A SOFTWARE SUITE FOR THE RADIATION TOLERANT GIGA-BIT TRANSCEIVER SLOW CONTROL ADAPTER

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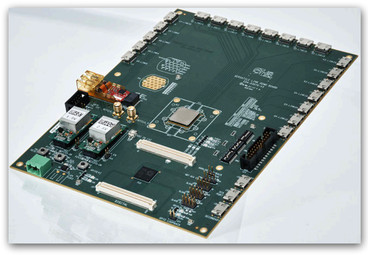
SCA SOFTWARE SUITE

WHAT IS IT?

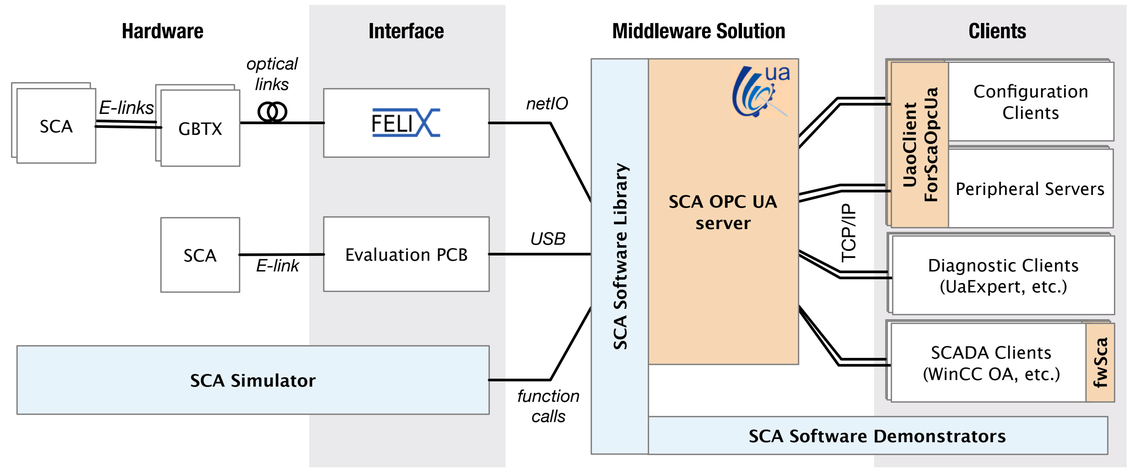
A comprehensive software solution for integrating the multi-purpose radiation tolerant GBT-SCA ASIC into data acquisition and detector control systems.



CONTAINS:

- The SCA Software package
  - SCA Software Library
  - SCA Simulator
  - Demonstrators
- The SCA OPC UA ecosystem
  - SCA OPC UA server
  - C++ client library for SCA OPC UA server
  - fwSca SCADA easy integration tool

Integration Overview of the SCA Software Suite



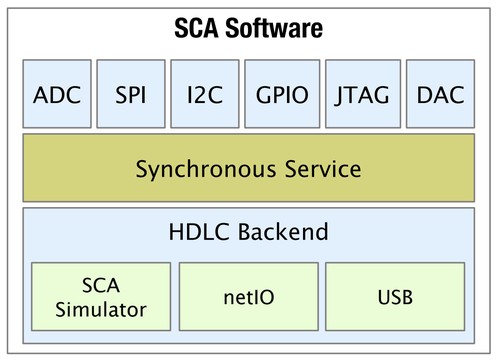
Global picture of the SCA usage scheme. The SCA Software package, in light blue, with its SCA Software API, the SCA Simulator, and the Demonstrators. The SCA OPC UA ecosystem, in orange, with its SCA OPC UA server, UaoClientForScaOpcUa library and fwSca.

SCA SOFTWARE PACKAGE

The architecture makes the solution suitable for large experimental physics control systems.

