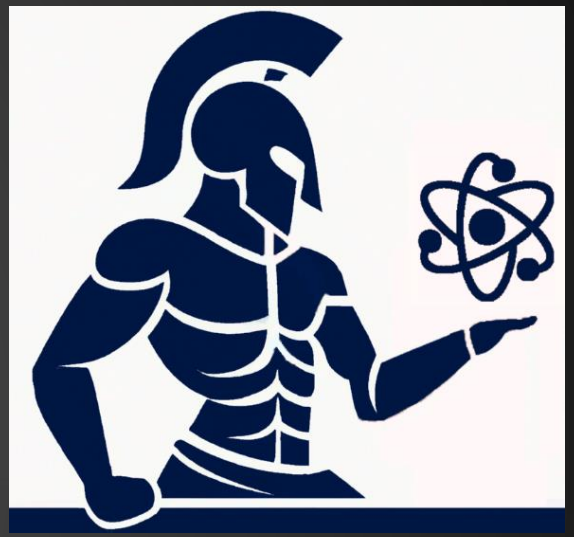
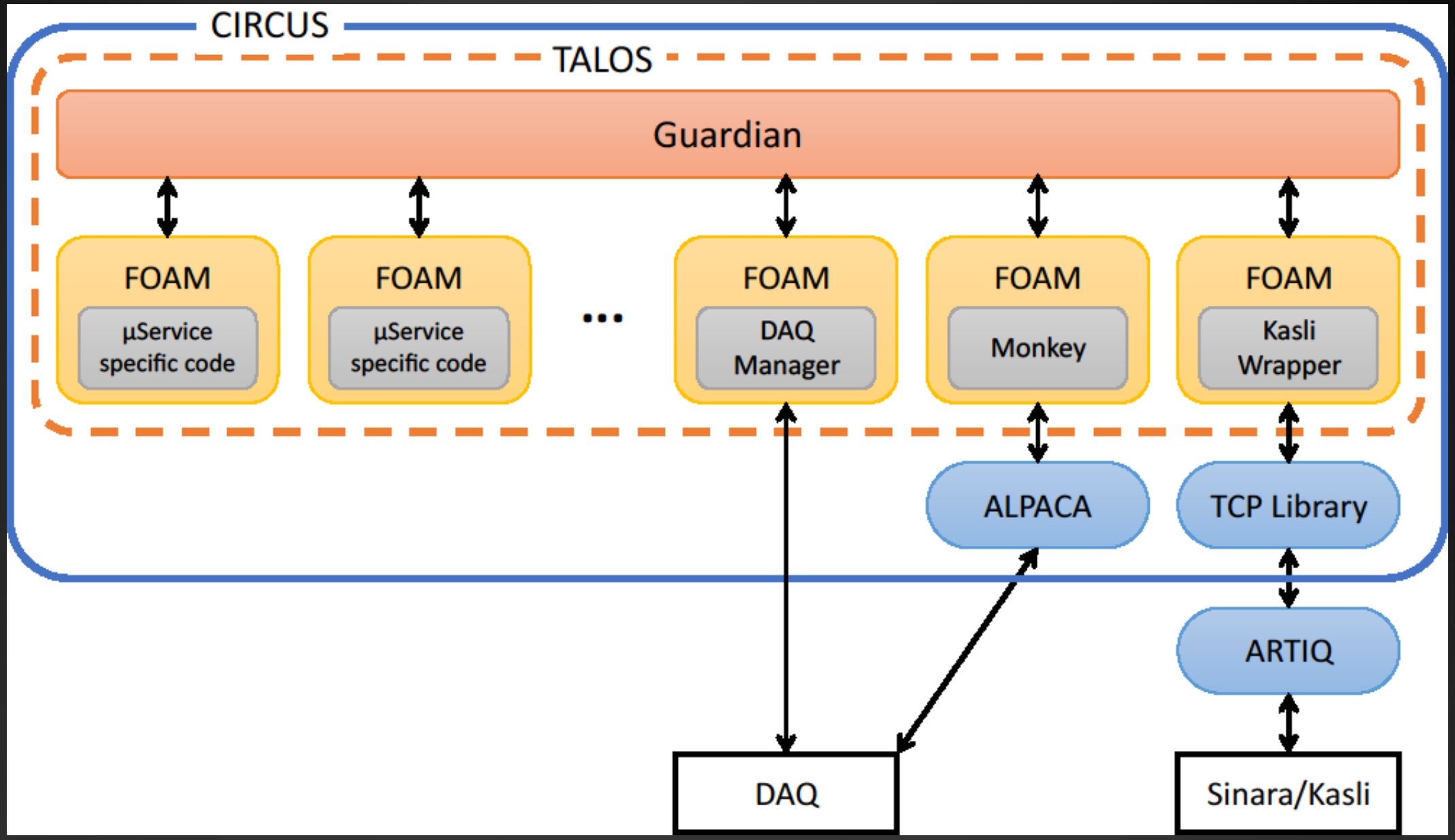
STATUS OF THE CONTROLS SYSTEM FOR 2024 CAMPAIGN

