



JOINT SYSTEM FOR PROCESSING OF SEISMIC INFORMATION

ANNUAL REPORT

Dr. Hofstetter A., Polozov A.

**Prepared
The Ministry of Energy and Water Resources**

December, 2012

**Report No ES-13-2012
GII Report 571/702/12**

STATE OF ISRAEL
THE MINISTRY OF ENERGY AND WATER RESOURCES
OFFICE OF THE CHIEF SCIENTIST

מדינת ישראל
משרד האנרגיה והמים
לשכת המדען הראשי

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INFORMATION**

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תקציר

הדרישה המדעית ל"בחינה ושיפור מתמיד" של תהליך איסוף ועיבוד הנתונים הסיסמולוגיים הנה הבסיס המדעי למחקר הנוכחי.

המכון הגיאופיזי לישראל (מג"י) משתמש, נכון להיום, במערכות עיבוד נתונים הבאות: JSTAR, SEISCOMP3, AUTOLOC. שלושת המערכות הנ"ל הינן עצמאיות ונותנות פתרונות בלתי תלויים: SEISCOMP3 - הינה מערכת "מושלמת" יחסית לאחרות בכל הקשור ל" תצוגת תוצאות סופיות": ממשקים גרפיים בזמן אמת, בניית מפות, מערכת התראה וכד'.

AUTOLOC - כוללת שיטות מתקדמות של קריאת נתונים ואיכון. היכולת שלה בנושאים הנ"ל (קריאת נתונים ואיכון) טובה מהיכולת של מערכת SEISCOMP3.

יתרונה של מערכת JSTAR בכך שבה מיושמות שיטות שפותחו באופן עצמאי במג"י (בדומה, ל"פיתוחים עצמאיים" במרכזים אחרים בעולם).

המחקר הנוכחי אמור "לבנות" מערכת חדשה שתאחד את היתרונות היחסיים של כל אחת משלושת המערכות הקיימות. המערכת החדשה תכלול מודולים חשובים ביותר, כגון: מפות סיכון סייסמי (עקומות ניחות המבוטאות בצורת "יחסי תאוצה-מרחק"), ומנגנון.

Abstract

This initiative follows the common approach adopted for improvement of data acquisition and data-processing in seismology. Practically all agencies have their own solutions which are incorporated in some standard well-known systems. In GII now we have several separate systems for processing of seismic signals: JSTAR, AUTOLOC and SEISCOMP3. These systems are separate and provide independent solutions. The SEISCOMP3 is the most complete in the sense of the final results presentation: graphical real-time interface, building of maps, giving alarms etc. The AUTOLOC includes advanced methods of picking and location outperforming those of SEISCOMP3. The JSTAR has an advantage of realization of processing methods adopted in GII. We suggest to create a new system which will unify the advantageous features of each of the systems and satisfy requirements of GII. The new system will have an opportunity for adding such important modules, as Hazard maps and focal mechanism. As the result we shall get the more reliable and flexible system which will essentially improve quality of data acquisition and processing

Introduction

In GII the trigger-based method of data-processing is accepted and realized in JSTAR program. Last time in parallel to the manual data processing of JSTAR there is autolocation processing provided by the AUTOLOC program. Both of these systems include advanced data-processing methods, however, they are lacking behind in what and how should be presented in modern seismic bulletin. On contrary the idea of SEISCOMP3 was issuing tsunami bulletins in real-time and it includes many of modern requirements, such as station state-of-health, station map, epicenter parameter map, wave propagation map, residuals graph, voice alarm and SMS alarm. On the other hand SEISCOMP3 allows inclusion of external modules such as autopicking, autolocation, parameter-estimation, etc. Particularly, there is an option to include such modules as: 1) focal mechanism representation, 2) hazard maps 3) intensity maps and real-time INTERNET publications, which will be realized in the project. The work is split in two stages and will be fulfilled during 2 years. At the first stage we planned to build the prototype system; on the second we shall accumulate and systematize data obtained by the new system.

Stage 1. Creation of the system prototype

At this stage we have built SEISCOMP3 interface for the existing GII modules in trigger-based processing mode. The flow-chart of the system which has been created at this stage and will remain during the whole project is shown in Figure 1.

