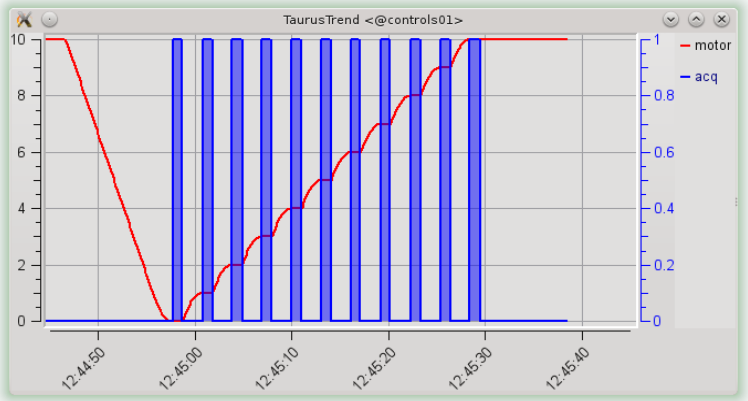
Continuous Scans in Sardana (SEP6)

Teresa Nunez,

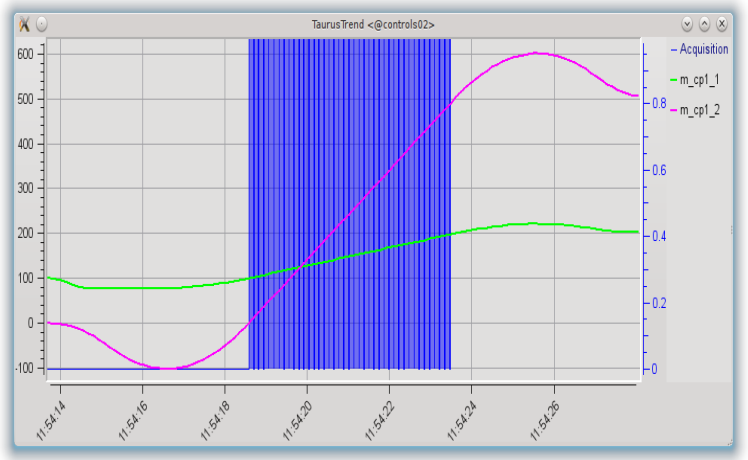
Zbigniew Reszela -

on behalf of the Alba Controls Group

Sardana Workshop 2015



Motion & acquisition during the step scan.



Motion & acquisition during the continuous scan

Important assumptions

- All elements, but slave motors, must be defined in the same Pool.
- Support only linear trajectories – constant velocity.
- Global integration time per scan point record.

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- All elements, but slave motors, must be defined in the same Pool.
- Support only linear trajectories – constant velocity.
- Global integration time per scan point record.
- Software development approach:
  - reuse the most from the existing Sardana
  - iterative development instead of upfront plan and designs
  - let's first obtain the complete model and later optimize it
  - strong emphasis on automated tests

Transparency

Only one motor is used as position synchronization source.

Continuous velocity move until the last sample is acquired

The same measurement group must be reusable between step and continuous scans (if hardware allows that).

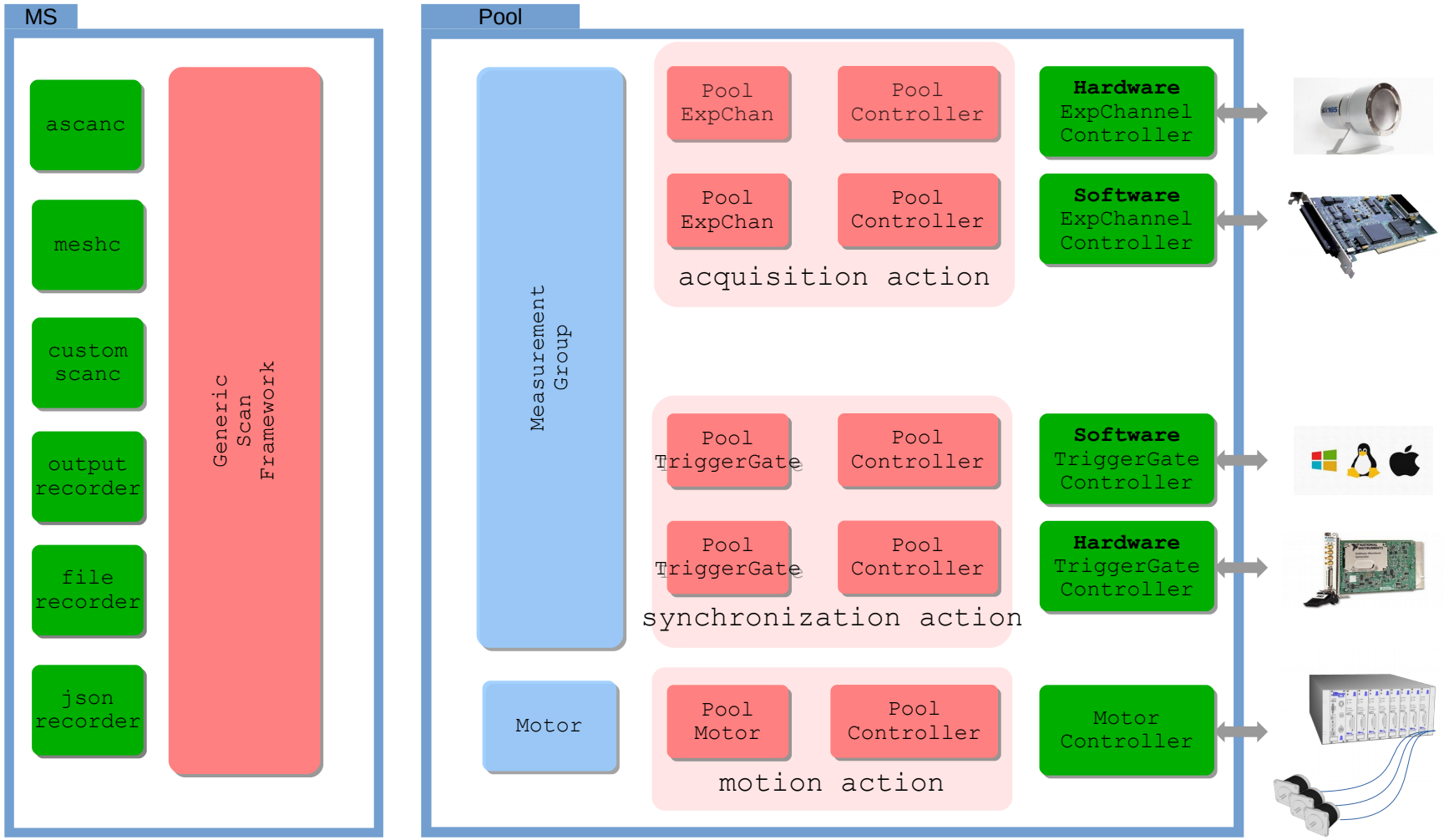
```
ascanc <motor> <start_pos> <final_pos> <nr_interv> <integ_time>

#Pt No    motor   integ_time   expchannel      dt
   0      13.0       0.01         8.780        0.0
   1      13.1       0.01         8.698        0.2
```

