Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation

Report

Centralised accelerometric station book
Definition for a web interface for viewing and updating accelerometric station metadata

Activity: Networking accelerometric networks and SM data users
Activity number: NA3, Task3.2

Deliverable: Guidelines for station and instrument response database integration, station metadata update tool
Deliverable number: D3.2
Reporting date: November 12th, 2012

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Seventh Framework Programme
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Foreword

This document presents the status of the accelerometric stationbook developments at the date of reporting in November 2012. Significant changes took place afterwards, particularly with the creation of the Orfeus new working group WG5 on “Acceleration and Strong Motion Data” and the set up of close coordination with WG1 “Observatory coordination of broadband data acquisition and data exchange”. An updated version of this deliverable (D3.2) will be issued for the NERA 3rd annual meeting (November 2013) to reflect the new developments.

Summary

Accelerometric networks in the Euro-Med region started to coordinate their effort to set up a unique and common access to accelerometric data. Within the NERA project, the main objectives of the work package NA3 are

1. to improve accelerometric data exchange in Europe after a major seismic event in Europe, providing useful and immediate information on the severity of the shaking (RRSM)
2. to build an European accelerometric database for earthquake engineering and engineering seismology activities (ESM)

While those two databases serve different communities, the mechanisms to access, view and retrieve them should be similar, using the same front end. Both systems share unique stations description. It is important, at this early stage, to set up a reliable and sustainable station book. The experience from the broadband and short period station international registries provides useful insight. Additionally, collaboration with other initiatives is necessary to define a unique reference tool.

Seismic station information are well described and spread in the community using the FDSN (International Federation of Digital Seismograph Networks; www.fdsn.org ) format dataless SEED. However, strong motion stations require several fields which are not defined. A complete description of the necessary station metadata is provided in this document.

The EMSC is in charge within the NERA-NA3 group to establish the station book, in collaboration with ORFEUS, ETH, INGV and ISTerre. This report presents the content, access and updating procedure which will be developed to describe station information. The tool that will be implemented for maintaining the accelerometric station information includes remote access to SEED station information for RRSM and ESM data, updating, maintaining and accessing to non-SEED station information for RRSM and ESM data.
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I. Introduction

The major objective of NERA-NA3 is to propose a living database infrastructure that is capable of bridging European Strong Motion (ESM) and Rapid Raw Strong Motion (RRSM) databases of Europe.

Accelerometric data are one of the primary sources of information used by the engineering seismology and earthquake engineering communities to evaluate the ground motion responsible for seismic damage. It is used to calibrate national building codes, to calculate earthquake scenarios and to define early-warning systems, shake maps or rapid damage evaluation scenarios.

The number and quality of strong-motion stations in Europe is increasing rapidly. New generation instruments can record weak-to-strong motions using real-time data transmission. Further, instruments are deployed both in the free-field and in many other engineered structures to investigate their response. 4 years ago, during the NERIES project, about 3,800 accelerometric stations were identified in the Euro-Med region (from Iceland to Oman).

In view of this large and increasing number of accelerometric stations, it is important to develop the tools to collect, update and archive their description. The information can range from basic details such as location and names to acquisition chain description, morphology of the installation site or velocity profiles.

The task 3.2 focuses on the development of an online interface to update and integrate new stations. It requires the definition of a dedicated database following specific formats and contents. This database should be synchronized with the accelerometric data exchange defined in NA3, namely RRSM and ESM.

The general schemes to archive and access strong motion data for the RRSM and the ESM are described in the deliverable D3.1. Within this general infrastructure, the NA3 accelerometric station book aims at creating a reference registry useful at an international level. The description of the station book developments is provided in agreement with the developments of the ESM and RRSM.

The aim of this specific task of NA3 is to set up a unique and reliable international registry of strong motion stations. Such a registry does not exist so far and has an important role to serve the accelerometric data community, seismologists and engineers. This registry should provide a simple and accepted interface to view and update accelerometric station metadata. This interface will be accessible through the seismic portal (www.seismicportal.eu) as well as through the EMSC web page, ensuring a wide audience.