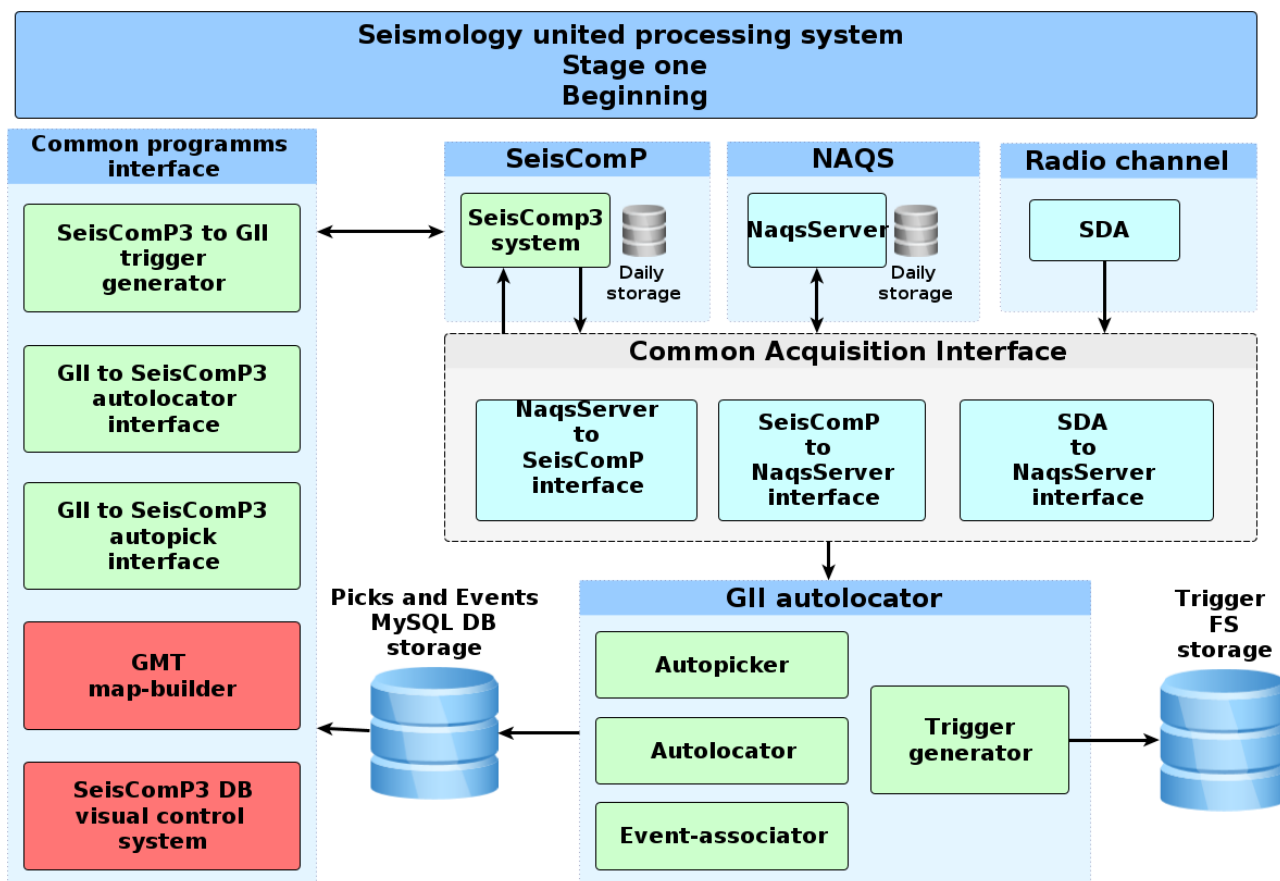


Figure 1. The block diagram of the joint system for processing seismological information

Modules depicted in Figure 1. are described below:

1. Modules created and tested (green):

1.1. Common program interface

Common program interface consists of the following modules:

- GII to SeisComp3 auto-picker interface,
- GII to SeisComp3 auto-location interface,
- SeisComp3 to GII trigger generator

1.2. GII Autolocator

GII Autolocator module consists of autopicker, autolocator, event-associator.

1.3 Picks and Events Database

It is instrument for transferring picks and events from GII to SEISCOMP3. It is a special module for trigger system.

