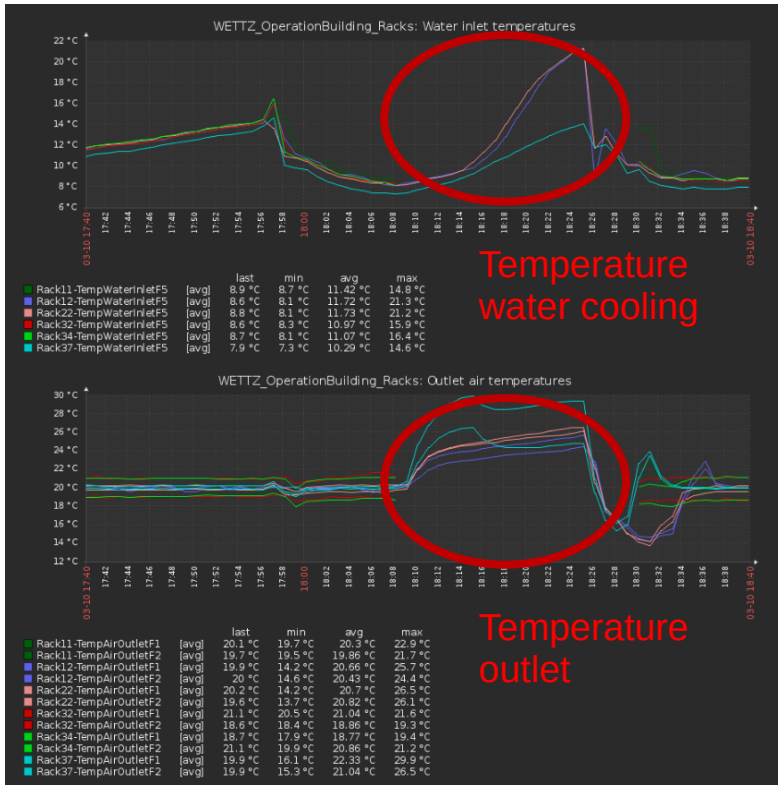
Time		Severity	Recovery time	Status	Info	Host	Problem	Duration	Ack	Actions	Tags
2019-03-10 18:09:37		High	2019-03-10 18:25:37	RESOLVED		WETTZ_OperationBuilding_UPS	Servers Are Running On Battery (Server laufen auf Batteriebetrieb)	16m	No		
2019-03-10 18:09:37		High	2019-03-10 18:10:37	RESOLVED		WETTZ_OperationBuilding_UPS	Input Line Failure Detected (Fehler in Eingangsleitung)	1m	No		

Displaying 2 of 2 found

UPS



Cooling of the server racks



Benefit: Central alerting - Real alert scenario II

Wind stow warning during storm “Eberhard” on March 10th, 2019
from 18:09 til 18:30 local time