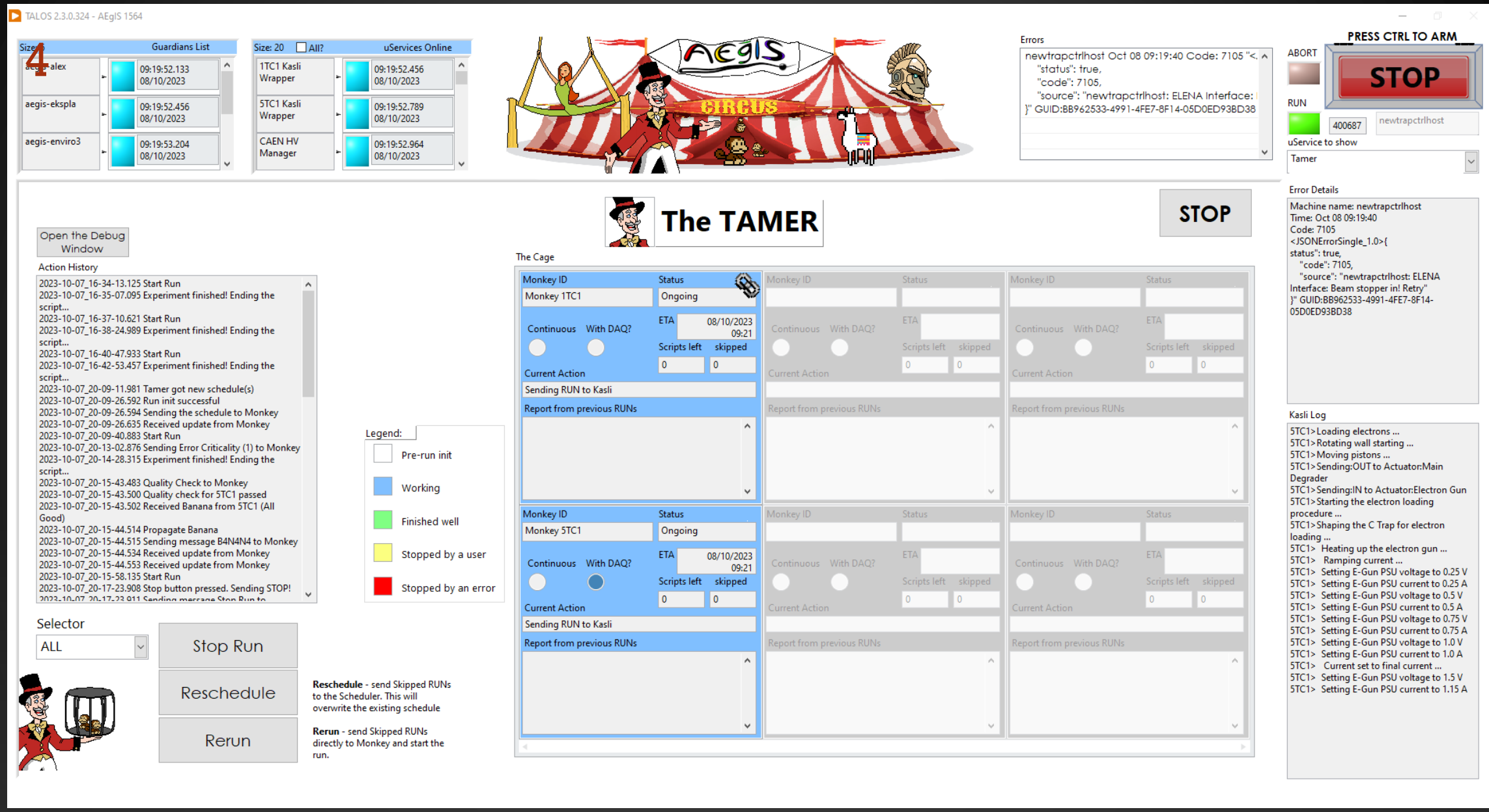


JAKUB Z., MARCO V.

A BOAT WITH TWO CAPTAINS

- TALOS does overall coordination, but it's "slow" (~ms)
- Sinara is used to control the fast operations (~ns)
- High integration:
  - TALOS controls Sinara, so no humans need to feed it experiments scripts
  - Sinara can ask TALOS to perform operations on hardware
  - In case of any error, TALOS guarantees their handling
- The helm is periodically switched between the two!


CIRCUS
TALOS
Guardian
FOAM
µService specific code
FOAM
µService specific code
...
FOAM
DAQ Manager
FOAM
Monkey
FOAM
Kasli Wrapper
ALPACA
TCP Library
ARTIQ
DAQ
Sinara/Kasli

