Development of the TANGO Alarm System

Contents

# *Overview*

- Alarm: asynchronous notification that some event has happened or that a given state has been reached

- Alarm system: a complex that allows creating, receiving and managing alarms

- The Alarm Collector: an alarm system developed for the TANGO control system framework

Requirements

- Easily configurable at runtime: tools to add or remove alarms without restarting the system

- Centralized system: alarm rules based on input values from multiple computers of the control system

- Support for complex alarm rules based on formulas

- Flexible enough to carry some specific additional information

- Consistent between multiple clients
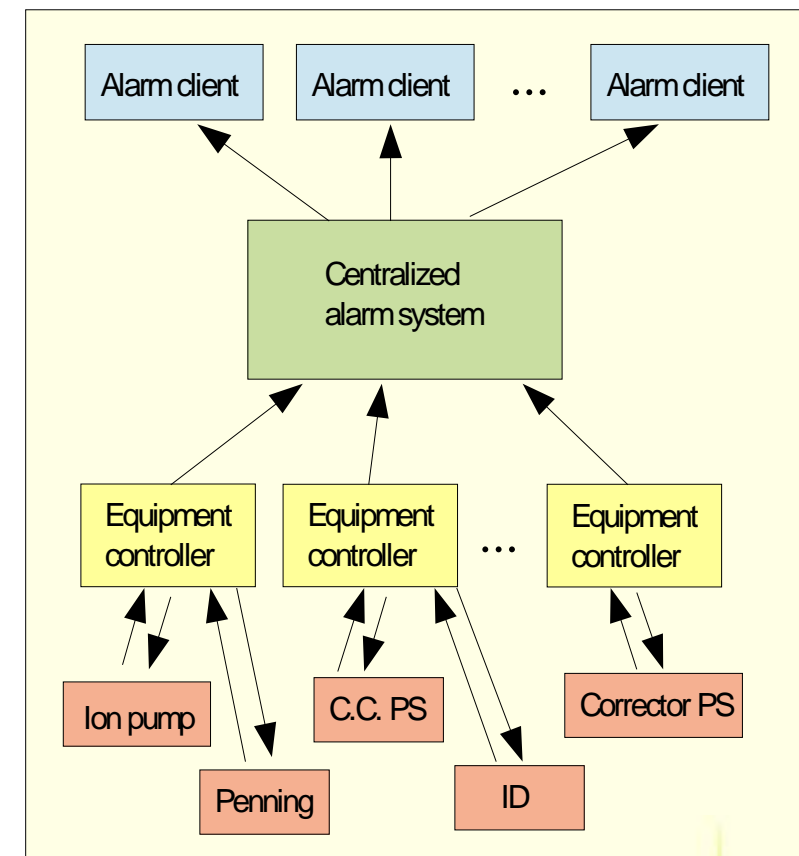
Alarm rules

- Define each alarm and specify the associated condition

- Each alarm rule is made by three distinct fields:

  - a unique self-explaining label: the *alarm name*

  - the condition to be evaluated: the *alarm formula*

  - an optional text *message*

- The alarm formula is made by identifiers, numbers, operators and simple mathematical functions

Alarm formula

- Identifiers are the TANGO attributes that specify the input values

- Binary and logical operators

  - &, |, ^, ~, *, +, -, (), <<, >>, <=, >=, <, >, !=, &&, ||, !

  - ...that allow for:

    - comparing a value with a predefined mask, reference or with another value

    - complement, negate, shift....

    - combining several logical conditions

- Round brackets allow for combining conditions

- Simple mathematical functions: abs, fabs,**...**

Alarm rule: examples

- Basic alarm rule: check PS status

  △ sr/pscid/s1.1/off ({sr/pscid/s1.1/stat} & 0x40) "C.C. PS off"

- Combining the status of two devices: correction coil power supply
  is off and insertion device feed-forward orbit correction loop is enabled

  △ sr/pscid/s1.1/off
  (({sr/pscid/s1.1/stat} & 0x40) && ({sr/carid/s1.1/stat} & 0x100))
  "Correction Coil Power Supply OFF"

- Mixing digital and analog values: corrector status and supplied current

  △ sr/psch/s10.1/highthr
  (({sr/psch/s10.1/stat} & 0x80) && ({sr/psch/s10.1/curr} > 15.0))
  "Corrector current high threshold"

Alarm message

- As a result of the formula evaluation the alarm status could assume two values: ALARM or NORMAL.