Benefit: Central alerting - Real alert scenario II

Wind stow warning during storm “Eberhard” on March 10th, 2019
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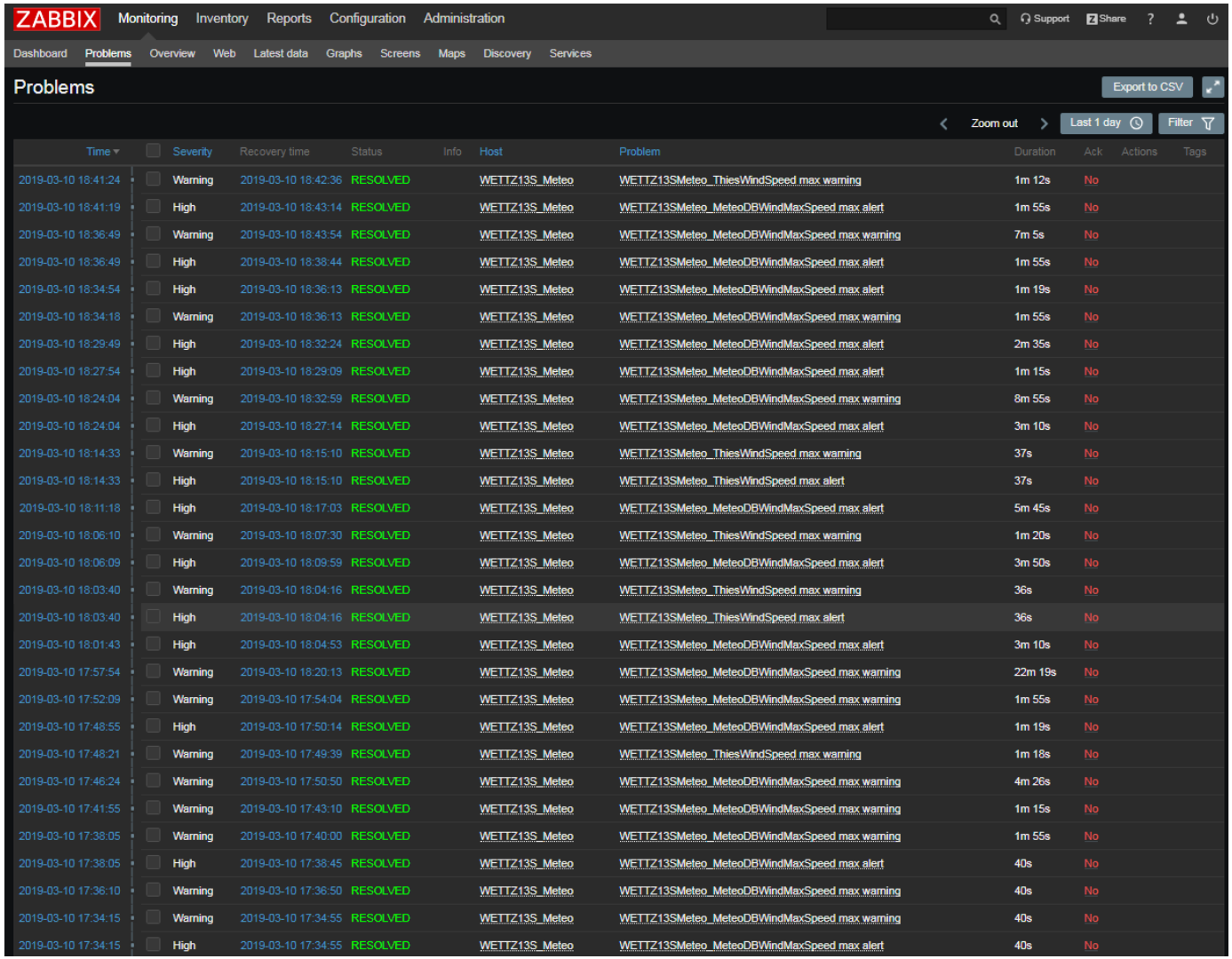

ZABBIX Monitoring Inventory Reports Configuration Administration

Support Share

Dashboard Problems Overview Web Latest data Graphs Screens Maps Discovery Services