2. Modules to be created (red)

GMT map-builder module,

DB visual control module.

3. GII to SeisComp3 auto-picker interface

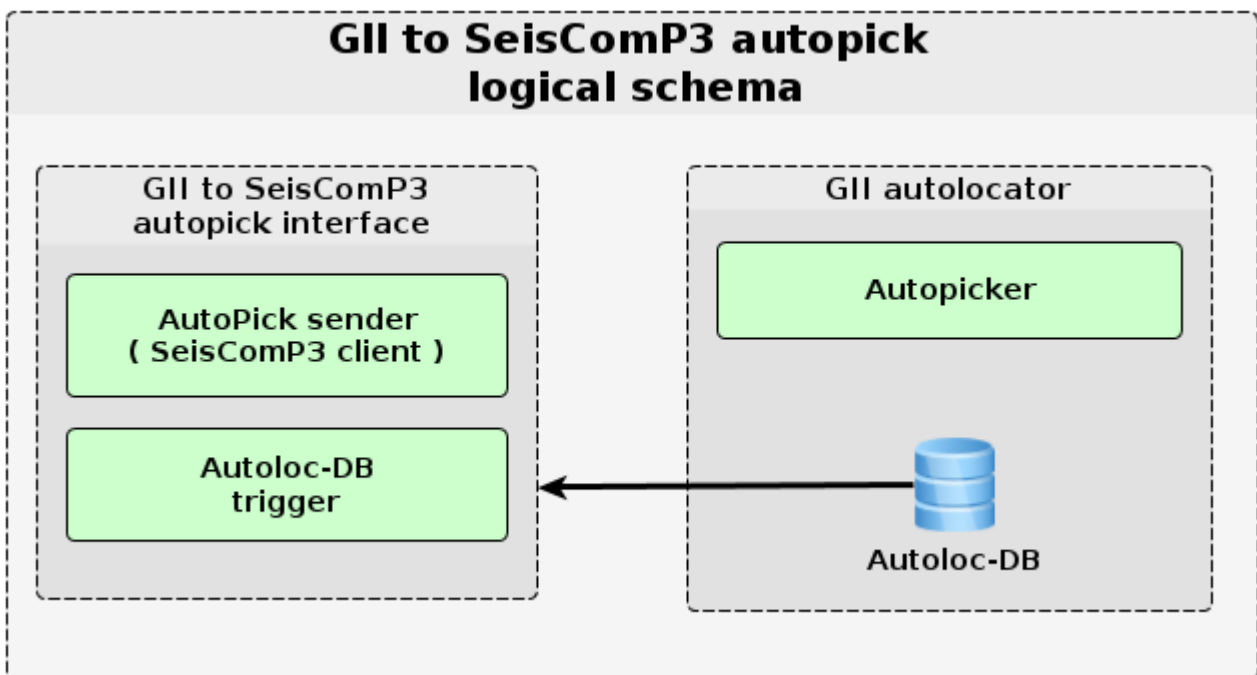


Figure 2. Block-diagram of special modules for autopicker and autolocator

This module transfers all picks from GII real-time auto-location program to SeisComp3 manager using MySQL server.

The interface consists of the two modules:

3.1. Client for registry picks in database.

This is the internal procedure in auto-location program for registry picks in the database. The database includes special table group for register and transfer data to SeisComp3.

3.2. Server to listen for new picks

This server fulfills the function of manager over the special table to transfer picks to the SeisComp3 server.

There are two options to select picks

- 1) It can manage all unassociated arrival picks or
- 2) Only picks associated after auto-location.

4. GII to SeisComp3 auto-location interface

This module transfers all events from GII real-time auto-location program to SeisComp3 manager using MySQL server.