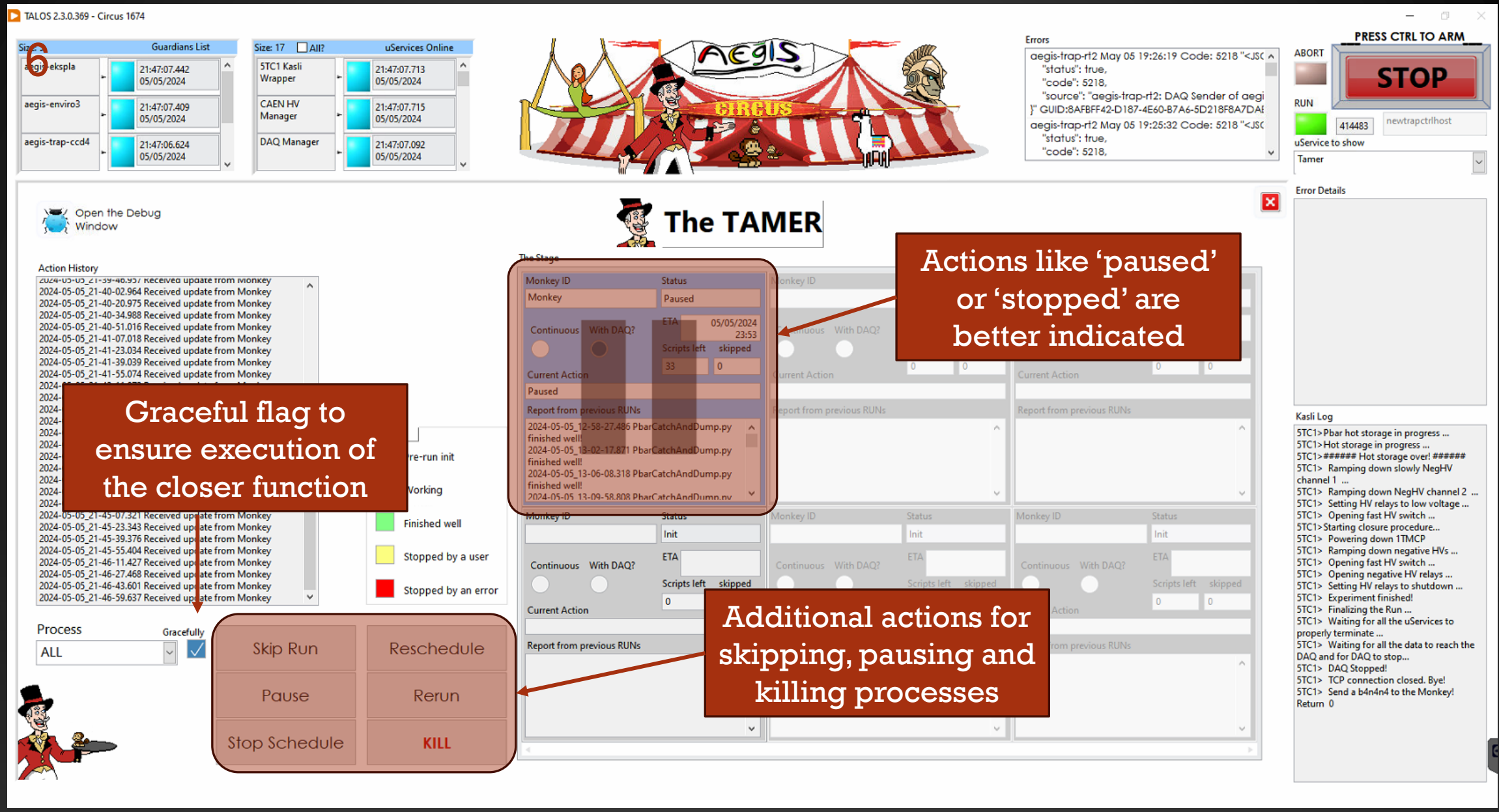


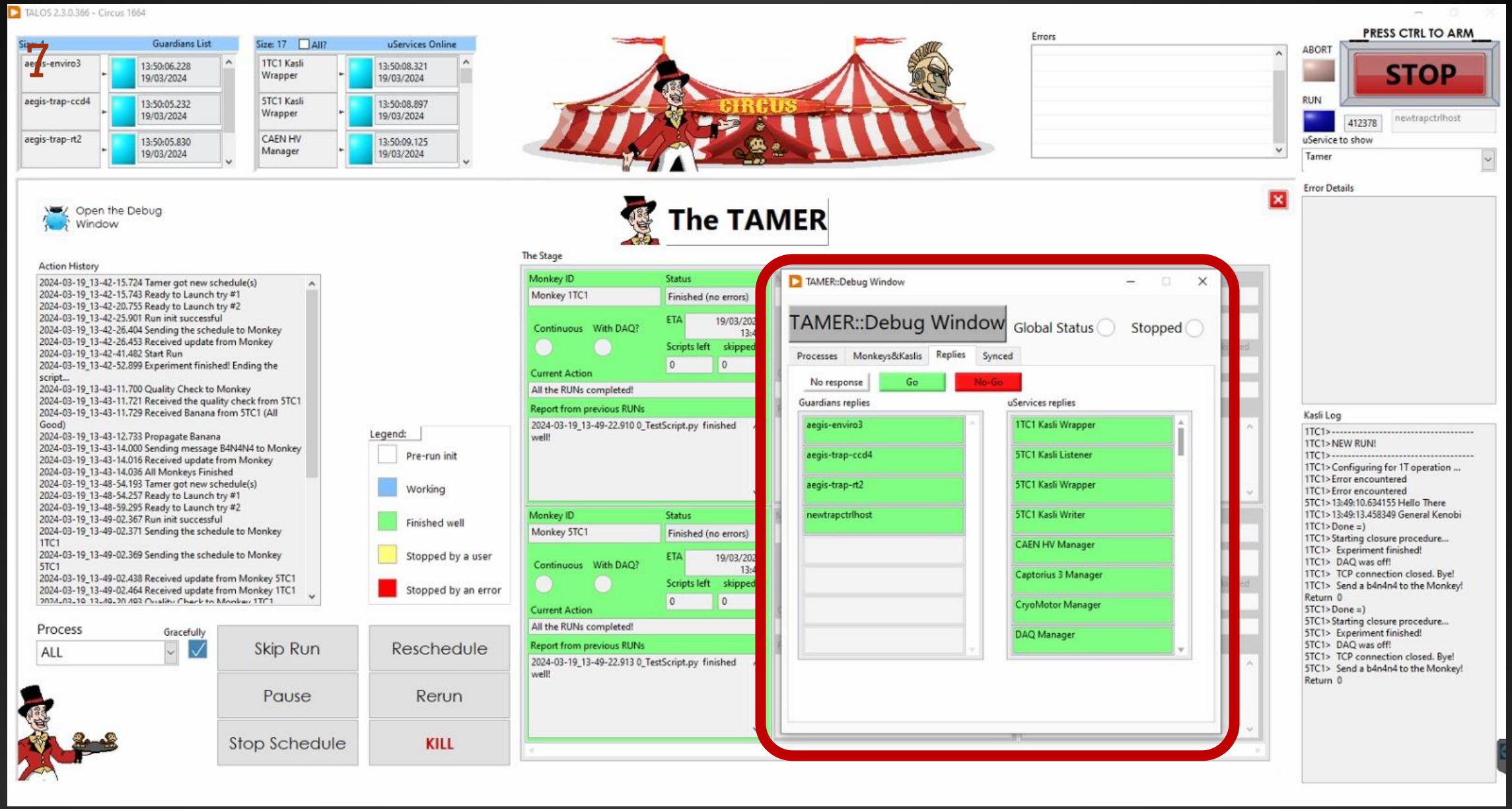
Jakub

CM Dec 2024

CONTROL SYSTEM UPDATES

Quality of life improvements


TALOS 2.3.0.369 - Circus 1674
Guardians List
uServices Online
5TC1 Kasli Wrapper
CAEN HV Manager
DAQ Manager
Errors
PRESS CTRL TO ARM
STOP
ABORT
RUN
uService to show
Tamer
Error Details
Kasli Log
Open the Debug Window
The TAMER
Action History
Monkey ID
Status
Paused
Continuous
With DAQ?
Current Action
Report from previous RUNs
Finished well
Stopped by a user
Stopped by an error
Process
ALL
Gracefully
Skip Run
Reschedule
Pause
Rerun
Stop Schedule
KILL
Actions like 'paused' or 'stopped' are better indicated
Graceful flag to ensure execution of the closer function
Additional actions for skipping, pausing and killing processes


TALOS 2.3.0.366 - Circus 1664
7
Guardians List
aegis-enviro3
13:50:06.228 19/03/2024
aegis-trap-ccd4
13:50:05.232 19/03/2024
aegis-trap-rt2
13:50:05.830 19/03/2024
Size: 17
All?
uServices Online
1TC1 Kasli Wrapper
13:50:08.321 19/03/2024
5TC1 Kasli Wrapper
13:50:08.897 19/03/2024
CAEN HV Manager
13:50:09.125 19/03/2024
CIRCUS
Errors
PRESS CTRL TO ARM
ABORT
STOP
RUN
412378
newtrapctrlhost
uService to show
Tamer
Error Details
Open the Debug Window
The TAMER
Action History
2024-03-19_13-42-15.724 Tamer got new schedule(s)
2024-03-19_13-42-15.743 Ready to Launch try #1
2024-03-19_13-42-20.755 Ready to Launch try #2
2024-03-19_13-42-25.901 Run init successful
2024-03-19_13-42-26.404 Sending the schedule to Monkey
2024-03-19_13-42-26.453 Received update from Monkey
2024-03-19_13-42-41.482 Start Run
2024-03-19_13-42-52.899 Experiment finished! Ending the script...
2024-03-19_13-43-11.700 Quality Check to Monkey
2024-03-19_13-43-11.721 Received the quality check from 5TC1
2024-03-19_13-43-11.729 Received Banana from 5TC1 (All Good)
2024-03-19_13-43-12.733 Propagate Banana
2024-03-19_13-43-14.000 Sending message B4N4N4 to Monkey
2024-03-19_13-43-14.016 Received update from Monkey
