Upgrading TriDAS for the 8 towers of KM3NeT-Italy

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## From NEMO to KM3NeT-Italy

<table>
<thead>
<tr>
<th>NEMO Phase 2</th>
<th>KM3NeT-Italy Phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 4 PMTs per floor</td>
<td>• 6 PMTs per floor</td>
</tr>
<tr>
<td>• 8 floors per tower</td>
<td>• 14 floors per tower</td>
</tr>
<tr>
<td>• 1 tower</td>
<td>• 8 towers</td>
</tr>
<tr>
<td>• Total: 32 PMTs</td>
<td>• Total: 672 PMTs</td>
</tr>
<tr>
<td>• Relative time of data</td>
<td>• Absolute time of data</td>
</tr>
<tr>
<td>(it wraps every 10 days)</td>
<td>(it wraps every 30 years)</td>
</tr>
<tr>
<td>• Old format of header of</td>
<td>• New format of header of</td>
</tr>
<tr>
<td>dataframes</td>
<td>dataframes</td>
</tr>
</tbody>
</table>
Global Overview

- Database
- Database Interface
- FCM server
- from offshore
- Data Manager
- Control GUI
- TSC
- TSV
- HM
- TCPU
- EM
- TriDAS core
- TriDAS

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TriDAS Functionality

$\Delta T$ event

$\sim O(1 \, \mu s)$

$\mu$

$\Delta T$ 200 ms

HM: handle subsequent data from a fraction of the detector

TCPU: process data from the full detector for a slice of time (i.e. the TimeSlice)

EM: collect from all the TCPU$s$ the selected events

HM$^0$, HM$^1$, HM$^2$, HM$^3$, HM$^4$

TCPU$^i$ with TS$_i$

TCPU$^{i+1}$ with TS$_{i+1}$

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Tools and libraries (1)

- Git is a distributed revision control system with an emphasis on speed, data integrity and support for distributed and non-linear workflows. Bitbucket is a web-based hosting service for projects that use either the Mercurial or Git revision control systems.

- Jenkins is an open source software written in Java providing continuous integration services for software development. Builds can be started by various means, including being triggered by commit in a version control system, scheduling via a cron-like mechanism, building when other builds have completed, and by requesting a specific build URL.

- JIRA is a proprietary issue tracking product, developed by Atlassian and written in Java. It provides bug tracking, issue tracking, and project management functions.
Tools and libraries (2)

- Boost is a set of libraries for the C++ programming language that provide support for a wide range of tasks and structures. Many of Boost's founders are on the C++ standards committee, and several Boost libraries have been accepted for incorporation into the C++11 standard.

- ØMQ is a high-performance asynchronous messaging library aimed at use in scalable distributed or concurrent applications. It provides a message queue and a ØMQ system can run without a dedicated message broker. The library is designed to have a familiar socket-style API.

- CMake is cross-platform free and open-source software for managing the build process of software using a compiler-independent method. It is designed to support directory hierarchies and applications that depend on multiple libraries. It is used in conjunction with native build environments such as make.

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FCMServer + HM

- FCMServers represent the first step of data aggregation. Each FCMServer is designed to receive data from 4 floors connected to the 4 optical channels of the Terasic board (see presentation of Andrea Biagioni). The FCMServer processes arriving data sending them to one HM via TCP/IP sockets.

- The HMs receive a continuous flow of data from a number of FCMServers. They read headers in real time and split up data in temporal intervals called TimeSlices (200 ms for each interval, tunable), creating the so called SectorTimeSlices (STSs). Finally each HM sends the STSs to the TCPUs.
Each TCPU receives STSs from the HMs and assembles them together in order to create a TotalTimeSlice (TTS), a structure that contains acquired data from the whole distributed detector in a specific time interval.

The split up of data in temporal intervals allows to analyze a TTS in a time greater than duration of the interval, increasing the number of TCPUs in order to observe the formula:

\[ \Delta T_{\text{acquisition TTS}} < \Delta T_{\text{analysis TTS}} / \text{n. of TCPU} \]

Once that a TTS has been analyzed, each TCPU sends to the EM the events identified by trigger algorithms. Finally the EM takes care of storing the events into structures called “Post Trigger Files”.

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Each TimeSlice has a unique ID that represents the time of acquired data.

TSV takes care of communicating to HMs which STSs have to be sent to which TCPUs.

Each HM keeps in memory last N acquired STSs (5-10 minutes of data), either they are sent to TCPUs or not. This is fundamental for handling GRB (Gamma Ray Burst) alerts and generic external triggers.
TriDAS Test Bench (at Bologna)
Other relevant activities

- Use TriDAS for Offline Trigger applications (see presentation of Luigi Antonio Fusco)

- Performed bandwidth tests on 10Gb switches (at Bologna with Andrea Paolucci)

- Checked FCMServer 10Gb network cards with p2p links and iperf (at Portopalo with Matteo Favaro)

Thank you!