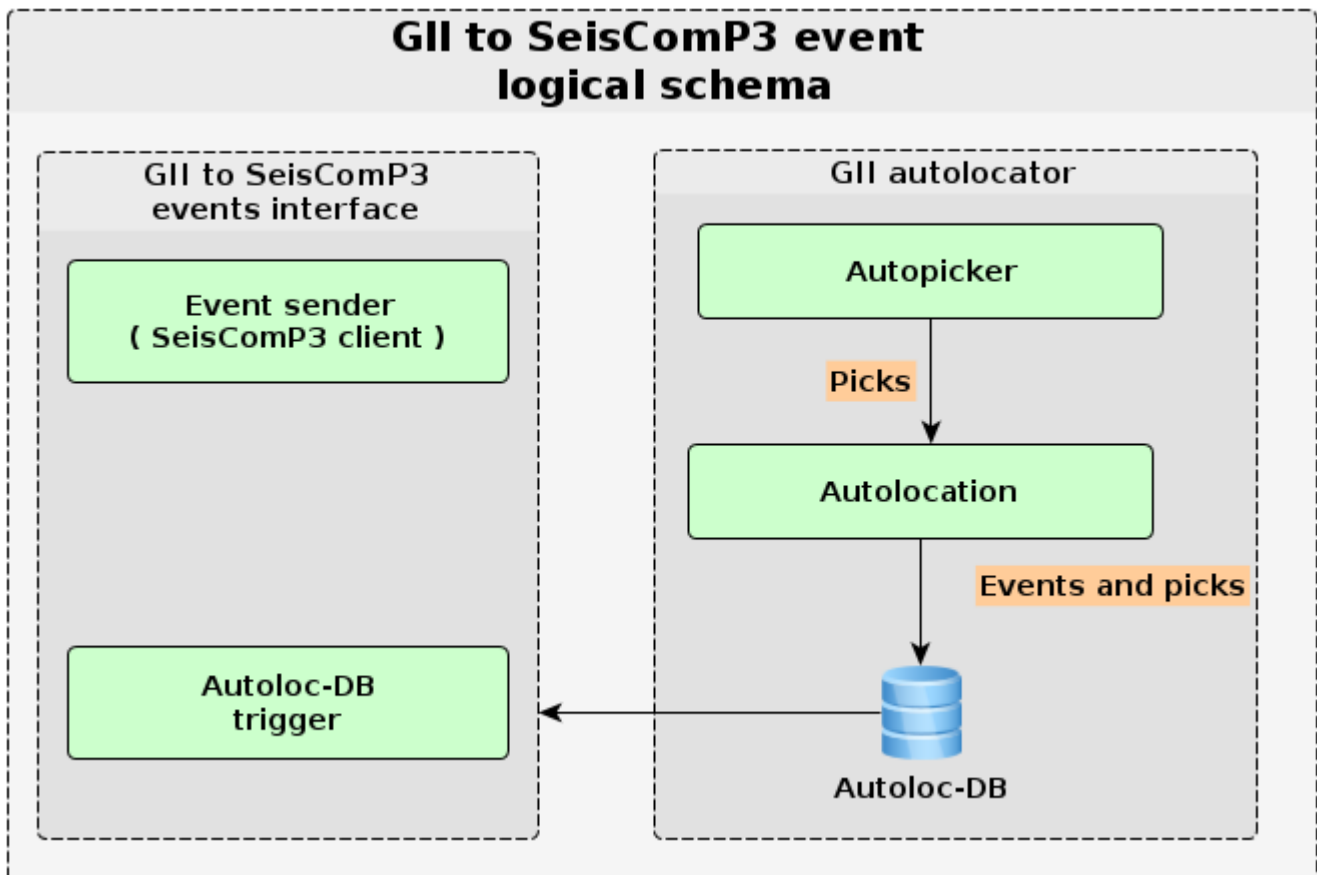


Figure 3. Block-diagram of special modules for autolocation

The interface consists of the two modules:

4.1. Client for registry events in the database.

It is internal procedure in auto-location program for registry events in the database. The database includes special table group for register and transfer data to SeisComp3.

4.2. Server to listen for new events

This server fulfills the function of manager over the special table to transfer events to the SeisComp3 server.

5. SeisComp3 to GII trigger generator

This module include two sub-modules: server and client realized as two independent programs.