Problems

Export to CSV

Zoom out Last 1 day Filter

Time	Severity	Recovery time	Status	Info	Host	Problem	Duration	Ack	Actions	Tags
2019-03-10 18:41:24	Warning	2019-03-10 18:42:36	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max warning	1m 12s	No		
2019-03-10 18:41:19	High	2019-03-10 18:43:14	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	1m 55s	No		
2019-03-10 18:36:49	Warning	2019-03-10 18:43:54	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	7m 5s	No		
2019-03-10 18:36:49	High	2019-03-10 18:38:44	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	1m 55s	No		
2019-03-10 18:34:54	High	2019-03-10 18:36:13	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	1m 19s	No		
2019-03-10 18:34:18	Warning	2019-03-10 18:36:13	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	1m 55s	No		
2019-03-10 18:29:49	High	2019-03-10 18:32:24	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	2m 35s	No		
2019-03-10 18:27:54	High	2019-03-10 18:29:09	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	1m 15s	No		
2019-03-10 18:24:04	Warning	2019-03-10 18:32:59	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	8m 55s	No		
2019-03-10 18:24:04	High	2019-03-10 18:27:14	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	3m 10s	No		
2019-03-10 18:14:33	Warning	2019-03-10 18:15:10	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max warning	37s	No		
2019-03-10 18:14:33	High	2019-03-10 18:15:10	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max alert	37s	No		
2019-03-10 18:11:18	High	2019-03-10 18:17:03	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	5m 45s	No		
2019-03-10 18:06:10	Warning	2019-03-10 18:07:30	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max warning	1m 20s	No		
2019-03-10 18:06:09	High	2019-03-10 18:09:59	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	3m 50s	No		
2019-03-10 18:03:40	Warning	2019-03-10 18:04:16	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max warning	36s	No		
2019-03-10 18:03:40	High	2019-03-10 18:04:16	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max alert	36s	No		
2019-03-10 18:01:43	High	2019-03-10 18:04:53	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	3m 10s	No		
2019-03-10 17:57:54	Warning	2019-03-10 18:20:13	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	22m 19s	No		
2019-03-10 17:52:09	Warning	2019-03-10 17:54:04	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	1m 55s	No		
2019-03-10 17:48:55	High	2019-03-10 17:50:14	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	1m 19s	No		
2019-03-10 17:48:21	Warning	2019-03-10 17:49:39	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_ThiesWindSpeed max warning	1m 18s	No		
2019-03-10 17:46:24	Warning	2019-03-10 17:50:50	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	4m 26s	No		
2019-03-10 17:41:55	Warning	2019-03-10 17:43:10	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	1m 15s	No		
2019-03-10 17:38:05	Warning	2019-03-10 17:40:00	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	1m 55s	No		
2019-03-10 17:38:05	High	2019-03-10 17:38:45	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	40s	No		
2019-03-10 17:36:10	Warning	2019-03-10 17:36:50	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	40s	No		
2019-03-10 17:34:15	Warning	2019-03-10 17:34:55	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max warning	40s	No		
2019-03-10 17:34:15	High	2019-03-10 17:34:55	RESOLVED		WETTZ13S_Meteo	WETTZ13SMeteo_MeteoDBWindMaxSpeed max alert	40s	No		

Benefit: Central alerting – next steps

- Automatic safety mechanisms
  - Shutdown PCs and servers after specific UPS time interval
  - Activate automatic wind stow

⇨ **Using error situations as feedback for autonomous activities**

- Integrate tested scripts and programs for autonomity
  - Automatic session preparation with status feedback
  - Automatic startup and recorder selection
  - Automatic status emails and log file entries

    e.g. WX (meteo): 50 percent coverage, no rain, light wind Bft 3

- Detailled risk analysis

…

Benefit: Central alerting – Risk analysis / comparison

ALARP - ***a**s **l**ow **a**s **r**easonably **p**racticable*

Risk matrix NOHL

Probability	Light injuries	Medium injuries	Heavy injuries	Death or catastrophy
very low	1	2	3	4
low	2	3	4	5
medium	3	4	5	6
high	4	5	6	7

Level of consequences

With operator

Without operator ?

www.maschinen-sicherheit.net

- 1-2: Nothing to do
- 3-4: Risk reduction suggested
- 5-7: Risk reduction required

Goal

“Automating” the NASA Field System

Using the data from the monitored (NASA Field) System

Towards a data achive for seamless auxiliary data

Benefit: Central alerting at the guard of the Wettzell observatory

Conclusion

Conclusion

Central alerting is on a good way to come to a first usable mode

Central alerting showed several times its benefits

Central monitoring will be installed at JIVE ERIC soon

Adaption for automated NASA Field System tasks are on a good way

Almost each part with tested scripts/progs. now => bring them together

Autonomous operation (test) will hopefully follow this year

Thank you for your attention!!!

Being a VLBI operator ...