Nominal motor positions

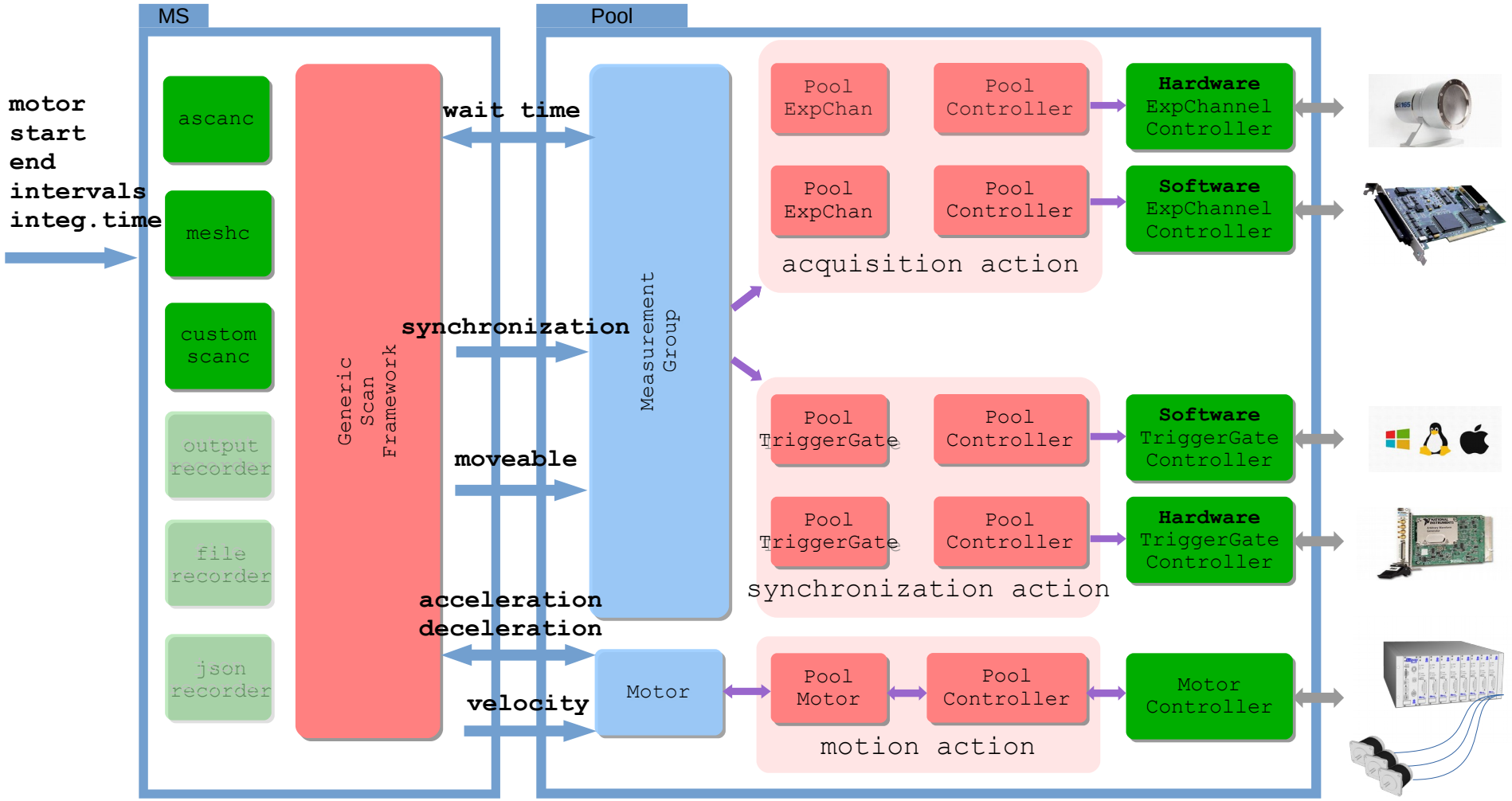
NEW: integration time set point

Nominal delta time from the start

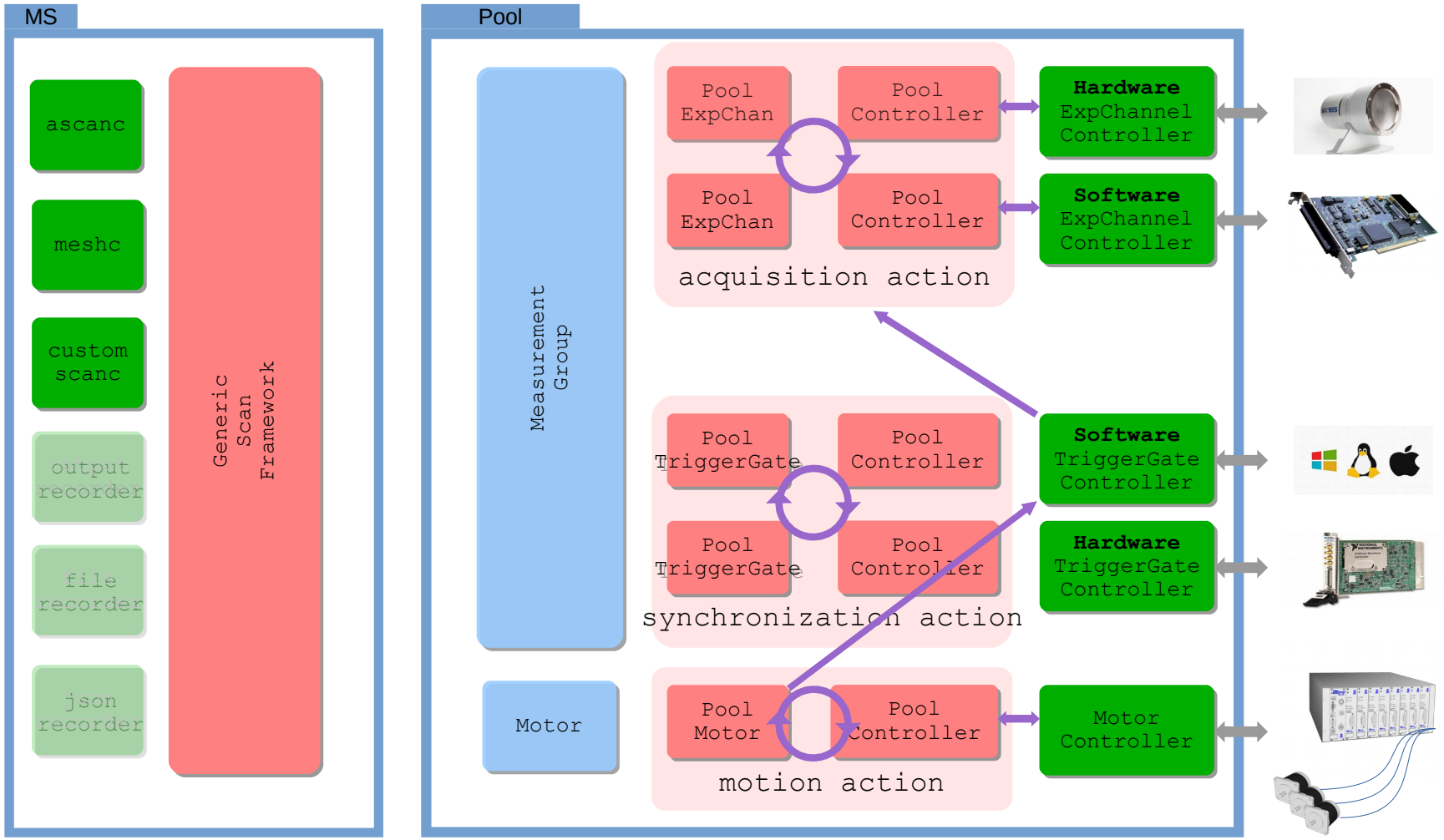
Involved elements



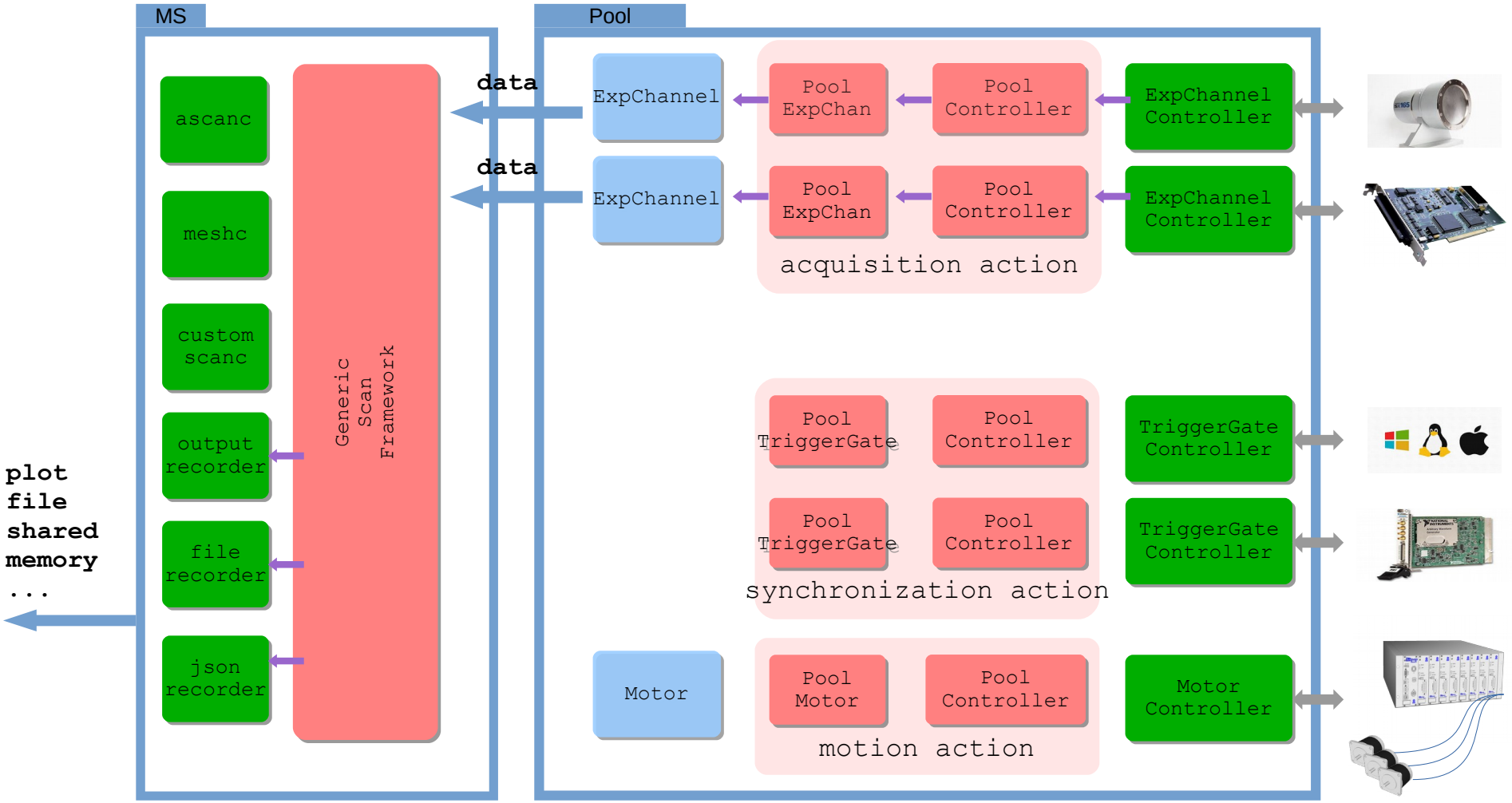
Scan configuration



Synchronization and acquisition



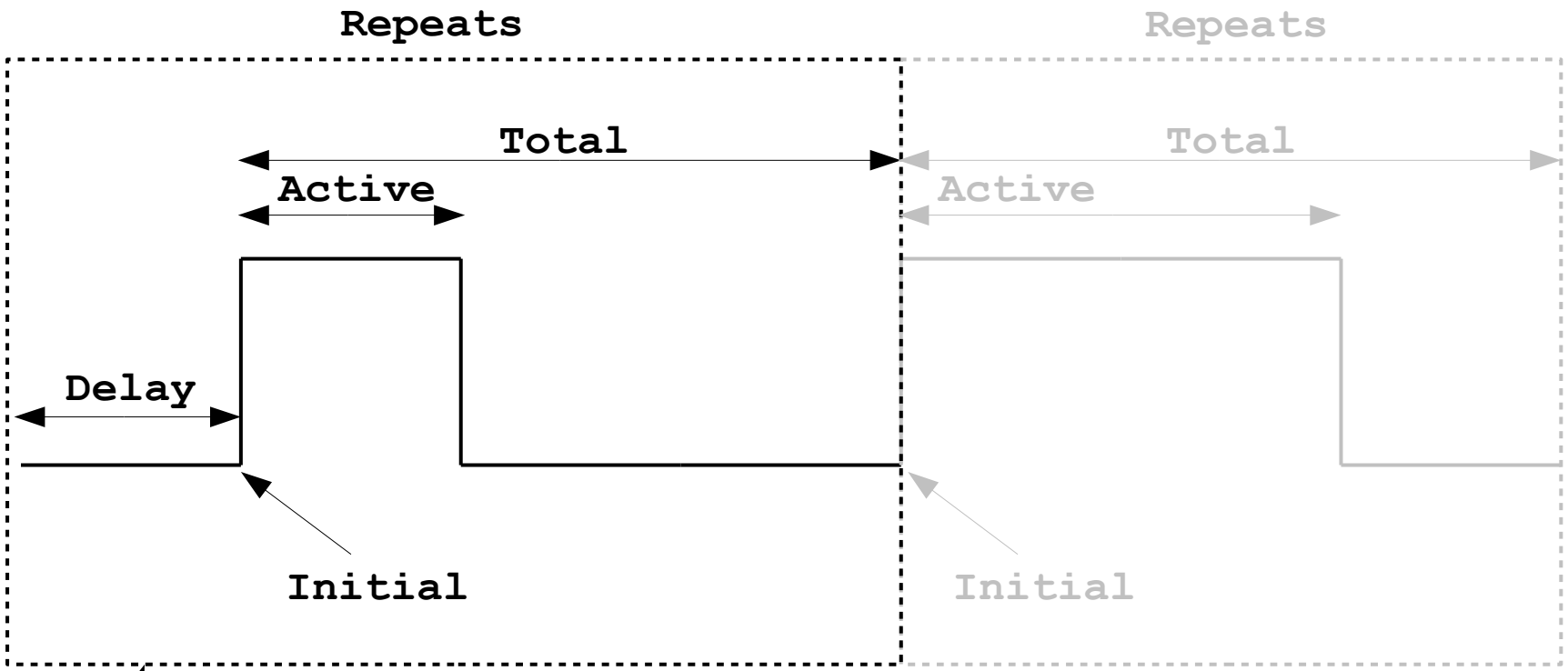
Data storage



Synchronization – hardware