2024-03-19_13-43-14.036 All Monkeys Finished
2024-03-19_13-48-54.193 Tamer got new schedule(s)
2024-03-19_13-48-54.257 Ready to Launch try #1
2024-03-19_13-48-59.295 Ready to Launch try #2
2024-03-19_13-49-02.367 Run init successful
2024-03-19_13-49-02.371 Sending the schedule to Monkey 1TC1
2024-03-19_13-49-02.369 Sending the schedule to Monkey 5TC1
2024-03-19_13-49-02.438 Received update from Monkey 5TC1
2024-03-19_13-49-02.464 Received update from Monkey 1TC1
The Stage
Monkey ID
Monkey 1TC1
Status
Finished (no errors)
Continuous
With DAQ?
ETA
Scripts left
skipped
0
0
Current Action
All the RUNs completed!
Report from previous RUNs
2024-03-19_13-49-22.910 0_TestScript.py finished well!
Monkey ID
Monkey 5TC1
Status
Finished (no errors)
Continuous
With DAQ?
ETA
Scripts left
skipped
0
0
Current Action
All the RUNs completed!
Report from previous RUNs
2024-03-19_13-49-22.913 0_TestScript.py finished well!
Legend:
Pre-run init
Working
Finished well
Stopped by a user
Stopped by an error
TAMER::Debug Window
TAMER::Debug Window
Global Status
Stopped
Processes
Monkeys&Kaslis
Replies
Synced
No response
Go
No-Go
Guardians replies
aegis-enviro3
aegis-trap-ccd4
aegis-trap-rt2
newtrapctrlhost
uServices replies
1TC1 Kasli Wrapper
5TC1 Kasli Listener
5TC1 Kasli Wrapper
5TC1 Kasli Writer
CAEN HV Manager
Captorius 3 Manager
CryoMotor Manager
DAQ Manager
Kasli Log
1TC1>----------
1TC1>NEW RUN!
1TC1>----------
1TC1>Configuring for 1T operation ...
1TC1>Error encountered
1TC1>Error encountered
5TC1>13:49:10.634155 Hello There
1TC1>13:49:13.458349 General Kenobi
1TC1>Done =)
1TC1>Starting closure procedure...
1TC1> Experiment finished!
1TC1> DAQ was off!
1TC1> TCP connection closed. Bye!
1TC1> Send a b4n4n4 to the Monkey!
Return 0
5TC1>Done =)
5TC1>Starting closure procedure...
5TC1> Experiment finished!
5TC1> DAQ was off!
5TC1> TCP connection closed. Bye!
5TC1> Send a b4n4n4 to the Monkey!
Return 0
Process
ALL
Gracefully
Skip Run
Reschedule
Pause
Rerun
Stop Schedule
KILL