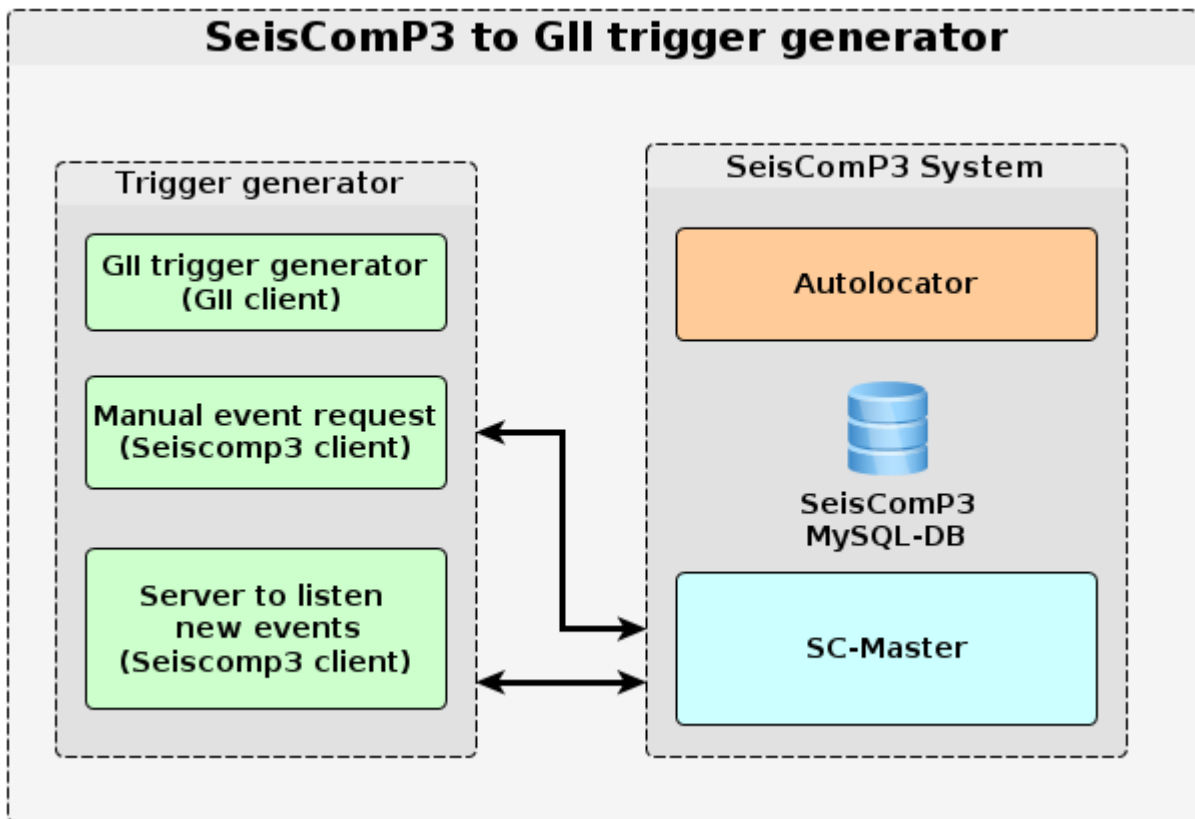


Figure 4. Block-diagram of special modules for the trigger generator.

5.1 Server to listen new events (SeisComp3 part)

It consists of two parts:

5.1.1. Connector module, which uses SeisComp3 library to connect to SeisComp3.

It subscribes to SeisComp3 manager for listening to new events from auto-location program.

When new event arrives, it creates time window for the event and requests waveforms corresponding to the associated picks (belonging to the event) from ArcServer, creates temp-directory for saving a multi-station MSEED file.

5.1.2 GII interface client to save triggers.

It converts multi-station MSEED to SAC format and stores in GII file-system database.

5.2 Client for requesting old events

It consists of two parts:

5.2.1. Connector module, which uses SeisComp3 library to connect to SeisComp3.

It requests one or more events from SeisComp3 database for the given time interval and using the modified 5.1.1 module stores events to the temp-directory.

5.2.2. GII interface client 5.2.1., which saves triggers to the GII file-system database.

6. GII Auto-location module

For the united ISN-DAS and SeisComp3 the GII autolocator scheme was changed and the new modules for the programs of Autopicker, Autolocator, Event-associator have been created.

In addition we have changed the SQL database: several new tables for picks and event management have been created.

