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Configurable Deadbands for Warning and Alarm Levels in cppTango

Q&A at slido.com #4094940

Alessio Igor Bogani · Elettra Sincrotrone Trieste

Thresholds at the edge of normal flap

- ✓ Warning and alarm thresholds sit a few percent from steady state — that is what makes them useful.
- ✓ Sensor noise, ADC quantisation, control-loop oscillation and thermal drift push the value across the line — hundreds of times per shift.
- ✓ Each crossing: ON ↔ WARNING ↔ ALARM transition, an alarm-log line, a change event to every subscriber on the bus.
- ✓ Operator screens, archived alarm statistics, event-channel bandwidth — they all pay for healthy attributes.

The silent cost of widening the threshold

The obvious workaround is to move the warning level further out until the noise no longer reaches it.
The cost is invisible: you lose sensitivity to slow drifts — the kind a fouled heat exchanger, a leaking valve, or an aging power supply will produce — until the drift is far larger than it had to be when you would have wanted to know.
From outside the configuration, nothing looks different. The threshold is just a little further from where the physics says it should be.

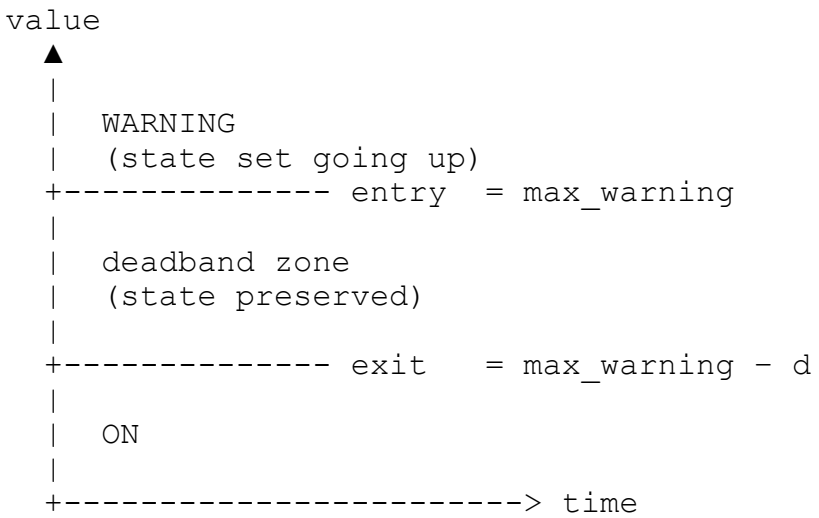
Asymmetric hysteresis: entry ≠ exit

Keep the threshold where the physics says it should be.

Once a value crosses into a warning or alarm region, it stays there until the value re-enters the safe region by at least the configured deadband.

One threshold to go in. A different effective threshold to come out.

In control jargon: asymmetric hysteresis on the alarm state.



Four new per-attribute properties

Four properties, additive to today's alarms:

- min_warning_deadband
- max_warning_deadband
- min_alarm_deadband
- max_alarm_deadband

Matching fields on AttributeAlarmInfo in the IDL — clients on the bus see them through the existing config call.

Same shape and same place as min_alarm / max_alarm / min_warning / max_warning. No new mental model.

```
# sys/test/1/temperature
max_warning           : 75
max_warning_deadband  :  2

# Noisy reading, exit at 73:
  reading  today      new
  74.6 °C  ON         ON
  75.3 °C  WARNING    WARNING
  74.8 °C  ON         WARNING
  75.1 °C  WARNING    WARNING
  74.7 °C  ON         WARNING
  75.2 °C  WARNING    WARNING
  74.9 °C  ON         WARNING
  72.8 °C  ON         ON
           6 events   2 events
```

Implementation notes

- ✓ Scope: SCALAR, SPECTRUM, DEV_ENCODED.
- ✓ Default value is 0 — every existing deployment behaves exactly as before until somebody opts in.
- ✓ Each deadband requires its matching alarm or warning level to be set; configurations missing it are rejected at device startup.
- ✓ Warning and alarm bands operate independently — each region has its own entry and exit threshold.
- ✓ About a thousand lines of tests cover the edge cases the review will want to see.

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Thank you!