NERA

Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation

Report

Data archival for Europe and its surroundings: inventory, organization and implementation

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Summary

This report provides an overview of the European Integrated waveform Data Archive (EIDA), the new data archival and services concept within ORFEUS. The EIDA concept with distributed centers enables the European seismological community to realize a core objective: provide researchers open access to high quality waveform data and metadata gathered by European-Mediterranean monitoring and research networks. EIDA is a robust model for a sustainable European large-scale archive of seismological and related data.

The organization of EIDA under the ORFEUS umbrella was agreed in 2012. Each main participant in EIDA signs an MoU. This agreement also includes the ORFEUS Data Center (ODC) and was signed between Orfeus and five major European Data Centers: Geofon/GFZ in Germany, Resif/CENRS-INSU in France, INGV in Italy, ETHZ in Switzerland and BGR in Germany. The 6 EIDA Primary nodes currently archive data from more than 4400 stations, of which ~1500 are permanent stations and ~2800 are temporarily deployed stations. Some temporary deployments lack a unique identification code, which bars them from overall EIDA access. Of the permanent stations more than 750 are broadband. The total volume of the accessible archive comprises 300 TB of waveform data. Currently, the software architecture underpinning EIDA is ArcLink, developed at GFZ. A broad range of services that are continually expanding are also provided. The services include ftp access, email requests, web services, web request forms, an integrated data portal, and real-time data access. These services are mainly based on ArcLink clients, often directly integrated within user software tools such as ObsPy.

Under the ORFEUS-EIDA governance structure, the participants will coordinate developments regarding services, monitoring of quality, coordination of data holdings and planning expansion both in terms of participants as well as data types. EIDA is envisaged to be the long-term framework for providing access to waveform data within NERA NA2 during the NERA project. Within NERA, the EIDA community expands– in addition to including new EIDA nodes across Europe, the data included is becoming larger and more diverse. The current focus on broadband datasets from permanent networks is expanding to include strong motion and short period archives, seismic data from temporary campaign networks, and is beginning to include non-seismic data. The ORFEUS-EIDA structure will become one of the pillars of the seismological core services within EPOS.

Even though only a small number of centers comprise the core nodal of the EIDA data distribution, all networks that currently provide open data to ORFEUS or any other EIDA node, are active participants in the EIDA community and their contributions must be explicitely acknowledged through EIDA tools. .

1. Introduction

The amount of digital seismological waveform data currently being recorded in and around Europe is increasing exponentially. Much of this data is being archived locally and/or regionally at the more than 100 observatories that serve national or regional priorities regarding monitoring, rapid alert and seismic hazard assessment. Data management procedures vary significantly between observatories, producing significant differences in quality of data, metadata, protocols, formats and access.

The localized data storage is not optimal for scientific research and engineering applications which would be better served by easy access to the full data archive in a standard manner. A single European archival facility, like IRIS DMC in the US, is presently not a realistic option as the majority of European funding for seismic networks is from the national level – there is no central European scientific funding agency. A compromise reached within ORFEUS by the EIDA infrastructure takes advantage of the diverse national resources and, through its diversity, gains a certain robustness. EIDA comprises a restricted number of Primary Nodes which take the responsibility to provide a homogeneous and efficient access to the whole data archive, act as backup for smaller national networks, and offer smaller networks the possibility of managing data access through the EIDA infrastructure.

In general, EIDA data from the permanent networks is made openly available to the community within seconds to minutes of real time.

To provide unified and easy user access such a set of distributed data archives requires a well-coordinated data management, quality control and access facilities. For this purpose a consortium of six large datacenters, the EIDA primary nodes, agreed in 2012 to coordination through an MoU with ORFEUS. This document describes the EIDA organization, its architecture, an overview of its data contents and current access facilities. Further, it describes our current vision on the developments.