Hardware	Supported domains	Non equidistant configuration	Config. active interval – gate support	Interpret configuration as absolute	Start on position and cont. in time	Require position calibration
Software	Time Position	YES	YES Time Position	YES	YES	**NO**
Icepap	Position	YES	**NO**	YES	NO	YES
Zebra	Time Position	NO	YES Time Position	YES (Position)	YES	YES (Internal)
TurboPmac2 (standard feature)	Position	NO	YES Position	YES	NO	YES
TurboPmac2 (PLC)	Time Position	YES	YES Time Position	YES	YES	?
NI6602	Time Position*	NO	YES	**NO**	NO*	YES
TFG	Time	YES	YES	**NO**	-	-

Synchronization - parameter



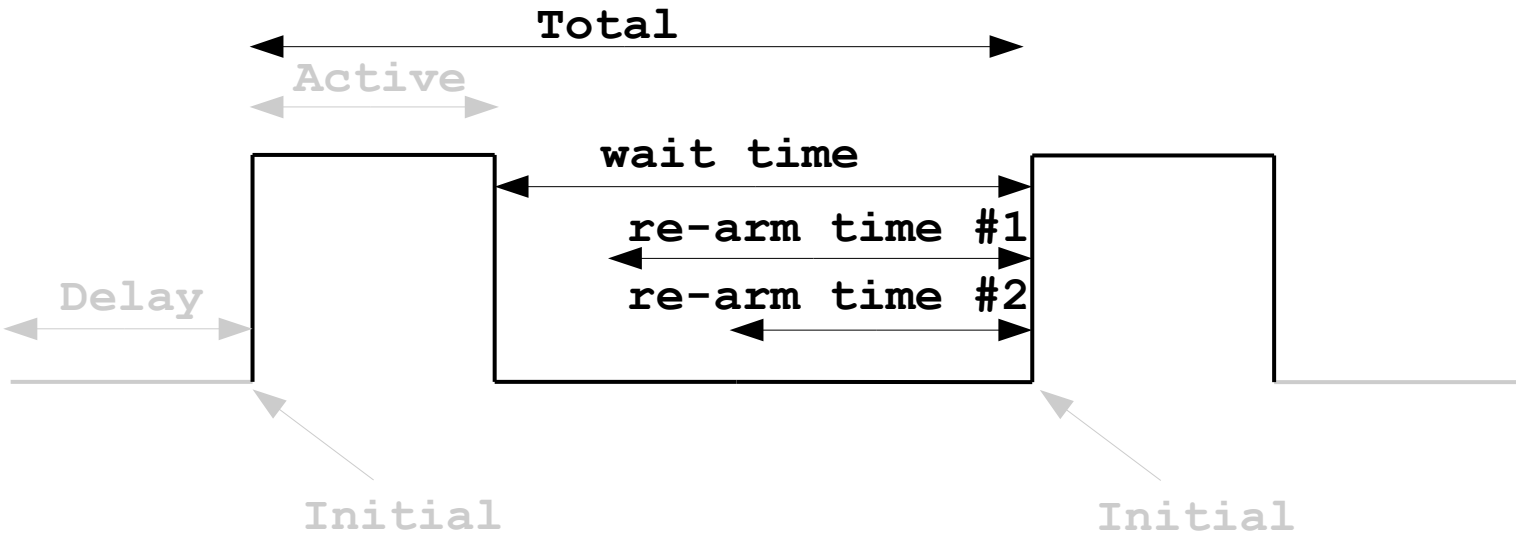

```
[{Delay:    {Time: 0.3, Position: 400},
  Initial:  {Time: None, Position: 0},
  Active:   {Time: 0.1, Position: 10},
  Total:    {Time: 0.15, Position: 15},
  Repeats: 1000},
 ...]
```

Synchronization

- Continuous scan fills the synchronization parameters in position and time domains.
- Time scan and step scan* fills just the time domain.
- Step scan uses just one *group* and starts the measurement group multiple times*.
- TriggerGate controller chooses the most appropriate parameters – controlled by users with extra attributes.
- Synchronization with first trigger on position and continues in time are possible.
- General rule: position domain takes precedence for Initial and Total but time domain takes precedence for Active.