- 1) For Autopicker program we have implemented client module for pick formatting, saving to DB and notification.
- 2) For Autolocator we have implemented procedures to transfer location results with selected unassociated picks to event-associator, which in turn sends already associated picks to SeisComp3 using special envelopes.
- 3) For Event-associator we have implemented a client module to send envelopes to DB and to broadcast notify about new event.

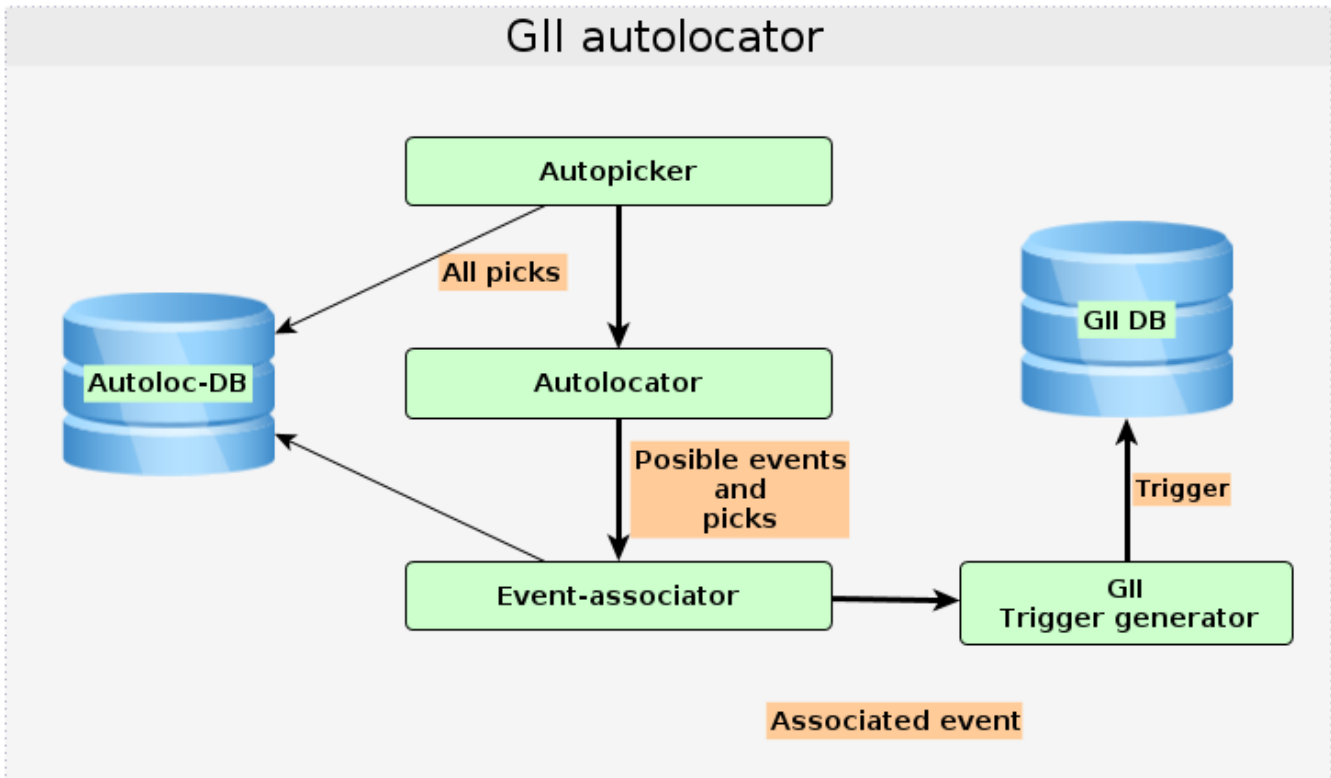


Figure 5. New Block-diagram of the GII autolocation module

Conclusions

During the first year we have fulfilled all the tasks related to the first stage of this 2 year project: Creation of the system prototype. This includes:

- 1) Building SEISCOMP3 interface for the existing GII modules: autopicker, autolocation, trigger-based processing;
- 2) Transferring the Database scheme of GII to SeisComp3.

For the second stage we plan building:

- 1) Earthquakes and explosions separation and classification module;
- 2) Earthquake classification (local, regional, teleseismic) module;
- 3) TDMT focal mechanism module.

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