- An acknowledge flag is also associated to each alarm (ACK, NOT_ACK)

- The alarm system composes a formatted text string called "alarm message" containing all the relevant information:

    - time stamp
    - alarm name (identifier)

    - alarm status
   - acknowledge flag status
    - optional text message

- Ex:

Mon Sep 19 10:50:55 2005	sr/pscid/s1.1/off	ALARM	NOT_ACK	*PS off*

The Alarm Collector

- A special TANGO device server based on a double client/server architecture

- Relies on the TANGO event system to collect input values as well as to provide alarm notifications

  - △ increased efficiency
  - △ lower network bandwidth load

- Manages the alarm system current status in a centralized manner

  - △ configuration of the alarm system in the database
  - △ information consistency between multiple clients

- More than one Alarm Collector instance feasible

How it works?
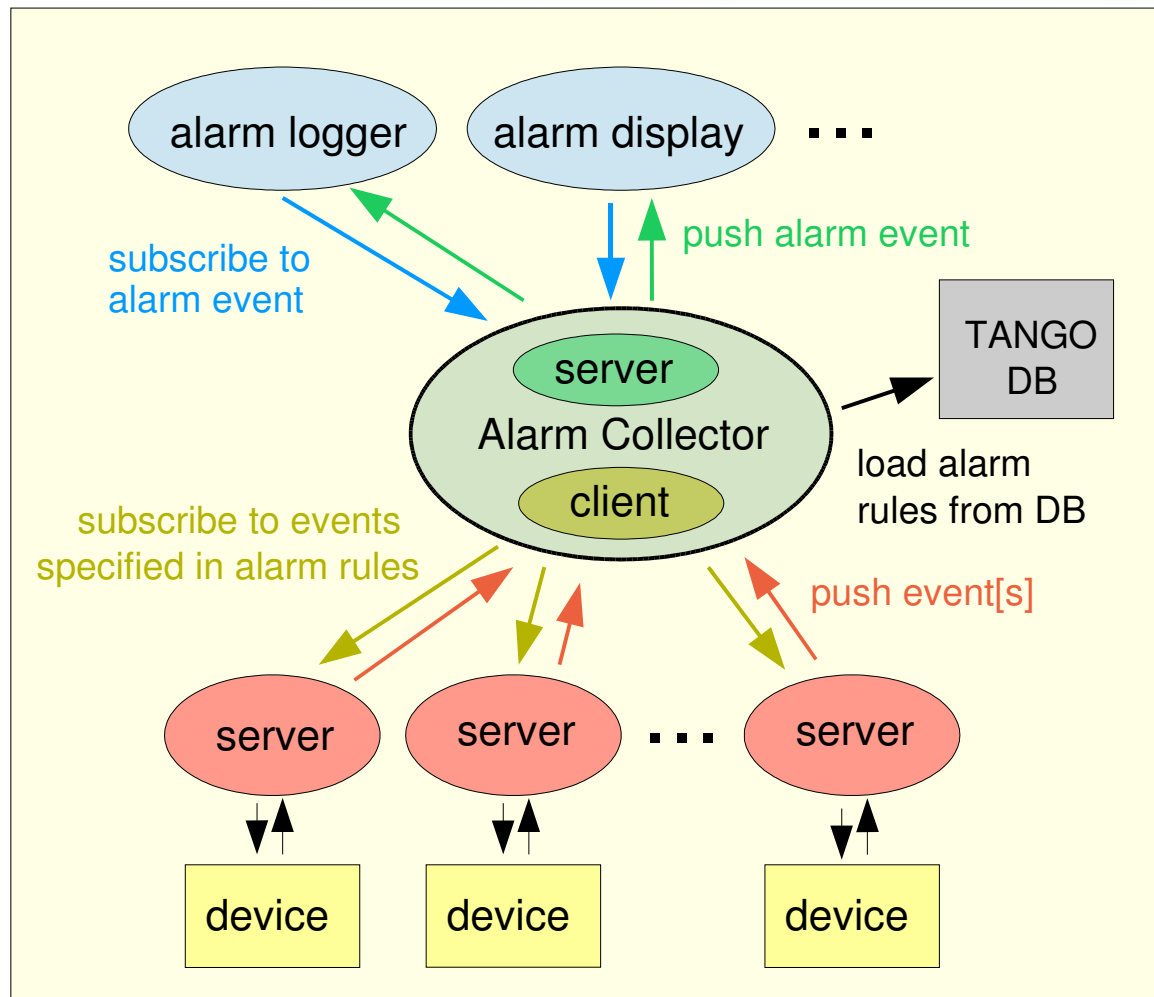
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System setup

A number of steps are required to setup the alarm system starting from an already working TANGO setup:

- create the *alarm* device server in the TANGO database (Jive)

- add a property "Header" containing the following tab-separated string:

  tv_sec   tv_usec   AlarmStatus   Ack   Message

- define the alarm rules, i.e. define all the involved attributes

- for each attribute chose the event notification threshold

- start the Alarm Collector device server

- load the alarm rules into the alarm system (load-alarm.py)