The target public is two-sided. Anyone interested in accelerometric station information will have access to the interface for viewing these information. However, restricted access will be given to network operators to update the information available in the database.

The EMSC and ODC (ORFEUS Data Center) are in charge of the technical developments and maintenance of the database and interface while the station information contained in the database is under the responsibility of each network operator.
This report presents the database content and architecture foreseen to be implemented. A second deliverable is due in month 40 to present the compilation of the data which will be included in the database.

II. Infrastructure

a. General architecture

The architecture imagined for the stationbook implementation is supported by infrastructures already existing. SeisComP3 is a central part of the RRSM data exchange and already provides station information as described in the station inventory which correspond to the dataless SEED. The information available concern primarily the instrumentation (instrument responses, instrument coordinates, sampling rate, etc), which are common to both strong motion and broad band stations and the base for inventory XML or SC3 data model. An additional module has been developed by Gempa/ETH to compute accelerometric parameters as soon as waveforms are available within the EIDA nodes. In parallel, ETH developed an extended database to include information on stations and sites.

The station book web interface is developed by the EMSC, while the database containing the station metadata will be primarily hosted at ODC. According to technical requirements, it will be decided between two possibilities. The database
can be deployed in both institutes. The contents of both instances are synchronized using messaging systems. Alternatively, one single database can be created at ODC and the web interface will interact directly with it using adequate protocols. As the interface is developed by the EMSC, the first option is more practical and is presented in the following sections.

The Strong Motion inventory database (SMinventory) at the EMSC is related to:
- The interactive station book website for viewing and updating
- The Strong Motion inventory database (SMinventory) at ODC for synchronization
  - Pushed by ODC for inventory information (SEED)
  - Pushed by the EMSC for station and site characterizations
- The Strong Motion inventory database necessary for ESM whose procedures will be defined

The Strong Motion inventory database (SMinventory) at ODC is updated by synchronization from the EIDA nodes for inventory information (SEED)

The database model is developed by ETH and is linked to the SeisComP3 model. It includes three main tables which are detailed in section III.
- Inventory information: embedded information in SeisComP3 model (dataless SEED information)
- Station characterization
- Site characterization

Figure 2: Architecture defined for the accelerometric station book access and population
b. Synchronisation method

The metadata stored in the database at the EMSC should be synchronized with the database at ODC. Seed information should be pushed from ODC to the EMSC. Non-Seed information should be pushed from the EMSC to ODC. We propose to use inventoryXML file transfer between both institutes using messaging tools, such as rabbitMQ. It implies opening specific communication ports between both institutes.

III. Content
   a. Metadata

The metadata related to accelerometric stations are separated into three different tables.
1. The first one is identical to the station inventory as embedded into SeisComP3. It contains core station information, as reported in dataless SEED. Those information are not specific to accelerometric stations and can also describe broad band stations.
2. The second table corresponds to the site characterization. It describes the geophysical information available for the implantation site of a station.
3. The last table is the station characterization in terms of ownership or related information, such as photos, monography.
b. Station inventory

An implementation of a station metadata scheme is available from SeisComP3 / Arclink as inventoryXML, documentation is available at http://geofon.gfz-potsdam.de/_uml/ . It covers sites, instruments, response, deployments, configuration while the site and station description are not available, nor the ownership. Currently, only one owner can be assigned. This drawback should be clarified later.
Figure 5: UML scheme of station inventory as described within SeisComP3 database model

c. Site characterization

The information gathered in the site characterization tables cover:
- Geophysical description of the site
- Geophysical site analysis type (borehole, noise array, H/V, active seismics, scp, cpt analysis results, etc)
- Output of the site analysis (dispersion curves, traveltime velocity, vs30)

d. Station characterization

The information gathered in the station characterization tables cover:
- Geological context
- Station housing
- References to site characterization results
- Geomorphology
- Documentation (photos, reports)
- Ownership
The site and station characterization tables are under developments at ETH. Accordingly, the present document will be updated when the specifications are available at the end of 2013. It should contain the following information:

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<tr>
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### IV. Viewing interface

#### a. Access and location

Any user can access the viewing interface. It will be reached through the Seismic portal ([www.seismicportal.eu](http://www.seismicportal.eu)) and will be linked from the EMSC and ORFEUS.