This document, in its original form,is also NERA deliverable D2.1.It provides a comprehensive overview of EIDA for data providers and data users and the first part of a Standard Operating Procedures (SOP) document. It is Part 1 of the EIDA documentations. A follow-up document, Part 2, will provide a more extensive description of the archives and services the EIDA community expect to develop in the coming year (and their relation to the proposed EIDA core services). Part 3will provide an overview of data not yet included within the EIDA Primary Nodes.

2. ORFEUS - EIDA organization: technical and administration aspects

Primary EIDA Nodes

Primary nodes are connected to EIDA system providing waveform and metadata directly from their servers. They commit to supplying high quality data and metadata with maximised uptime, and will respond immediately to technical problems. They also contribute to development and maintenance of the EIDA system. Primary Nodes sign an MoU with ORFEUS, and participate in the management (EIDA Management Board, EMB) and technical (EIDA Technical Committee ETC) committees.

Five European seismological data centers (see Table 1) signed an MoU (appendix 1) with ORFEUS as Primary Nodes joining the ORFEUS Data Center (ODC) into one coordinated network of distributed waveform data archives, EIDA.The objective is to create and implement an effective EIDA providing data services for the scientific community.

Table 1. *Primary EIDA Nodes that signed an MoU with ORFEUS.*

Facility	Host institute	country	Basic data holdings
ORFEUS DC	KNMI	Netherlands	EU + immediate surroundings
Geofon/GFZ DC	GFZ	Germany	Geofon EU+global+ mobile
Resif/CNRS-INSU DC		France	French + mobile
BGR DC	BGR	Germany	German
INGV DC	INGV	Italy	Italian and MedNet + mobile
ETHZ DC	ETHZ	Switzerland	Swiss + mobile

The MoU contains an "EIDA implementation document" defining the organizational and technical constraints within which the EIDA Primary Nodes will cooperate. The EIDA Management Board (EMB) discusses its strategy and interacts with the ORFEUS ExeCom to ensure a broad community base. Figure 1 provides a schematic overview of the current organization as approved by the ORFEUS board on November 26, 2012. On the same date the ORFEUS board approved of an MoU with all five nodes in Table 1 and agreed that the ODC joins as one of the Primary Nodes.

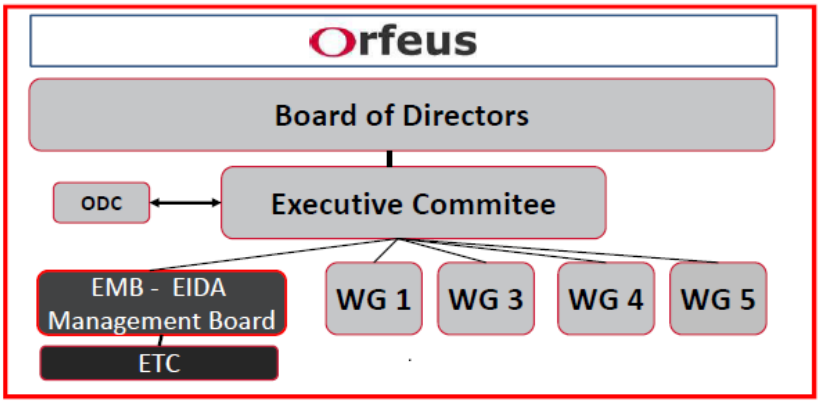

Figure 1a *Schema of the EIDA management structure within the ORFEUS governance.*

