

The Geological Survey of Israel

**Request for Information
(RFI)**

Concerning procurement to upgrade the real-time acquisition performance of the Israel Seismic network and the addition of Earthquake early warning system capabilities.

Feb 2014

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system capabilities.

1. Introduction

The Geological Survey of Israel ("GSI") and the Division of Seismology at the Geophysical Institute of Israel ("GII") hereby requests information from potential manufactures and suppliers with regards to upgrading the real-time acquisition performance of the Israel Seismic Network and the addition of Earthquake Early Warning System capabilities.

This RFI, as defined in section No. 14A on the Israeli Mandatory Tenders Regulations 5753-1993, is not to be considered as a request for proposals or as a tender and nor the Government Procurement Agreement shall apply hereto.

Notwithstanding the aforesaid, GSI may, as a result of this RFI, approach one or more of the respondents to this RFI and/or any other party, in order to obtain additional information.

In addition, as a result of this RFI, GSI may, at its sole and absolute consideration, conduct an additional procedure, including, inter alia, tender procedure, and any use, at its sole consideration, any of the information provided to this RFI.

This RFI shall not, under any circumstances, constitute any commitment on GSI's part to negotiate with any or all interested parties, nor to enter into any agreement for provision of services.

2. General Information and Key Factors

Following Government decision number 4738 June, 07.2012 , the GSI and the Division of Seismology at the Geophysical Institute of Israel ("GII") have taken the responsibility to set and deploy an Earthquake Early Warning System ("EEWS") for the state of Israel, and to upgrade the existing Israeli Seismic Network ("ISN"). An international advisory committee carried out an initial examination for EEWS in Israel during 2012, recommending an implementation strategy for the deployment of EEWS in the state of Israel ^[1] (see Figure1). The current document uses the committee's report as a basis for defining the guidelines and components required for upgrading the real-time seismic acquisition network and for adding to it EEWS capabilities examined for and adjusted to the geographical and seismological settings of Israel. In addition to the committee's report, we emphasize the significance of the real-time acquisition system, and require that it would be highly reliable and worldwide proved^[2] as capable of handling successfully up to 200 stations network with a maximum of data-return and minimal latencies. As we see it, a robust and well-proved real-time acquisition system is the basic layer for an efficient and successful EEWS.

GSI is interested in a solution and associated information for a robust turnkey real-time system, from the end-member sensors through the data-loggers and telemetry possibilities, to the data-hub, processing and analysis software, and EEWS module capabilities.

GSI also requests the respondents to explicitly define the flexibility of their solution, meaning what components are replaceable by alternative solutions, and how does it affect the liability of their offer. Furthermore, GSI request the respondent to provide references, supporting the reliability of the suggested solutions, including the main different components: sensors, data-loggers, telemetry, data-hub, processing software and EEWS modules. These references may include scientific reviewed papers, official reports and website links provided by non-interest acquisition networks or companies worldwide. In addition, the respondents are requested to provide

information regarding the measures taken for quality assurance of the different components in their suggested solution

3.1 GSI is interested in a turnkey real-time seismic acquisition system, with EEWS capabilities, for a network consisting of 120 strong ground motion accelerometers and 40 stations with both, broadband seismometers and strong ground motion accelerometers.

Sensors requirements:

| | Frequency Band (Minimum) | Self-Noise | Dynamic Range |
|--|--|------------------------|------------------|
| Broadband Seismometers | 120s – 50Hz (preferably 100Hz upper limit) | < NLNM @ 40s – 10Hz | > 135dB |
| Strong Ground Motion Accelerometers | DC – 200Hz | ~ -95dB @ 0 – 100Hz | > 155dB |

In addition, respondents are requested to provide information regarding:

- The reliability of the sensor and the sensor’s performance in the long run.
- The distribution of the sensor in seismic networks worldwide
- Proved and tested connection-options and interfaces with data-loggers.
- Sensor saturation of at least 1g for the strong motion accelerometer.

3.2 Data-loggers Requirements:

- Digitizing the full dynamic range of the signals recorded by the sensors. A minimum of 24-bit digitizer is required.
- Sample rates of at least 200sps.
- Locked to GPS timing with time accuracy < 100µs.
- Providing onsite recording of at least 3 months of continuous data at high sample rates (in case communication is lost during a critical seismic sequence), minimum

of 24GB per 3-Channels stations @ 200sps, and 48GB per 6-Channels stations @ 200sps.