The software stack provides:

- concurrent usage by multiple applications
- emphasizes reliability, availability, scalability
- a high-level abstraction for all ASIC functions
- communication and design aspects of the hardware largely transparent



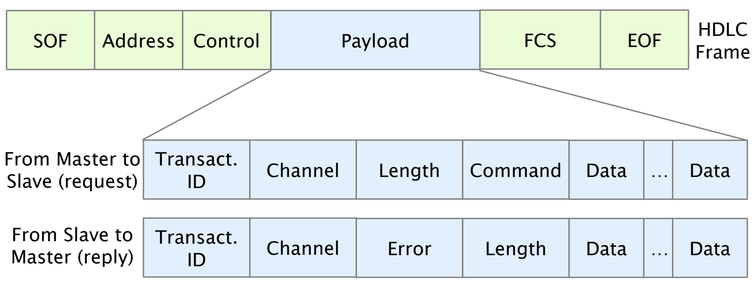
SOFTWARE MODULES

SCA API

- high-level abstraction library to control user interface ports and the configuration of the SCA
- used to perform complex operations e.g. SPI/I²C configuration of an ASIC or programming a Xilinx FPGA via JTAG etc with simple API calls.

HDLC Back-end

- abstraction of the back-end to be used independent of the actual SCA interface provider:
  - FELIX via netIO (interprocess communication)
  - SCA Simulator via function calls
  - SCA evaluation board via USB



Synchronous Service

- synchronization of multiple threads accessing the same SCA
- allows for full concurrency among SCA channels

Accompanying Demonstrators

- able to perform standalone operations like I2C write/read or ADC monitoring
- used for debugging and diagnostic tools
- as a template of the SCA API usage

\+ **SCA *Simulator***

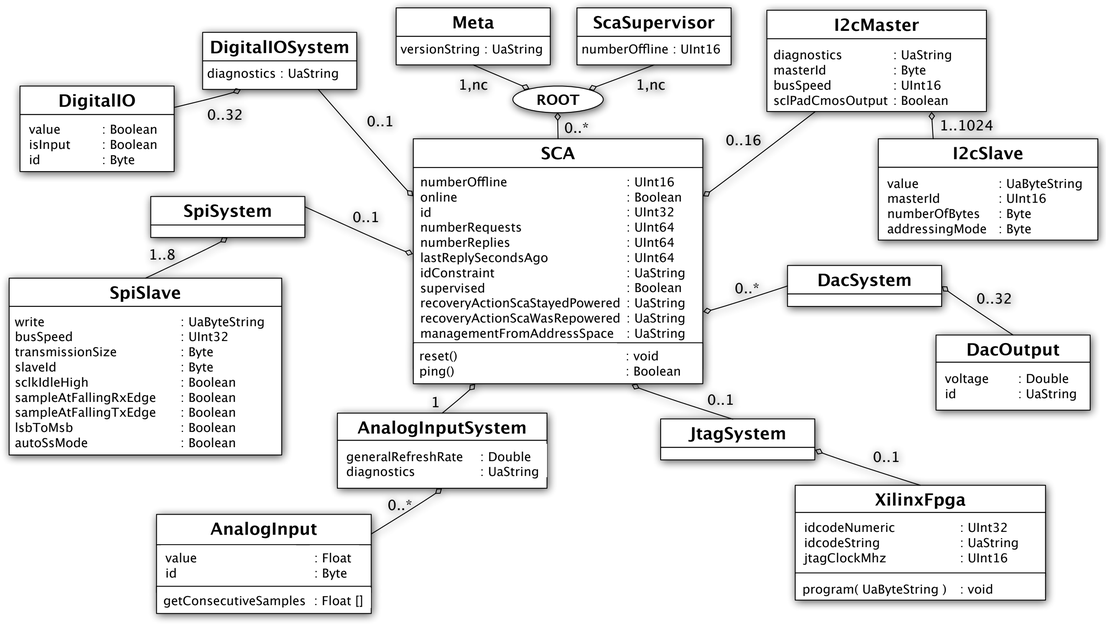
- generates SCA traffic, simulating realistic SCA behaviour
- allows for development and testing without real hardware

SCA OPC UA ECOSYSTEM

Ecosystem of middleware and client infrastructure components for SCA back-end integration, designed and implemented within the quasar framework.