#### b. Design

Station information will be viewed online via
- An interactive map
- A list of stations
- A description page for each station
The station dedicated page will be developed using the Geoscope interface as model: http://geoscope.ipgp.fr/scripts/stations/fiche.php?sta=ATD&id=186

In the duration of the NERA project, we will focus on the following information:

- A general description of the station: network, location, code
- Acquisition description: sensor and digitizer
- Site description: photos, morphology

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**Figure 6:** Snapshot of the Geoscope viewing interface to be used as model for the NA3 station book interface

It will be kept in mind that the developments made for the accelerometric stations may be useful in the future for broadband stations. The NA3 developments will be discussed with the working group 1 of ORFEUS defining the registry of broadband (BB) seismograph stations in the European-Mediterranean area (http://www.orfeus-eu.org/WorkingGroups/wg1.html).

**c. Output**

The information available in the stationbook database will be mostly accessible and viewed online. However, they may also be extracted as inventoryXML. Several tools for conversion into more common formats are already available, for example conversion into dataless SEED in python (obspy.xseed).
V. Updating interface

The interface will also allow the update and creation of station information. The access to the updating tool will be restricted in terms of users and of metadata.

a. Registration

Only network operators will have access to the updating interface. One contact person should be defined for each network. A list of network operating accelerometric stations will be created for the Euro-Med region, as is available at ORFEUS for seismograph stations: http://www.orfeus-eu.org/Links/euromed.html

The contact person will be responsible for the use of the administrator login and password assigned to the network.

b. Accessible metadata

Updates of station metadata update are limited to
- RRSM stations: station characterization and site characterization. All other information will be updated through the EIDA nodes.
- ESM stations: all station information
- Other stations: all station information

For the creation of a new station, three different levels of information will be defined.
- Compulsory (beginner) level: basic information necessary for an accurate review of the existing accelerometric stations. It includes: latitude, longitude, altitude, station code, network code.
- Data exchange (intermediate) level: information necessary for a RRSM or ESM data exchange. It includes all information of the inventory database, equivalent to a dataless SEED file. All those fields are required.
- Complete (advanced) level: information on vault, site, etc as described in station and site characterization. Any of the fields can be filled.

c. Conventions and restrictions

The fields of the database will be modified using drop down menus as much as possible. This will avoid mistakes and multiple spelling for the same element. It implies the creation of accurate lists of possible choices for several fields of the database. Those lists will be compiled by the NA3 group. Lists for sensors and digitizers are available in Annex C.

Networks should have or should request a FDSN code to join the data exchange. http://www.fdsn.org/forms/netcode_request.htm

**Code of the NA3 network participants:**
- CH: Swiss national network
- RA: French strong motion network
- FR: French broadband network and co-located strong motion
- IV: INGV Italian national network
- IT: DPC Italian civil protection
- ???: Turkish strong motion network
The two letters code assigned is necessary to generate SEED volumes and incorporate raw waveformd data into RRSM.

Station codes are recommended to be registered to the International registry maintained by ISC and NEIC at ISC. http://www.isc.ac.uk/registries/. Each station code should be unique within the deployment, following the IASPEI recommendations. The station code should be of length of 3 to 5 letters.

The station book updating interface will not allow modifications of SEED metadata (inventory information) from EIDA stations. Such changes must be inserted in EIDA after which it is synchronised in the NA3dB.

d. Design

The ITACA web page has a station information updating interface that will be used as model for the NA3 station book developments. http://itaca.mi.ingv.it/ItacaNet/

Figure 7: Extract of the ITACA update tool for station information
VI. Data collection

a. Initial population

The population of the database will start with the stations operated by the networks involved in NA3