- Recording packets either in MiniSeed formats, or provide a well-known format with durable software for acquisition and conversion to MiniSeed / SeedLink.
- Supporting multicast of the signal, so independent seismic processing hubs can each receive the data.
- Supporting Real-time telemetry with TCP/IP or UDP protocols

In addition, respondents should provide information regarding:

- The reliability and performance of the data-logger in the long run.
- The distribution of the data-logger in seismic networks worldwide
- Proved and tested connection-options and interfaces with various sensors and various telemetry protocols.
- Both the data-logger and sensor must provide full system response in known format (dataless Seed).
- Temperature Requirement: -20 - 70°C operative.

3.3 Telemetry Requirements:

- Providing at least two telemetry options (i.e., satellite, cellular, radio, etc.), one as the main and the others as backup.
- Supporting TCP/IP or UDP protocols for communication.
- Total latency (from actual time sample to reading at the hub) should be a maximum of 3 seconds for 99% of packets.
- Bandwidth should exceed at least two times the average throughput of the data, providing continuous data transmission for a total of 600 channels, with 200sps per channel.
- Minimal gaps or out-of-sequence data packets (daily data-return reports and time latencies per day could be useful to provide).

3.4 Power:

- Respondents are requested to provide the power consumption of the total and of the different components per station.

- The power-supply sources (Solar, AC to DC converters) and the backup power supplying at least 1 week of independent power (typically batteries).

Note, many of the strong ground motion stations will be located in areas with AC power supply; respondents should provide the power regulation-schemes for the proposed solutions.

3.5 State of Health Monitoring:

GSI is interested in continuous monitoring of the state of health of the stations, including Temperature, Humidity, Voltage, and Current monitoring (and many other measures), so that many of the problems that stations might encounter in time could be identified remotely, and given an appropriate solution in minimal time. The respondents are requested to provide the measures, sample rates, and data formats, of the monitored state of health channels, as suggested in the respondent offer.

3.6 Data-Hub:

Should consist of:

- The appropriate communication hubs according to the telemetry options.
- At least 1 Server, 2 operator terminals and 2 analyst terminals.
- A second identical redundant hub at a separate geographical location, with duplication of all system elements in each of the hubs, and a master-slave configuration.
- An architecture (hardware and software) that supports virtual appliance.
- Real-time data acquisition, processing and analysis software, with the following requirements:
 - The capability of acquiring data and processing it in real-time for up to 200 stations (600 channels).
 - Extensively and successfully tested for Quality Assurance.
 - Well-known and used in real-time seismic networks worldwide, with at least 50 stations, per network, transmitting in real-time, and show high

data-return performance.

- Extensive documentation, support system and online support forums.
- A clear architecture of the relations between the real-time system and the database archive.
- Ability to add open-source modules to the software, and modify some or all of the modules, for facilitating research and development in the seismic community.
- Capability to configure different levels of security and permissions for different layers of the real-time system, including the overlying EEWS.
- Should support parallel work of analysts in the case of aftershock sequences and post-event processing (e.g., shake-maps).

3.7 EEWS Capabilities:

Early Warning algorithms are still in an initial stage of development, although some have been implemented in networks around the world. Early Warning is also a function of the geography, reflecting the distance between the seismically active faults and the urban population centers. Together with the differences in lithologies of different regions, this means different designs and alarm-times required for effective early warning. Therefore, the existence of EEW modules in some of the seismic processing software has an advantage, but is not a fundamental requirement. More value is given for software that EEW modules could be added to, in a relatively short notice, once an EEW algorithm and thresholds are defined, either in the data-hub or at the seismic stations.

GSI is interested in one of the following possibilities:

1. Open-source software with proved and tested modules for 4P^[3] and S-phase-threshold EEW alarms^[e.g., 4] that could be studied and adjusted to the geographical and lithological constraints of the state of Israel.
2. Software, which has the proper architecture for implementing 4P and S-phase-threshold alarms, in the data-hub and in the individual stations, and that the basic module constructions would not take more than 6 months to build and test, and would be kept as an open source module for further research and development.