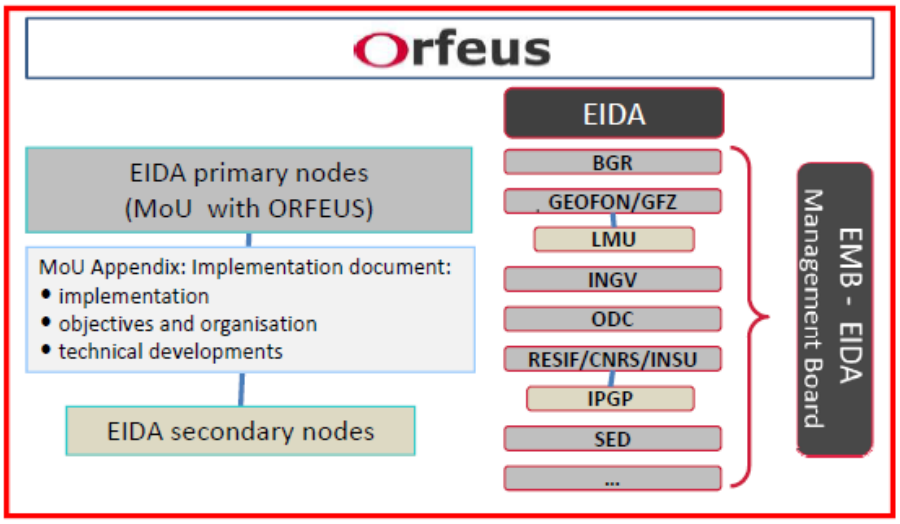

Figure 1b. *Schema organizational structure of EIDA under the umbrella of ORFEUS.*

Secondary EIDA Nodes

EIDA Secondary Nodes are datacenters that are directly connected to the EIDA system. Secondary Nodes do not sign an MoU with ORFEUS, and are not full participants in the management structure. They cooperate closely with a Primary Node on issues concerning uptime, latency and data quality control.
Presently two additional Secondary EIDA Nodes, IPGP (GEOSCOPE) and LMU (Bavarian Network) maintain arclink access in cooperation with one of the Primary Nodes.

Technical cooperation

The EIDA Technical Committee (ETC), ensures an optimal technical coordination between the nodes and consist of people responsible for the day-to-day operations of the EIDA Primary Node archives. An EIDA wiki has been created to facilitate the exchange and communications (http://eidawiki.orfeus-eu.org/doku.php). This wiki will host all EIDA technical documentation and provide a discussion platform for technical developments. To channel feedback from the users a mailing list has been set up eida@gfz-potsdam.de.

Meetings

At the first EMB meeting on February 14, 2013 in De Bilt, The Netherlands. John Clinton from the ETHZ has been chosen as chair of the EMB for a 2 year period. THE EMB and ETC expect to meet regularly (1-2 times /year).

3. The basic technical implementation; ArcLink

The ArcLink protocol, developed by GFZ, provides the virtual framework for the distributed data archives as presently implemented. The current design of the EIDA system relies on a number of user clients that communicate requests to the ArcLink server at each individual data archive. Consequently, each EIDA primary node has implemented ArcLink and ArcLink clients enabling a homogeneous data access.