GENERAL TALOS UPDATES

Framework expansion

MIGRATION OF SYSTEM USERVICES

DEDICATED LV PROJECT

System uServices:
- ✓ Scheduler
- ✓ Tamer
- ✓ Monkey
- ✓ Kasli Wrapper

TALOS

But why?

They are essential for the main features of TALOS like:
- Scheduling
- Autonomous execution
- Kasli – LabView integration

ADDED ABSTRACTION LEVELS TO TALOS

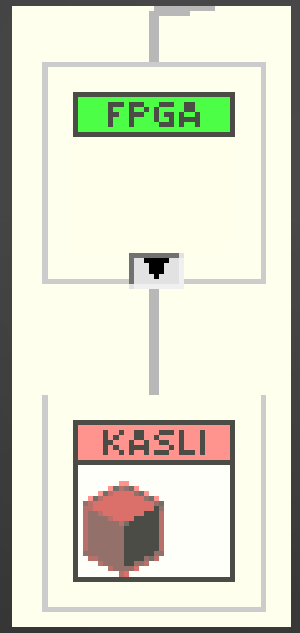
Defined in TALOS

FPGA Interface.lvclass

Implemented in TALOS for the Kasli Wrapper

Kasli.lvclass

Used by the Kasli Wrapper



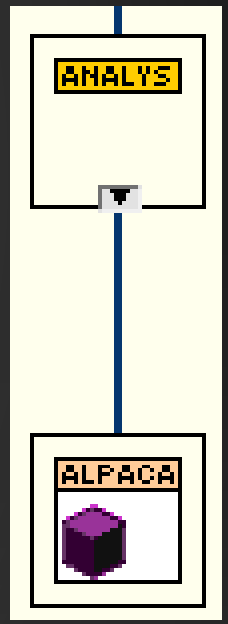
Allows for definition of new FPGA types as long as they support TCP communication

Defined in TALOS

Analysis Framework.lvclass

Used by Monkey

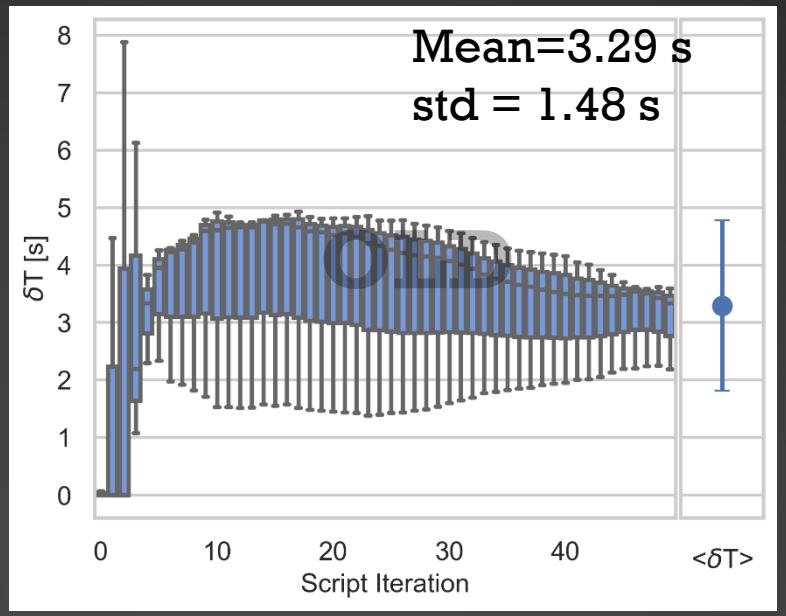
But implemented in the AEgIS dedicated project as the ALPACA class

