ATCA Shelf Manager Controls & Monitoring
Status of AtcaOpcUa server and Integration in DCS Applications

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Outline

- Intro: ATLAS ATCA DCS Scheme
- Plans set in 14 xTCA Interest Group Meeting
  - Progress on AtcaOpcUa Server
    - Integration with WinCC OA
    - Integration with ATLAS FSM
      - Use cases in ATLAS
  - Conclusions
Introduction

Diagram from S. Schlenker
DCS: Requirements Document for HL-LHC
EDMS Id: 2276493 v.1
ATLAS Off-Detector Electronics Based on ATCA

Legend:
- Hardware
- Software

ATCA shelf

SoC: FPGA
+ processor

FPGA

Custom ASICs, etc.

Configuration

OPC UA

Diagnostic

(TCP/IP or UDP
on ATCN or via private-ATCN gateway)

OPC UA server

IPMI via I2C

WinCC OA OPC-UA client

IPMC

Shelf Manager

SNMP

agent

Legend:
- OPC UA server
- SNMP
- WinCC OA OPC-UA client
- TCP/IP or UDP on ATCN or via private-ATCN gateway
- IPbus core
- TCP/IP or UDP on ATCN or via private-ATCN gateway

Diagram from S. Schlenker

DCS: Requirements Document for HL-LHC

EDMS Id: 2276493 v.1
14th xTCA Interest Group Meeting - Plans

- Plans from last year’s xTCA meeting:

- Automatize common deployment procedures
  - Including device discovery
  - Creation of the configuration file based on the discovered devices
- Expand device support and custom sensors to more sensor types
- Easy integration to WinCC OA with a dedicated framework component
  - fwAtca for ATCA OPC UA
AtcaOpcUa Server
Why combining ATCA with OPC UA?

- **OPC UA**
  - focuses on communicating with industrial equipment and systems for data collection and control
  - Open specification and various implementations available (free or commercial)
  - Cross-platform
  - Service-oriented architecture
  - Integral information model, which is the foundation of the infrastructure necessary for information integration where vendors and organizations can model their complex data into an OPC UA namespace

- **Current experience with OPC UA @CERN**
  - Works natively with the tools used in Detector Control Systems
  - ATLAS DCS and BE-ICS developed a framework, quasar, for developing OPC UA servers
  - It is the standard preferred by the “big” vendors (e.g. CAEN, ISEG, Weiner, etc.) for their power supply devices
  - It is used by various custom devices in experiments used widely at CERN (ELMB, SoC)
  - CERN foresees to have support and provide maintenance on those solutions on the long term through the quasar framework
AtcaOpcUa Server for ShM management

Basic Points

- A quasar OPC UA server for managing ATCA shelves via the **shelf manager path** based on the **SNMP** external interface to monitor/control activities using IPMI
- For “CERN-standard” **Pigeon Point** Shelf Managers (ShMM 500, ShMM 700R)
  - Compatible with **xTCA**
- The ATCA Software is **template**-based on the MIB and auto **generated** using Jinja2
- Provides automatic **hardware discovery** walking over the SNMP tree
  - Only existing entries are populated
  - Throttling traffic towards for specific sensor types
AtcaOpcUa
Traffic Handling Improvements

ATCAs that are highly populated by sensors/IPMC/boards can congest IPMB towards the shelf manager.

- ~O(100) of variables can be handled smoothly for individual shelves
- That is one of the reasons for the second path (SoC)

To ensure smooth traffic

- A survey has been conducted within ATLAS ATCA shelves users to prioritize data relevant to DCS monitoring over excessive information and based on the feedback from the community in-server polling groups were used to categorize sensors (and their variables) with different priorities
- Support for a selection of advanced variables was introduced
- The server, while supporting all basic variables, by default populates the DCS-important ones during automatic discovery
- Introduced support for TELCO alarms which can capture and inform of emergency situations
  - Automatic actions based on alarming events should be done within-shelf manager using Platform Event Filtering mechanism
SNMP module for OPC UA

- An **ongoing effort** to provide a generalized C++ module has been initiated by Central DCS team that can be reused for various **SNMP-based devices** requiring control and monitoring using **OPC UA** solutions
- This module is **based on the AtcaOpcUa** server software backend experience
- The main motivation is to provide a commonalized way of interfacing to
  - Phase-II upcoming **power supplies** that use standard SNMP
  - the **AC/DC power rectifier** systems for ATCA shelves that are foreseen to be procured by centrally by CERN. It is actually part of CERN requirements
- **Work-In-Progress** in collaboration with BE-ICS to ensure long term maintenance
AtcaOpcUa
Design Model Visualization
IPMC and sub-detector specific hardware

- Generic representation of IPMC and sensors following the hardware representation
  - Sensors “belong” to IPMCs
- Any IPMC that conforms with the standard can be monitored
  - The connected custom sensors are also monitorable using their IPMC address and sequence number
- A sophisticated mechanism that distinguishes in-between types of sensors was developed
  - temperatures, voltages, fans speed etc
  - sensor types enriched
  - mechanism to facilitate addition of ad-hoc types of sensors was introduced
- IPMC and sensors are automatically discovered and populated into the server
The AtcaOpcUa server in action
Integration with WinCC OA
WinCC OA and Integration Objectives