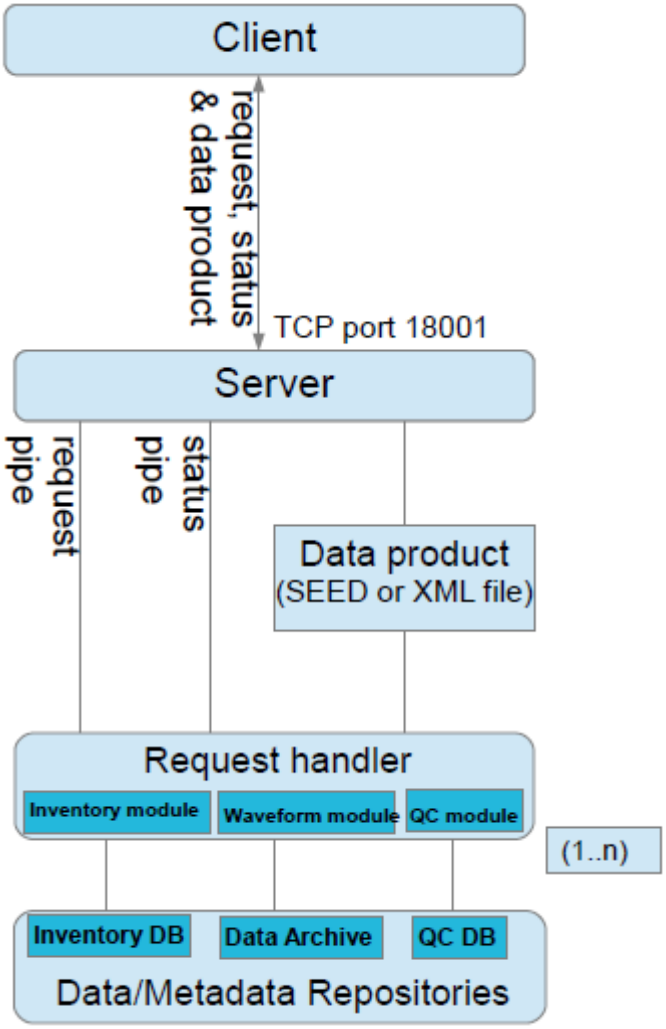

Figure 2. *Schematic view of how ArcLink works.*

Communication protocol: ArcLink

ArcLink is an innovative protocol to serve waveforms and meta data from arbitrary data archives and meta databases in a fully transparent way. An ArcLink system consists of three components: the server, the request handler and the client (see Figure 2). The ArcLink server is the central component which establishes the TCP connections and evokes a request handler instance for each request. The request handler is responsible for the actual processing of a request and connects to both the meta databases and to the waveform archives.

An ArcLink server usually operates a data base, containing routing and inventory (incl. instrument responses) information as well as outages and other QC parameters. Each specific data archive or metadata database requires the implementation of an individual request handler. The client software (e.g. web portals, email clients, web tools) identifies and locates the relevant servers, requests required meta and waveform data, compiles the resulting products and delivers them to the users (see Figure 2). Server and client communicate interactively by the ArcLink protocol through a single TCP port (default:18001). In this respect, ArcLink is a twin of the real-time protocol SeedLink developed for real-time data exchange communicating via port 18000. One conceptual difference is that the client not “subscribes” to real-time streams, but requests data based on time windows. Unlike SeedLink, the data will not be sent immediately, but possibly minutes or even hours later, when the request is processed.