<table>
<thead>
<tr>
<th>Responsible institute</th>
<th>ISTerre</th>
<th>ISTerre (Data collected during the NERIES project)</th>
<th>INGV</th>
<th>METU</th>
<th>ETH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of strong motion stations available</td>
<td>266</td>
<td>103</td>
<td>120 INGV 400DPC</td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>Stations eligible for rapid data exchange (RRSM):</td>
<td></td>
<td></td>
<td>120 INGV</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Already in EIDA</td>
<td>87</td>
<td></td>
<td>120 INGV</td>
<td></td>
<td>116 (65 real time)</td>
</tr>
<tr>
<td>To be integrated in EIDA</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Stations eligible for validated data exchange (ESM)</td>
<td>169</td>
<td>all</td>
<td>all</td>
<td>335?</td>
<td>all</td>
</tr>
</tbody>
</table>

b. Future population

The process for the network operator to include or update station information will follow different schemes

- Stations to integrate the RRSM data exchange:
  - Dataless SEED information will be uploaded through the EIDA nodes and synchronized using ArcLink, the requirements will be described by ODC (those information are compulsory)
  - Site and station characterization will be done via the web interface

- Stations to integrate the ESM data exchange
  - Dataless SEED information will be uploaded via the web interface (those information are compulsory)
  - Site and station characterization will be performed via the web interface

- Other stations
  - Dataless SEED information will be uploaded via the web interface
  - Site and station characterization will be performed via the web interface

In the future, we may define alternative ways to populate the database, in particular for a large set of stations. It could rely on the use of dataless SEED volumes.

All information will be under the responsibility of the network operators. ODC and the EMSC do not have the scientific expertise to control the complete content of the database. It may be necessary to define a validation procedure
for all information included. However this is beyond the scope of the current project.

If time and resources allow, effort will be done regarding the data that were accessible within the NERIES framework: those data (and metadata) will possibly be integrated to the ORFEUS EIDA node by ISTerre. They contain:

TS : institute of engineering and earthquake Greece : 107 station, 25 events
IST : instituto superior tecnico, Portugal : 39 stations, 27 events
IGC : institut geologic de catalunya, Spain : 10 stations, 22 events

Stations for which no SEED metadata are available will be only available in the RRSM DB @ the EMSC and will not be synchronised with the RRSM DB @ ODC

VII. Activity meetings

<table>
<thead>
<tr>
<th>Date</th>
<th>Meeting description</th>
<th>Location</th>
<th>Attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 october 2012</td>
<td>Technical Meeting on stationbook</td>
<td>Zürich</td>
<td>EMSC, ISTerre, ODC, ETH, INGV</td>
</tr>
<tr>
<td>13 september 2011</td>
<td>Technical Meeting</td>
<td>Zürich</td>
<td>All NA3 participants</td>
</tr>
<tr>
<td>23 june 2011</td>
<td>Technical meeting</td>
<td>Paris</td>
<td>All NA3 participants</td>
</tr>
<tr>
<td>19 january 2011</td>
<td>Technical Meeting</td>
<td>Zürich</td>
<td>All NA3 participants</td>
</tr>
</tbody>
</table>

VIII. Next actions

The SeisComP3 extended data model has been provided by ETH, it contains the additional station information and event information necessary for the RRSM data exchange. ODC is implementing this instance.

The site and station characterization tables are being finalized by ETH and will also be implemented at ODC and the EMSC. A review for the ESM information may be realized to ensure the creation of a unique and complete database.

The best scenario for the station inventory database implementation is being decided. It includes the location and/or duplication of the database at EMSC and ODC, the communication and synchronisation protocols and the database management system to be used.