- **Standard** at CERN for Detector Control Systems
- Commercial and custom detector hardware is monitored and controlled through it
- It is the *interface* to the *shifter* in the control room
- Provides *interface to OPC UA servers* and integrates well with it

Objectives:

- ATCA shelves that use AtcaOpcUa should be *integrated* into the DCS
- Provide *monitoring* via WinCC OA UI
- Include *archiving* of *historical data* and *alarm* handling

Further ATLAS objectives:

- Integrate in *ATLAS FSM tree* structure
WinCC OA data availability
fwAtca

- WinCC OA integration is done by the **fwAtca** tool (uses fwQuasar)
- It creates datapoints for the discovered hardware based on the automatically created xml of the AtcaOpcUa server
- By default and optionally creates additional configuration for the datapoints including
  - Archiving
  - Alarms
  - Descriptions
WinCC OA data availability

- fwAtca provides a library with helper functionality intended for use in sub-detector DCS experts custom scripts
- Functionality to set alarm limits on sensors based on hardware defined thresholds (non-critical, critical, non recoverable)
  - Communication to the hardware is required

Information as exposed by the AtcaOpcUa server

WinCC OA Para Module

fwAtca tool UI
Integration with ATLAS FSM
Many sub-detectors with suchlike (CERN-standard) ATCA setups that need to integrate with ATLAS FSM

A common centralized way of generating the ATLAS FSM tree for all ATCA was chosen, allowing for custom user extensions

The motivation is to provide easy uniform monitoring (bottom to top state/status propagation)

To allow shifters have an overview with a nicely informative visual interface

The fwAtcaFsm tool automates the tedious development procedure by additionally

- Identifying the sub-detector it is deployed into
- Handling the FSM tree states during creation
- Creating the sub-detector specific ATCA FSM tree based on its discovered hardware
- Generate, Start, examine the FSM tree etc.
ATLAS FSM integration
fwAtcaFsm Usage

- Pleasant one-click operation
  - Literally <1 minute task
ATLAS FSM integration
fwAtcaFsm

- Pleasant one-click operation
  - Literally <1 minute task
  - Results to a fully functional ATLAS FSM ATCA project (tree+UIs)
ATLAS FSM integration
ATCA FSM API & accompanying functionality

- The fwAtcaFsm framework package exposes additionally an ATCA FSM API (WinCC OA library) with functionality to handle the flow of the procedure to create the tree
  - Sub-detectors developers can use this method to create custom scripts in order to integrate and extend with more complex solutions (integrate with information from other ATCA-related OPC UA servers)
- Comprises functionality for custom board information
  - Functionality that binds external-source information to board node status. The ATCA FSM API user provides relevant to blade datapoints in a sensitivity list which is taken into account for the calculation of the status of the node

  ```c
  fwAtcaFsm_addDpesToBoardStatus(string boardDp, dyn_string appendToSensitivitydpeList)
  ```
LAR ATCA integrated in ATLAS FSM

LAr panel from S. Chekulaev
STF L1Calo ATCA integrated in ATLAS FSM

Example in L1Calo, left fwAtcaFsm, right custom path for additional board information

L1Calo panel from P. Thompson
Use cases and applications
# Current AtcaOpcUa Use Cases in ATLAS

<table>
<thead>
<tr>
<th></th>
<th>ATCA Shelves</th>
<th>OPC UA ATCA Servers</th>
<th>fwAtca</th>
<th>fwAtcaFsm</th>
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<td>3</td>
<td>✓</td>
<td>✓</td>
<td>In integration sites and in development setup</td>
</tr>
</tbody>
</table>

Big effort with sub-detectors to facilitate deployment in their test setups. Thanks to P. Thompson and TDAQ team for providing their hardware.
Final Points

- The ATCA software ecosystem has made progress and fulfilled the required functionality
- An automatic discovery mechanism was introduced, covering standard and custom variables and sensors
- The performance has been improved taking into account users DCS-needs
- A set of tools for easy integration in WinCC OA complementing the controls ecosystem
  - Including archiving and alarm handling
- An extra set of tools for easy integration in ATLAS FSM has been introduced
  - One-click from datapoints to tree
- The software gained mileage in various sub-detectors ATCA setups including 2 LAr ATCA in P1

Thank you!
AtcaOpcUa server and WinCC OA integration references

- General interest group for OPC UA (releases, news, feedback etc)
  - opc-ua-atca

- Main project page
  - https://gitlab.cern.ch/atlas-dcs-opcua-servers/AtcaOpcUa/-/releases
  - Suggested v. 0.9.1

- fwAtca - WinCC OA integration for AtcaOpcUa
  - https://gitlab.cern.ch/atlas-dcs-fwcomponents/fwAtca
  - Suggested v. 8.4.2

- fwAtcaFsm - ATLAS FSM integration
  - https://gitlab.cern.ch/atlas-dcs-fwcomponents/fwAtcaFsm
  - Suggested v. 8.4.2

Thank you!
Backup