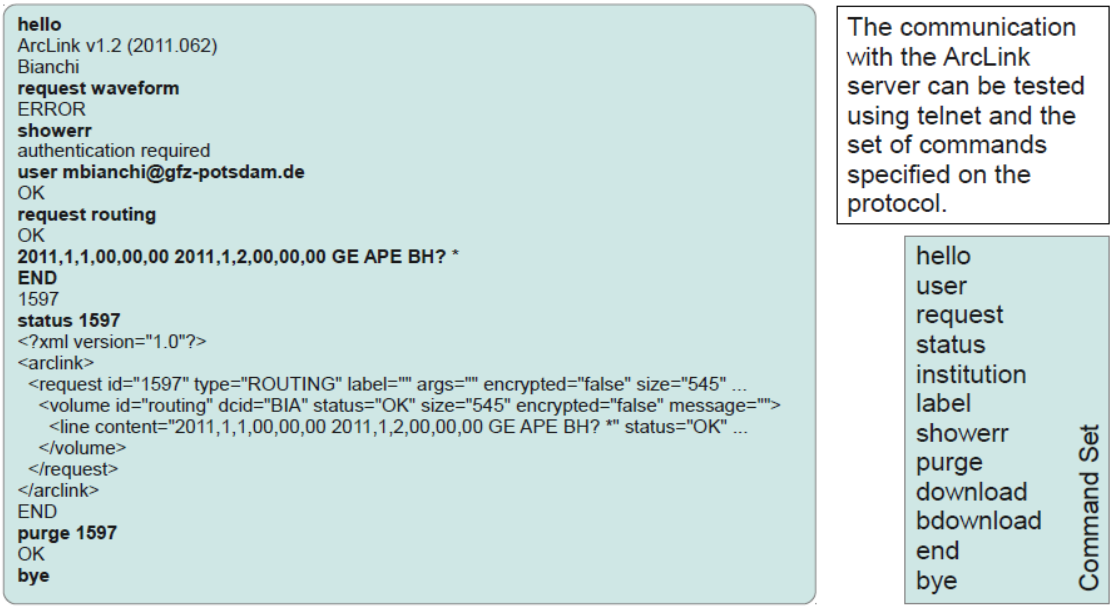

Figure 3. *ArcLink protocol*

An ArcLink network has a star-like structure (see Figure 4), The ArcLink client communicates normally directly with the target node. These so-called “active” nodes (as the present six primary and two secondary EIDA nodes) have ArcLink servers sharing its inventory data with all other “active” nodes. An exception is a sub-node which is only accessible through its parent node. There exists also a “passive” node option: holding only own inventory data and without re-routing requests for other data (see also Figure 4). There are presently no passive nodes in EIDA.

Firewall issues

For cases where firewall issues exist also a proxy ArcLink server mode is available which takes over request routing and data collection behind the scenes and delivers a single data set to the user that combines the derived contributions from all involved nodes (this feature is presently only available at eida.gfz-potsdam.de:18001 – see Figure 2).

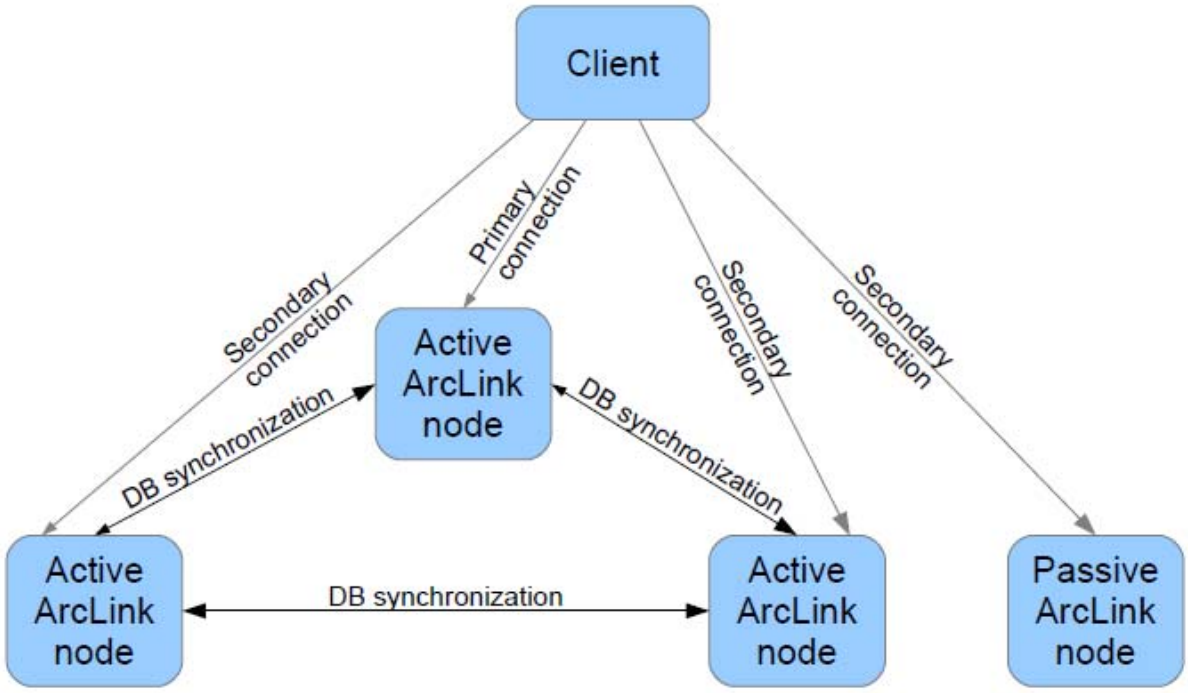

***Figure 4**. Basic Arclink network.*

Archive request handler

An ArcLink server does not access the data archive directly, but delegates this job to a "request handler". Thus, it is possible to use ArcLink for accessing different data archives by using different request handlers.