SCA OPC UA Server

- divides the SCA channels into device classes, corresponding to the respective hardware function
- Global Statistician: collects and measure general statistics across the setup and to expose the collected metrics to the clients
- ScaSupervisor: oversees the state of the system and provides supervisory functionality such as automatic recovery of communication loss with SCAs

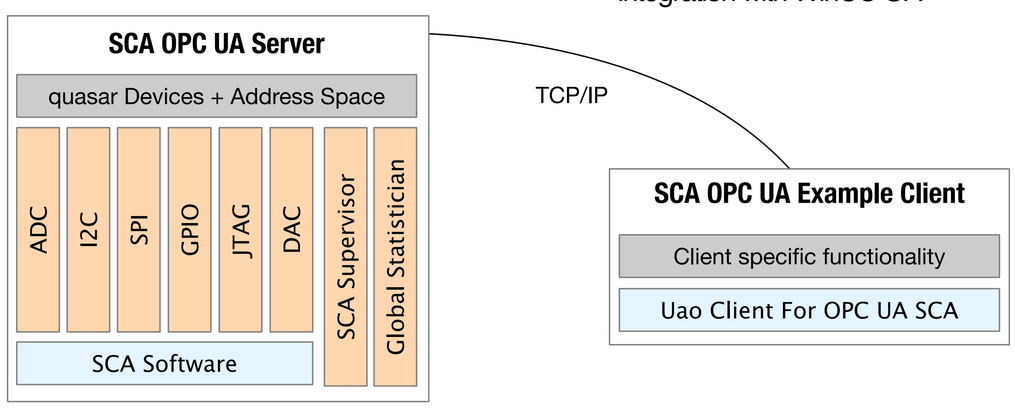


SCA OPC UA Clients

- New ATLAS sub-detector NSW Trigger/DAQ configuration clients
- Peripheral servers for calorimeter
- Diagnostic clients like UaExpert
- SCADA clients (WinCC OA etc.)

→ Based on the generated quasar UaO client library for SCA OPC UA server

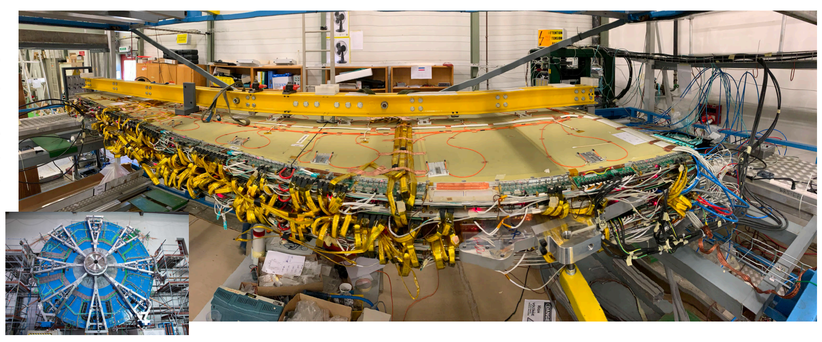
→ Supplied **fwSCA** tool for easy integration with WinCC OA



PERFORMANCE AND INTEGRATION

ATLAS NSW Sector Slice

Board Name	MMFE8	ADDC	L1DDC
Functionality	readout	trigger aggregator	data aggregator
SCA Numbers	128	16	16
ADC Inputs	15	10	9
Calculated variables	15	10	9
I²C Master	2	6	2
I²C Slave	44+60	6	2
SPI Slave	8	-	-
GPIO	19	18	-



Constant-throughput monitoring traffic

~7800 SCA requests/s

- Monitoring data from 2192 ADC inputs
- Refresh rate ~2Hz
- 4 OPC UA clients
- Average CPU usage 25% on a Xeon E5-1650v4

On-demand SCA traffic - Front-end Configuration

~35000 SCA requests/s

- Front-end configuration plus monitoring traffic
- 132 OPC UA clients
- Average CPU usage 218%

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