These modules should provide network EEW alarms, with the ability to provide alarms at the data-hub within 6 seconds from the arrival of first P motion, at the closest station to the epicenter.

In addition, there is an advantage for EEWS solutions that support real-time simulation and verification by applying synthetic earthquakes.

Respondents are requested to provide an estimated time line showing the time latencies: recording, packaging, sending on site and receiving in data center, and processing time for alarming.

3.8 System Security:

Data should be secured from external manipulation. This includes: a) the data-hub having strict permitting rules for personnel and hardware, b) site-to-hub communication is secured from external penetration, and c) sensors and data-loggers are monitored for any on-site physical manipulation or vandalism. In addition, system security should consist monitoring and alerts for attempts of external manipulation.

3.9 Station Siting and Deployment:

Respondents are requested to provide guidelines and initial guidance in the process of choosing sites for seismic networks. This includes noise testing and analysis for seismic site surveys, and complete deployment and verification of the first two prototype stations (one with only strong motion accelerometer and the second with both, broadband seismometer and strong motion accelerometer).

Respondents are requested to inform whether or not the company is capable of providing full installation of all stations, and if so what is the time-estimate for deployment of the above two station configurations.

3.10 Synchronization with Tsunami Warning Systems:

The Respondents are requested to provide approach and proves for Tsunami warning synchronization of their turnkey solution.

3.11 Liability and Flexibility:

Respondents are requested to state the liability provided to the turnkey system offered, and if and what would be the modifications in the liability, given some of the components are purchased from other companies, considering especially alternative sensors or / and data-loggers, than the respondent's suggestion.

3.12 Support and Maintenance:

The Respondents are requested to state what kind of support is given, and what are the maintenance possibilities that could be provided for the different components of their suggested solution.

3.13 Time-line:

The respondents are requested to provide a detailed proposed time-line for:

1. Hardware supply for sites and data-hub.
2. Obtaining an operational real-time acquisition network, with EEWS infrastructure.
3. Developing and implementing EEW modules of 4P and S-phase-threshold.

3.14 MISCELLANEOUS

1. As stated above, the fundamental requirement for an efficient EEWS is the underling real-time acquisition layer. Therefore the data-hub and processing software should show top real-time performance proved from existing seismic networks.
2. Sensors and data-loggers should fulfill the above requirements, have good reputation, and show high performance and wide distribution within real-time seismic networks. We expect this system to operate robustly for years to decades.
3. Stating feasible timelines and availability of hardware and software.
4. Capability for EEW and a clear plan and proposed schedule for providing 4P and S-phase-threshold EEW modules.
5. External documentation supporting the respondent's turnkey solution, and the various components within it.

3.15 The Request for Information and Potential responders

1. Respondents are requested to provide available information with regards to delivery time estimation of the upgrade for the real- time acquisition performance of the Israel Seismic network and the addition of Earthquake early warning system capabilities and information with regards to the most suitable delivery quantities and/or estimated cost varies depending on the delivery capacity.
2. The Respondents to this RFI are requested to address the issues on this document and any additional issue with they may deem as relevant in a written response. Respondent shall take into account the limited time and effort which may be invested in this process and therefore are highly requested to submit GSI with the most concise and essential information.
3. In addition, It is clarified that GSI reserves the right to invite any or all Responders which GSI finds their information relevant for further inquiry, including face-to- face meetings, in Israel or abroad to introduce their submitted information and/ or any further information.
4. Furthermore, if the Responders would be interested in sending their scouting team, GSI would provide an appropriate accompanying team for this purpose.

3.16 Form of Response

The Respondent shall fill and submit a detailed PDF document with their solution and associated information. .

3.17 Language of Response

Responses shall be in English.

3.18 Submission of a Response

Responses shall be submitted in writing by Mar. 12th, 2014, at 12:00 PM to mail: ittaik@gsi.gov.il you must make sure that Ittai has received your RFI by email (preferably) or by phone number: 02-5314254

3.19 Additional Information

Clarifications relating to this RFI shall be addressed in writing only to Dr. Ittai Kurzon by email ittaik@gsi.gov.il.