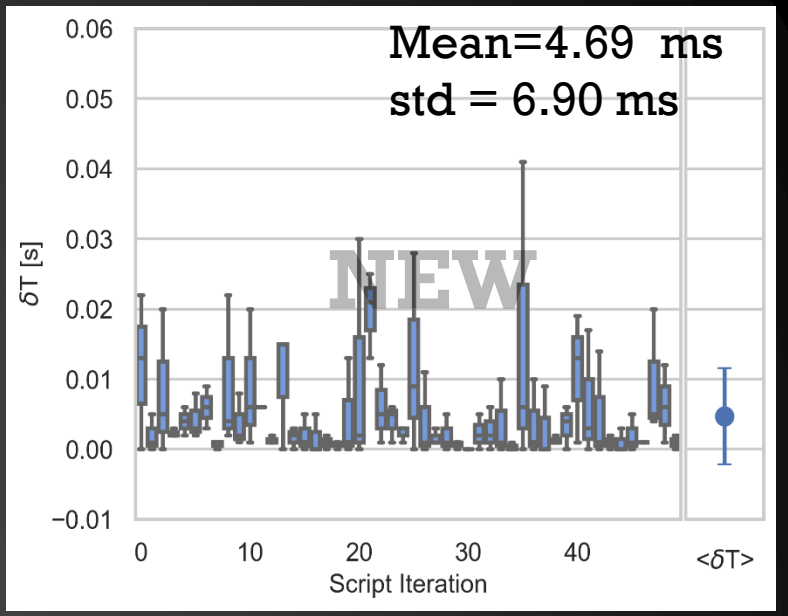


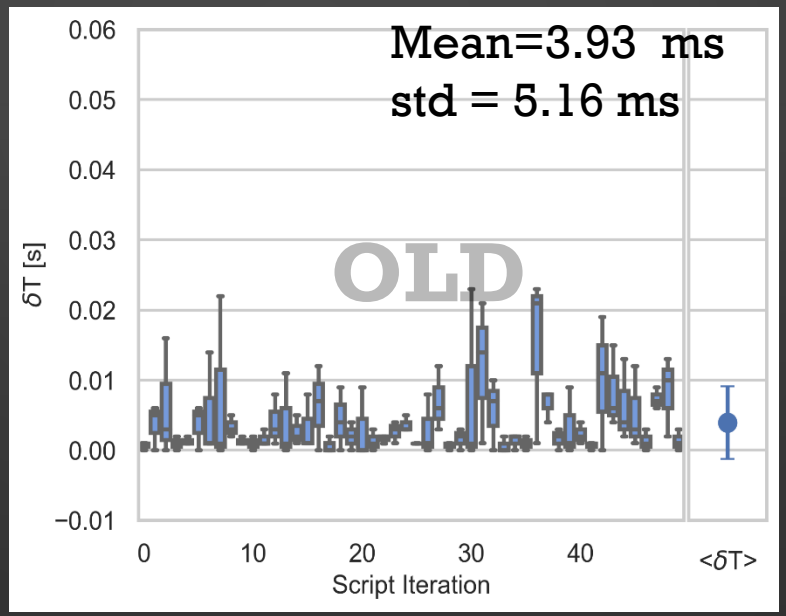
Allows TALOS to work with any analysis framework (the dedicated functions need to be implemented for each framework)

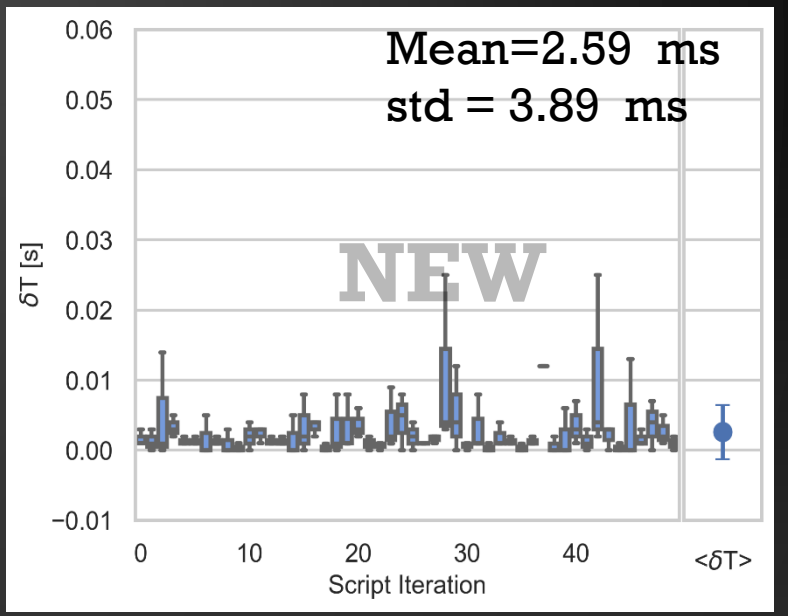
IMPROVED SYNCHRONISATION BETWEEN SCHEDULED SCRIPTS IN TALOS

δT is the time between the starts of the scripts of two consecutive Kaslis in a sorted array for the given script number









SOME KNOWN PROBLEMS

- ELENA Interface had a problem setting beam parameters (thanks Ruggero for finding/patching the bug)
- Communication between Monkey and ALPACA exhibits some unwanted behaviours (thanks Tassilo for looking into it)

- If you see a bug or misbehaviour or have an idea of how the system can be improved, please let us know. We appreciate all the feedback we can get

FUTURE DEVELOPMENT

GOING OPEN-SOURCE

TALOS: a framework for autonomous control systems for complex experiments

M. Volponi,[1,2,3,a)] J. Zielinski,[4] T. Rauschendorfer,[1,5] S. Huck,[1,6] R. Caravita,[3,2] M. Auzins,[7,1] B. Bergmann,[8] P. Burian,[8] R. S. Brusa,[3,2] A. Camper,[9] F. Castelli,[10,11] G. Cerchiari,[12,13] R. Ciuryło,[14] G. Consolati,[10,15] M. Doser,[1] K. Eliaszuk,[4] A. Giszczak,[4] L. T. Glöggler,[1] L. Graczykowski,[4] M. Grosbart,[1] F. Guatieri,[3,2] N. Gusakova,[1,16] F. Gustafsson,[1] S. Haider,[1] M. A. Janik,[4] T. Januszek,[4] G. Kasprowicz,[17] G. Khatri,[1] Ł. Kłosowski,[14] G. Kornakov,[4] V. Krumins,[1,7] L. Lappo,[4] A. Linek,[14] J. Malamant,[1,9] S. Mariazzi,[2,3] L. Nowak,[1] D. Nowicka,[4] E. Oswald,[1] L. Penasa,[3,2] V. Petracek,[18] M. Piwiński,[14] S. Pospisil,[8] L. Povolo,[2,3] F. Prelz,[10] S. A. Rangwala,[19] B. S. Rawat,[20,21] B. Rienäcker,[20] V. Rodin,[20] O. M. Røhne,[9] H. Sandaker,[9] P. Smolyanskiy,[8] T. Sowiński,[22] D. Tefelski,[4] C. P. Welsch,[20,21] T. Wolz,[1] M. Zawada,[14] and N. Zurlo[23,24]

finishing revision

Volponi et al. *EPJ Quantum Technology* (2024) 11:10
https://doi.org/10.1140/epjqt/s40507-024-00220-6
EPJ Quantum Technology
a SpringerOpen Journal
EPJ.org
RESEARCH Open Access