Block diagram

Development of the TANGO Alarm System   *Lorenzo Pivetta – ICALEPCS 2005*
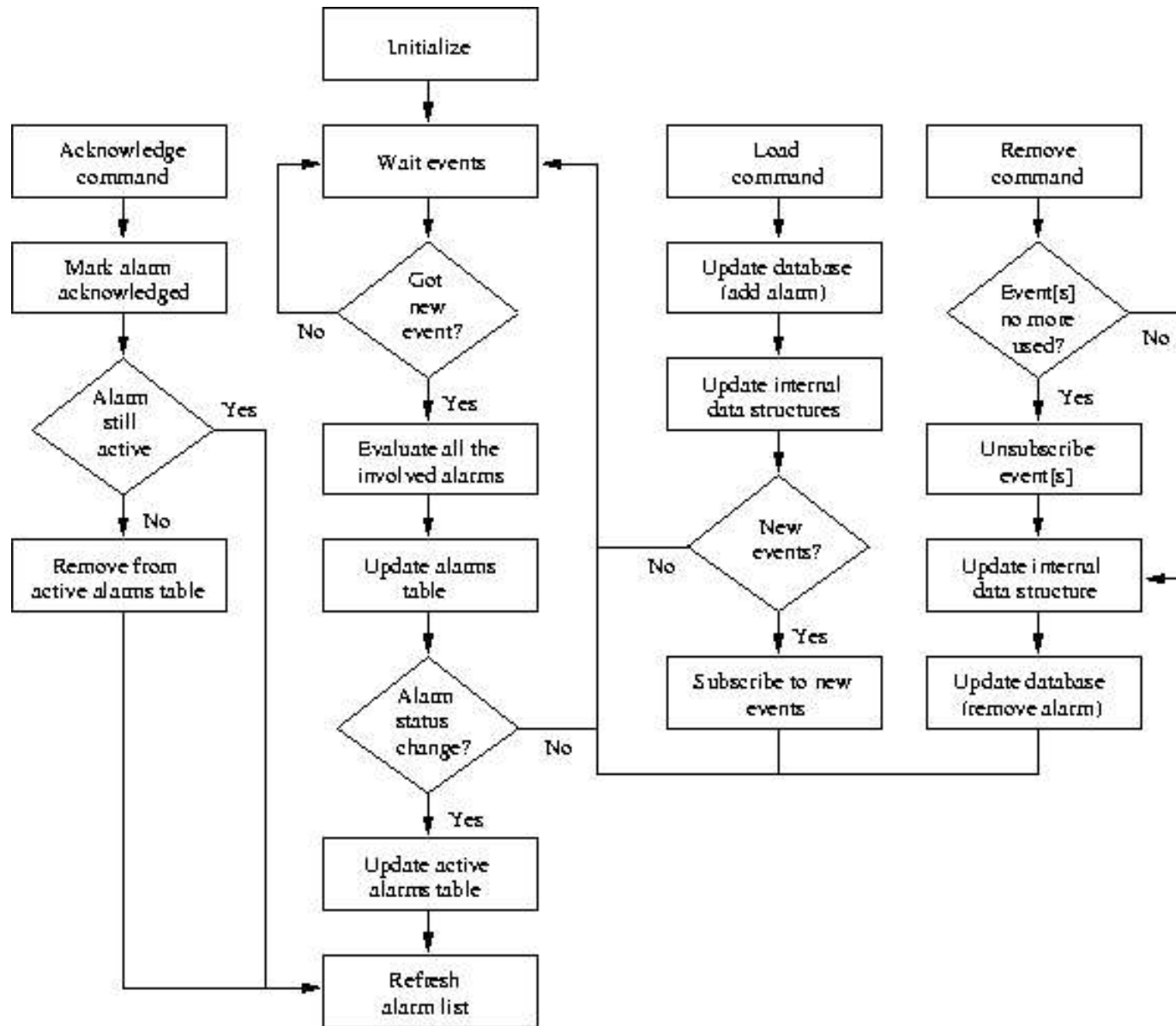
Scanner and parser

- The alarm formula evaluation is made at runtime by means of a lexical scanner and a parser
  - △ GNU Flex and Bison used to write the scanner and the parser
- The scanner is able to split each alarm formula into its basic tokens: operators, numbers and attributes
- Each token is assigned a unique value to be returned to the parser while scanning the formula
- The parser can apply to the operands the composing rules specified in its grammar and finally evaluate the whole formula

Alarm visualization

Courtesy V.Forchi'

Summary

- Proven to be flexible and quite easily configurable

- Support of digital and analog values

- Straightforward use of complex alarm formula

- Collection of input values transparently from any TANGO device server

- Centralized alarm management: consistent between multiple alarm clients

Conclusions

- An alarm system integrated into the TANGO control system framework has been proposed

- Successfully tested at ELETTRA

- Plans to adopt in the new booster control system

- But... young, thus availabile for improvements

  - wider TANGO events support
  - alarm hierarchy for selective visualization
  - ...