General

- 4 This RFI shall not be construed under any circumstances as a pre-requisite or pre-qualification procedure.
 - 4.1 GSI may consider information provided to it after the date specified in section 7.
 - 4.2 This RFI is merely for the purpose of obtaining any relevant information for consideration purposes only, and GSI shall not be construed as having taken any commitment to procure such service nor to publish any tenders or any other further procedure
 - 4.3 A response to this RFI shall not constitute a condition of participation in the tender that will be held in the future, nor lead to any advantage in the tender, and will not obligate the participation of the responder in any tender or contract in any other way in accordance with **the Israeli Mandatory Tenders Regulations 5753-1993** article 14 .
 - 4.4 GSI may, as a result of this RFI, approach, at its sole discretion, one or more of the Respondents and/ or any other party, in order to obtain additional technical information.
 - 4.5 It is hereby clarified that GSI shall not be obligated to engage in any contract on the basis of this RFI and that any information presents and/or submitted to GSI through this RFI is provided voluntarily. GSI shall not be charged in any manner for the submission of information in accordance with this procedure and every Respondent shall bear its own costs with respect to this RFI.
 - 4.6 Moreover, to preclude any doubt, it is emphasized that GSI shall have the right to reject in whole or in part, any opinion, conclusion or information delivered

to it through this RFI. GSI shall also have the right to use the information delivered to it through this RFI. GSI shall also have the right to use the information presented and/or submitted to it for the purpose of planning and preparing a tender or any other procedure, should GSI decide to implement one.

- 4.7 All given information will be under the right to review according to **asthe Israeli Mandatory Tenders Regulations 5753-1993** article 21(7).
- 4.8 GSI may at its sole discretion, request from any of the Respondents, additional information, details, approvals, recommendations and/or certificates, as required by GSI.
- 4.9 GSI may ignore any response with lack of information or has unclear details.
- 4.10 GSI shall not be bound to accept and/or consider any response and it does not undertake herein any commitment whatsoever towards any of the interested parties.
- 4.11 GSI reserves the right, at any time and at its sole discretion, to amend this RFI or any aspect, thereof, as well as to extend the date for submittal of the Responses. These actions, if taken, will be advertised on the GSI website: www.gsi.gov.il. The responsibility of being updated is on the respondents.
In addition, GSI reserves the right to cancel this RFI in its entirety at its sole discretion, without providing the Respondent(s) any (or no) reason or explanation.
- 4.12 This RFI process is undertaken by GSI for the purpose of receiving data and information, and it does not create any obligation on GSI's part to commence, continue or complete any purchase procedure and/or to act any other method of acquisition, and GSI shall act at its sole and absolute discretion in this respect.
- 4.13 GSI reserves the right to accept, in further stages, information and/or any commercial proposals from entities which did not participate in this RFI process, as GSI shall deem fit.

References

- [1] R. M. Allen, Baer G., Clinton J., Hamiel Y., Hofstetter A., Pinsky V., Ziv A. and Zollo A. Earthquake early warning for Israel: Recommended implementation strategy, *GSI/26/2012 or GII 500/676/12 reports*, December 2012.
- [2] B. Hutt, Estes S., Evans J., Hough S., Nigbor B., Savage W., Steidl J. and Uhrhammer B. Instrumentation Guidelines for the Advanced National Seismic System, *U.S. Geological Survey and ANSS National Implementation Committee*, 13 June 2007.
- [3] H. S. Kuyuk, Allen R. M., Brown H., Hellweg M., Henson I. and Neuhauser D. Designing a Network-Based Earthquake Early Warning Algorithm for California: ElarmS-2, *Bull. Seismol. Soc. Americ.*, 104(1), doi: 10.1785/0120130146, (and references within).
- [4] V. Pinsky. Assumptions and guidelines for building an earthquake early warning system in Israel, *GII 500/682/12 report*, 2012. (prepared for the National Steering Committee for Earthquake Preparedness Prime Minister's Office).

Annex A- respondent General Information

RFI concerning procurement to upgrade the real- time acquisition performance of the Israel Seismic network and the addition of Earthquake early warning system capabilities.

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| General Information Concerning the Respondent |
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|-----------------------------|--|
| Name of Respondent | |
| Respondent Address | |
| Respondent Contact person | |
| Respondent Business Profile | |