CIRCUS: an autonomous control system for antimatter, atomic and quantum physics experiments

Strip code and release it on GitHub (v0.1)

Clean-up the code and add abstractions

Release full final version (v1.0)

LICENCE???

WHAT UPGRADES CAN BE EXPECTED??

- Better optimiser integration
  - Using previously acquired data as the starting point of the new optimisation
- Improved response times for Monkey/Tamer (and Telegram Bot)
  - Higher synchronicity between Kaslis on the software side
- Moving away from SV Update notifications
  - No one is using them anyway – slowing transition to newer LV versions
- Eliminating last SV from TALOS engine
  - Less need of rebooting Windows if TALOS is restarted
  - ABORT needs another solution
- Updating to LV 2024 (probably at the end of the Run)
  - Better Python integration, further upgrades are easier (unique driver folder)
- Automatic skin updater
  - Based on the date, no restarts required

CONCLUSIONS

- System is more user-friendly and allows for better control of the running schedule
- The TALOS framework has been expanded to allow for higher experiment and hardware independence
- Running Parallel Schedules needs a proper stress test (still)
- The system is in the final stage of preparation for release to the public
  - Decide on the LICENSE and double-check TALOS code

THE MOST IMPORTANT METRIC

	Vis		Pixels of wires		Meters of wires*	
	2023**	2024	2023**	2024	2023**	2024
TALOS	471	939	2.7 M	5.5 M	902	1518
AEgIS LV Code	1156	801	7.7 M	5.3 M	2579	1478
Total	**1627**	**1740**	**11.4 M**	**10.8 M**	**3481**	**2996**

* Calculated using a 24” screen with Full HD resolution (1920 x 1080). Thanks Piotr Demski!
** State for 11.12.2023

THANK YOU

BACKUP SLIDES

OPEN-SOURCE LICENCES

Don't use Creative Commons but OSI-approved ~ Open Source Program Office

Permissive licences

- Apache v2
- BSD
- MIT

- Nobody is forced to release the source codes (theirs and ours)
- Only need to follow basic conditions (including copyright notice, etc.)

Weakly-reciprocal licences

- LGPL3
- LGPL2.1
- MPL2

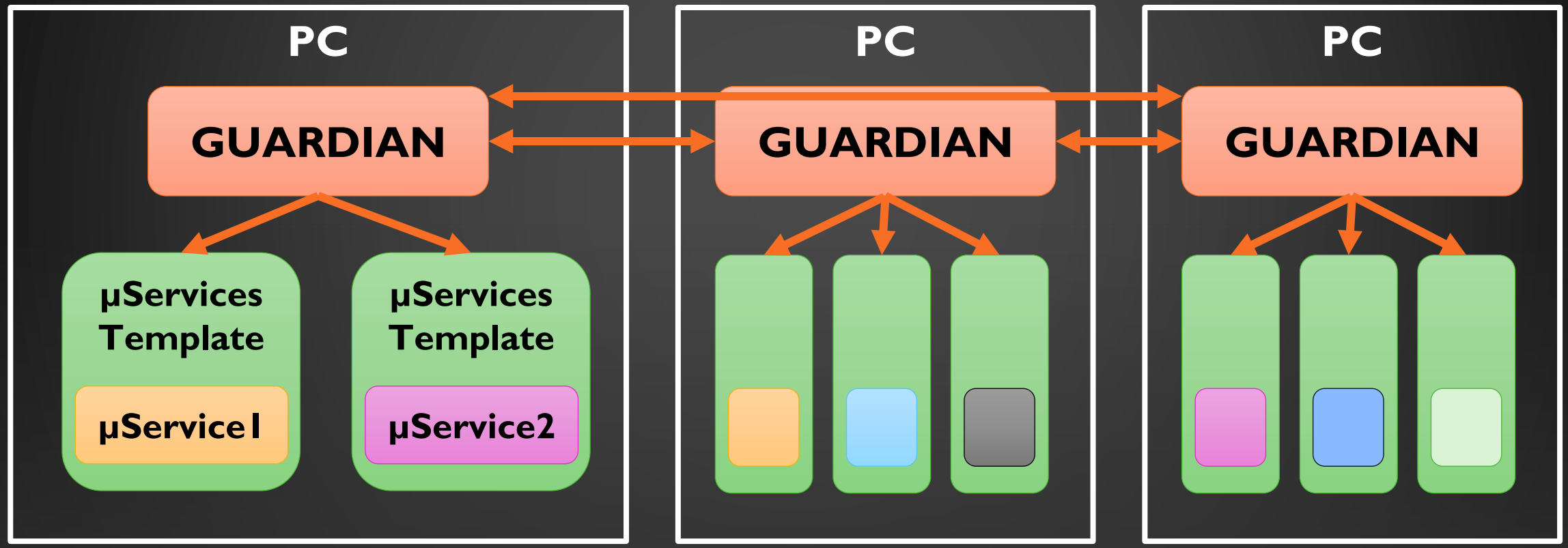
- The code of our software used needs to be released (even if not modified)
- No need to disclose their code