* step scans could use synchronization with Repeats > 1 in the future

Wait time



- Useful in software synchronized channels – helps to avoid skipped acquisitions
- wait time = max(re-arm#1, re-arm#2, MG wait time)
- Affects: motors velocities, total interval (time)

Acquisition – hardware

Hardware	Type of controller	Multiple channel	Channels are independent	Synchroni-zation	Require external timer	Allows readouts while acquiring
Software (TaurusAttr.)	Counter, 0D, 1D, 2D	YES	**YES**	SW Trigger SW Gate	NO	YES
AlbaEM	0D (Electrometer)	YES	NO	HW, SW Trig. SW. Gate	NO	**NO**
Adlink2005	0D (ADC)	YES	NO	HW, SW Trig. HW, SW Gate	NO	YES
Keithley	0D (Electrometer)	YES	NO	HW, SW Trig. ?, SW. Gate	NO	**NO**
NI6602	Counter, Timer	YES	**YES**	HW, SW Trig. HW, SW Gate	**YES (can use internal)**	YES
Mythen	1D	YES (but used as single)	NO	HW, SW Trig. HW, SW Gate	NO	YES
CCDs & Detectors	2D	**NO**	NO	HW, SW Trig. HW, SW Gate	NO	YES
SIS3820	1D	YES	NO	HW, SW Trig.	**Yes**	**NO**
XIA	1D	YES	NO	HW, SW Trig.	NO	**NO**
Zebra	Counter	YES	NO	HW Trig.	NO	YES (but not in use)

Acquisition action

- Start action:
  - configure synchronization: software trigger, software gate, hardware trigger or hardware gate
  - configure number of repetitions
  - call the Load sequence on all triggered channels
  - call the Start sequence in the reversed order of configuration
- Action loop:
  - while channels are acquiring
    - call the State sequence
    - call the Read sequence (for channels with the online readout capability)
  - call the Read sequence (for channels without the online readout capability)

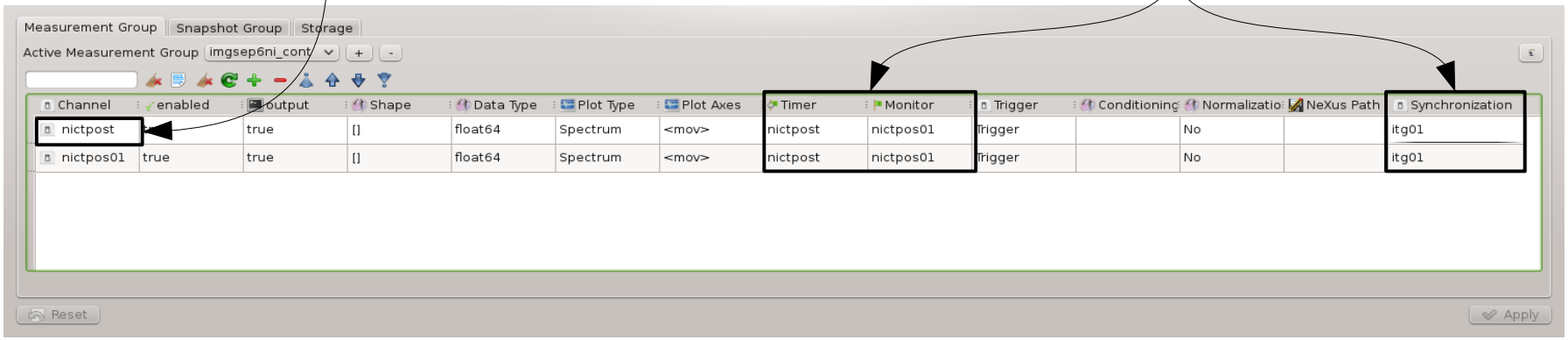
Data merging

- SardanaValue contains: value, timestamp and **index.**
- Controllers may return SardanaValue objects or just the python base objects: float, sequence of floats, or numpy objects (in the last case the acquisition action fills the rest of the fields).
- GSF receives data in chunks and fills the records in base of the indexes.
- Zero order interpolation is applied in case of missing data.
- Interpolated data must be easily distinguishable from the raw data.