The web interface to view and update the station inventory will be developed by the EMSC and will be validated by the NA3 group.
IX. Conclusions

The stationbook developed with NA3 will provide a unique access to accelerometric station information online. Its implementation and maintenance will allow the creation of a repository useful for all the seismological and engineering community. Maintained technically by EMSC and ODC, it should grow rapidly towards an international registry.
Appendix A: current initiatives for station and network inventories

**Broad band station registry:**

ORFEUS WP1 has launched an initiative to create a Central database of broadband seismic stations in the European-Mediterranean region. This database will contain detailed instrumentation information. The interface is in developments:
http://silo.ig.cas.cz/stationsdb/stationsdb_index.php

**Seismic station registry:**

The ISC in conjunction with the NEIC is responsible for running the International Registry (IR) of Seismograph Stations. This registry is well established and contains limited information (no instrumentation details) for almost 20,000 stations. http://www.isc.ac.uk/registries/

**Network registry:**

The International Federation of Digital Seismograph Networks (FDSN) maintains a list of unique network codes for data providers.
http://www.fdsn.org/station_book/

Appendix B: current list of sensors and digitizers

Sensors currently identified
Kinemetrics FBA1
Kinemetrics FBA3
Kinemetrics FBA11
Kinemetrics FBA13
Kinemetrics FBA13DH
Kinemetrics FBA23
Kinemetrics FBA23DH
Kinemetrics FBAEST
Kinematics QDR
Kinematics Episensor
Kinematics Episensor ES-U
Sprengnether FBX-23
Sprengnether FBX-26
Syscom MS2002
Sig-geophon SM2
Terratech SSA120
Terratech SSA220
Terratech SSA320
Wilcoxon 731A
Guralp CMG5T
Guralp CMG5HP
Guralp CMG5
Geosig AC23
Geosig AC53
Digitizers currently identified

Geosig
- AC63
- GSR18
- GSR24
- GSR12
- GSR16
- SMACH12_EPOCH
- SMACH12_CH
- SMACH16
- IDS
- DM24-MK2
- HDR24
- TAURUS
- TRIDENT
- MR2002
- 3CS5321_22
- 3FCS5321_22
- 3NTCS5321_22
- 3NTCS5323_22
- 6CS5321_22
- 6NTCS5321_22
- 6NTCS5323_22
- 3CS5323_22
- 3FC5323_22
- M3XTH17190
- DR-100
- DR-200
- DR-300
- DR-3016
- DR-3024
- DCA-300
- DCA-310
- DCA-333
- IDS-3602
- IDS-3602A
- A700
- A800
- A900
- A900A
- Q330 series
- Q4120
- Q4128a
- Q730
- Q736

Kinematics
- ETNA
- Basalt
- QDR
- K2
- MTWHITNEY
- EVEREST
- SSA-1
- SSA-2
- SSA-16
- SSR-1
- DSA-1
- DSA-3
- PDR-1
- PDR-2
- GSR18
- GSR24
- GSR12
- GSR16
- SMACH12_EPOCH
- SMACH12_CH
- SMACH16
- IDS
- DM24-MK2
- HDR24
- TAURUS
- TRIDENT
- MR2002
- 3CS5321_22
- 3FCS5321_22
- 3NTCS5321_22
- 3NTCS5323_22
- 6CS5321_22
- 6NTCS5321_22
- 6NTCS5323_22
- 3CS5323_22
- 3FC5323_22
- M3XTH17190
- DR-100
- DR-200
- DR-300
- DR-3016
- DR-3024
- DCA-300
- DCA-310
- DCA-333
- IDS-3602
- IDS-3602A
- A700
- A800
- A900
- A900A
- Q330 series
- Q4120
- Q4128a
- Q730
- Q736
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quanterra</td>
<td>Q980</td>
</tr>
<tr>
<td>Reftek</td>
<td>72A</td>
</tr>
<tr>
<td>Analog</td>
<td></td>
</tr>
<tr>
<td>USC&amp;GS</td>
<td>C&amp;GS-Standard</td>
</tr>
<tr>
<td>Teledyne</td>
<td>AR-240</td>
</tr>
<tr>
<td>Teledyne</td>
<td>RFT-250</td>
</tr>
<tr>
<td>Teledyne</td>
<td>RFT-350</td>
</tr>
<tr>
<td>Kinematics</td>
<td>SMA-1</td>
</tr>
<tr>
<td>Kinematics</td>
<td>SMA-2</td>
</tr>
<tr>
<td>Kinematics</td>
<td>SMA-3</td>
</tr>
<tr>
<td>Kinematics</td>
<td>CRA-1</td>
</tr>
</tbody>
</table>