Strongly-reciprocal licences

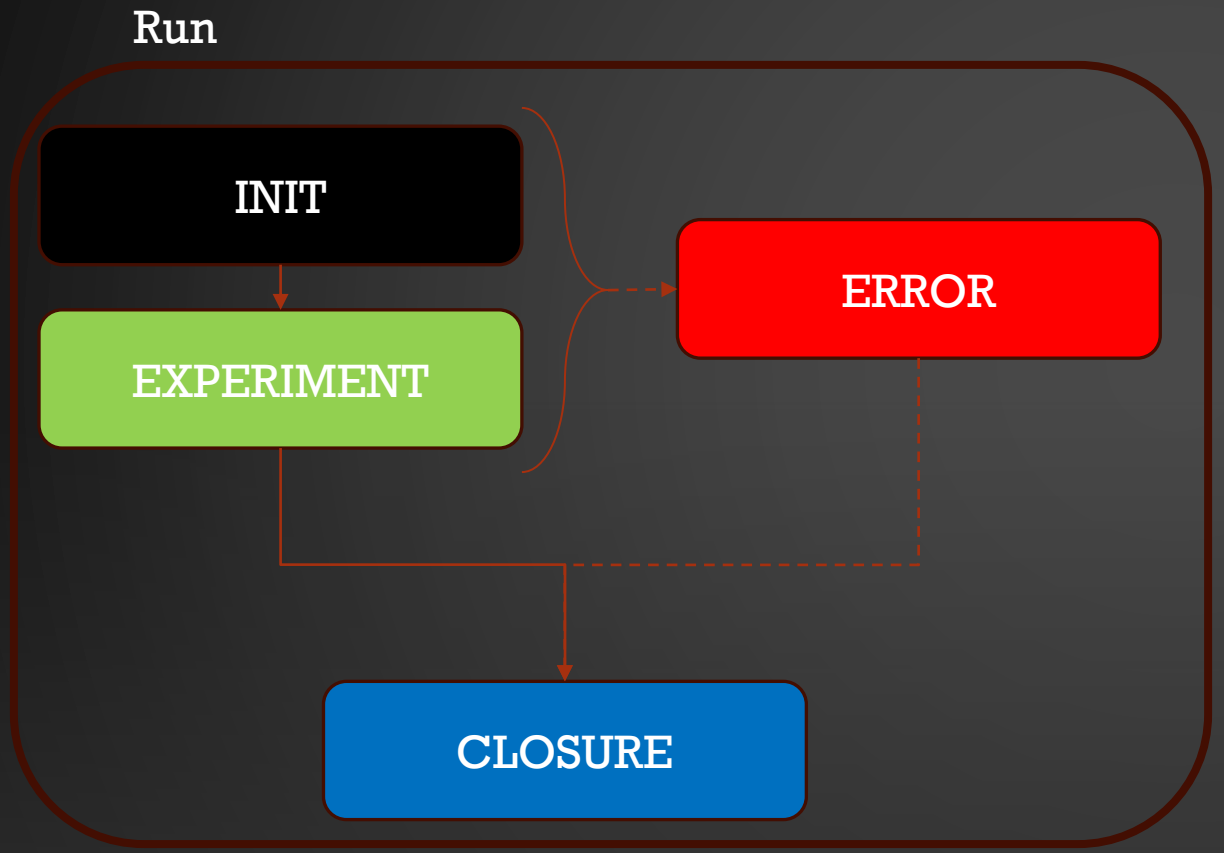
- GPL3
- GPL2

- All the source code needs to be released

TALOS: STRUCTURE



ARTIQ – ERROR HANDLING




```python
def run(self):
    try:
        # Start procedure
        self.Simplified_Init()
        self.Print("Waiting a bit before starting the run...")
        self.StartRun()
        # uService resetting where needed
        self.Simplified_Reset()
        # Experiment routine
        self.experiment()
    # Exception handling and script closure
    except Banana as error:
        self.ExceptBanana(error)
    except RTIOOverflow as error:
        self.ExceptKernelBanana(error)
    except Exception as error:
        self.ExceptException(error)
    finally:
        # Post-measurement cleanup
        print("Starting closure procedure...")
        self.closure()
        # Closing
        self.StopRun(self.RetCode)
        return
```

MACHINES TOPOLOGY

NewTrapCtrlHost	AEgIS-Trap-RT2	AEgIS-Trap-CCD4	AEgIS-EKSPLA	AEgIS-Alex	Enviro-3
Error Manager	TimingClock	1TCMOS	Avantes Spm	Alex SHG1	Environment Mngr
DAQ Manager	HV	5TCCD	TC200 UV	Alex SHG2	
ELENA Interface	5152	Captorius (2x)	TC200 IR	Alex THG1	
Kasli Wrapper (2x)	6133	Kasli UART Logger (3x)	SFG205	Alex THG2	
Telegram Bot	Rotating Wall	Degrader Ladder	HWP532	Alex VBG Rotator	
Monkey	Pulser Manager	Electron Gun	HWP1064	Alex Prism Mngr	
Scheduler			Energy Meter 2	Energy Meter 1	
Positron Reader				Moglabs MWM	
Kasli Writer (2x)					
Kasli Listener (2x)					
PMT					
CAEN HV					

Status for May 2023

Jakub

CM Dec 2024