Configuration up to now

Some controllers create Timer just to pass the integration time to the HW

Timer, Monitor, TGElement are competing for the synchronizer role

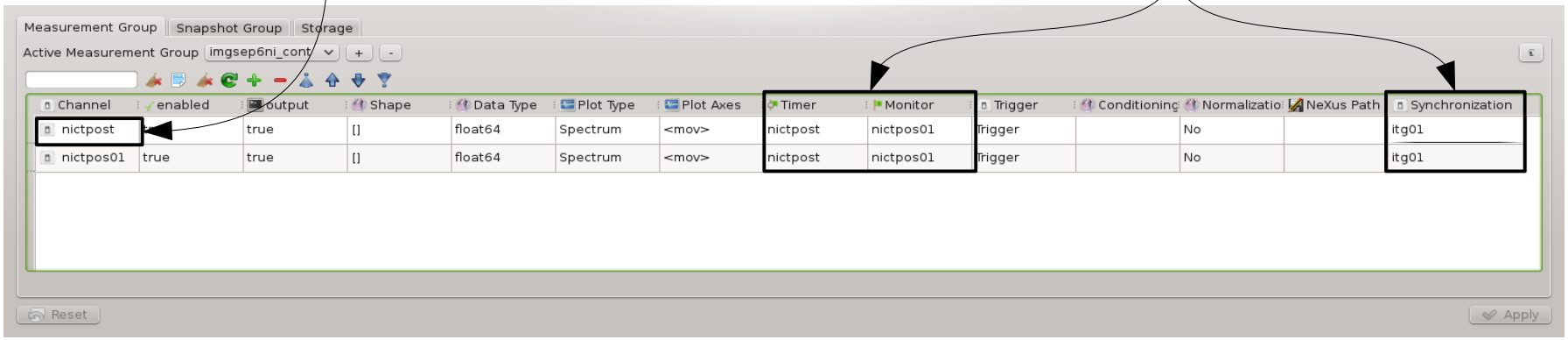


- Timer & Monitor, master Timer & Monitor roles are not clear to all users
- Many times Timer/Monitor element do not change between the measurement groups
- expconf does not allow to use Timer or Monitor from another controller
- expconf forces the same Timer and Monitor for the whole controller
- expconf forces the same synchronization (trigger or gate) for the whole controller

Config. w/o Timers/Monitors

Some controllers create Timer just to pass the integration time to the HW

Timer, Monitor, TGElement are competing for the synchronizer role



Less Timers means:

- less elements to control in the acquisition actions
- less Tango devices & events
- no problem with the Value attribute format
- less columns in the records

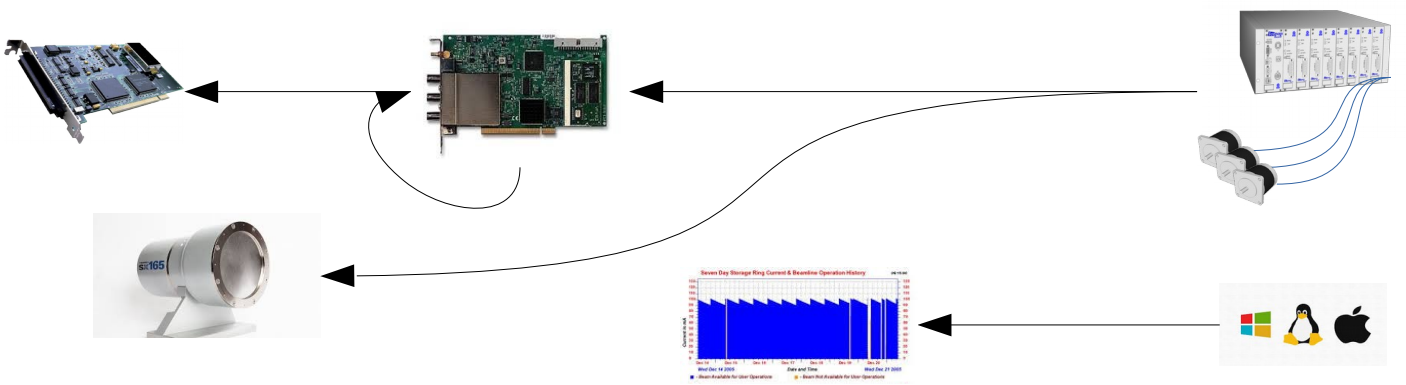
Configuration w/o Timer/Monitor means:

- simpler expconf GUI
- simpler data structures for the programmer

Configuration

- Configuration is a table containing **all** information about the acquisition and synchronization elements
- **Timer** and **Monitor** columns should disappear in favor of the **Synchronizer** column
- No Timer for the ExpChannels means no info about the real integration time, is it a problem?
- The Synchronizer column represents the element in charge of controlling the acquisition (either software or hardware)
- Valid options for the Synchronizer column are any of: **TriggerGate** elements or **CounterTimer** elements

Configuration



Channel	Control	Synchronizer
CounterTimer#1	Trigger	HW TriggerGate
ExpChannel#1	Trigger	HW TriggerGate
CounterTimer#2	Gate	**CounterTimer#1**
ExpChannel#2	Gate	**CounterTimer#1**
ExpChannel#3	Trigger	SW TriggerGate

Timer

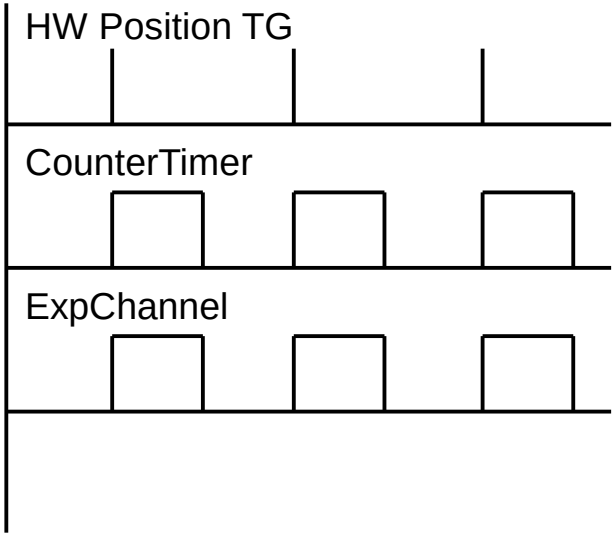
Timers **do not** belong to the synchronization action

Slow channel

Call **LoadOne** on all of them

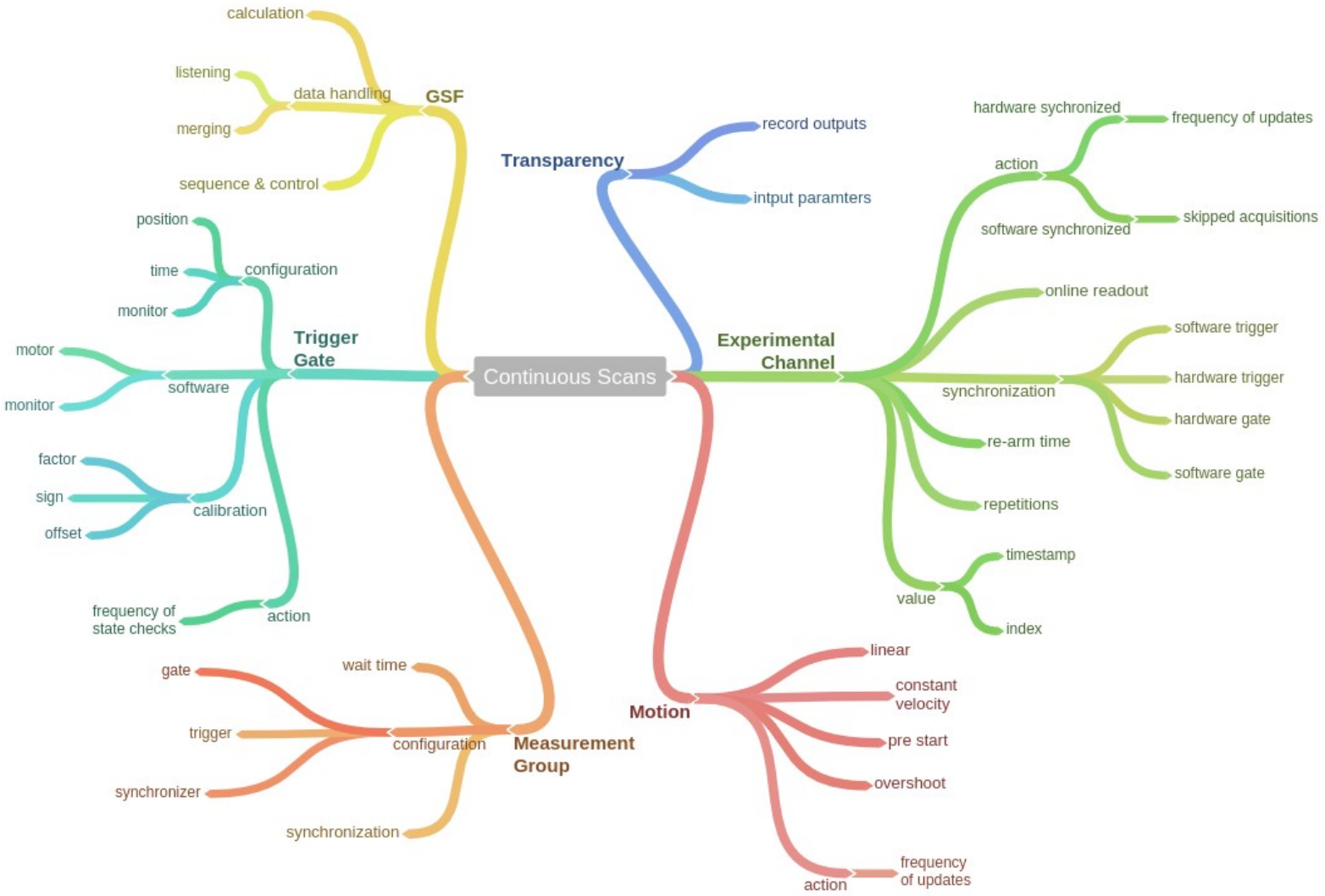
Direction of the synchronization control

Composed gate



Channel	Control	Synchronizer
ExpChannel	Gate	CounterTimer
CounterTimer	Trigger	HW Position TG

Summary


Continuous Scans
GSF
data handling
calculation
listening
merging
sequence & control
Transparency
record outputs
intput paramters
Trigger Gate
configuration
position
time
monitor
software
motor
monitor
calibration
factor
sign
offset
action
frequency of state checks
Experimental Channel
hardware sychronized
frequency of updates
action
skipped acquisitions
software synchronized
online readout
synchronization
software trigger
hardware trigger
hardware gate
software gate
re-arm time
repetitions
value
timestamp
index
Measurement Group
configuration
gate
trigger
synchronizer
wait time
synchronization
Motion
linear
constant velocity
pre start
overshoot
action
frequency of updates