This is equivalent to SeedLink, that can get real-time data from different sources. The request handler is analogous to a SeedLink plug-in, except that while SeedLink starts exactly one instance of each defined plug-in at startup, ArcLink uses a single request handler and starts one instance of the request handler per request.

Routing information

In addition to waveforms and metadata, it is also possible to request routing information from an ArcLink server. The routing information specifies which ArcLink server provides the waveform data for a given station. The routing database itself is supposed to be synchronized between all ArcLink servers jointly with the inventory database. In this way a client can connect to any public ArcLink server, requesting routing information and splitting the request accordingly.

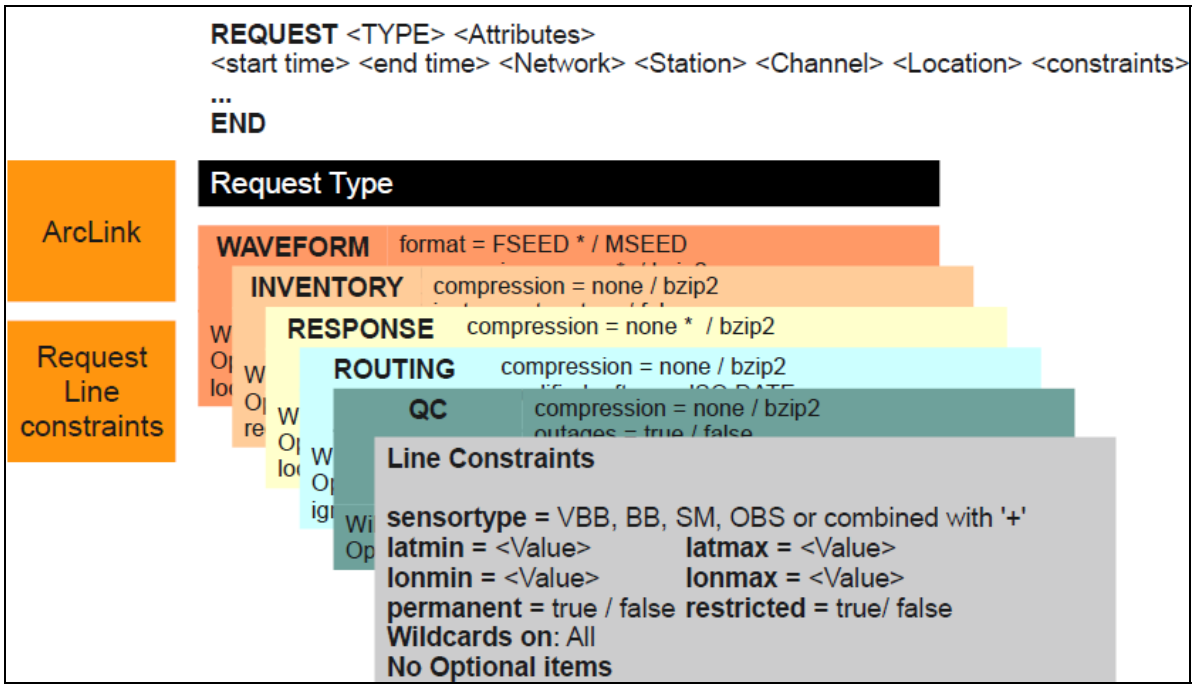

Figure 5. *ArcLink request types*

Request types

Allowed request types are currently WAVEFORM, RESPONSE, INVENTORY, ROUTING and QC (Figure 5). Data format of WAVEFORM and RESPONSE requests is SEED (Mini-SEED, dataless SEED, full SEED). Data format of INVENTORY, ROUTING and QC requests is XML. Data can be optionally compressed by bzip2.

Restricted data sets

For restricted stations waveform data – e.g. from temporary networks within in the first few years after the deployment – requests will only be successful for authorized users. For further safety these data files are encrypted and can only be decrypted with a valid individual user password provided independently from each node. More information on ArcLink including a description of the request syntax is provided at:www.seiscomp3.org/wiki/doc/applications/arclink.

Table 1*. EIDA/ArcLink request descriptions*

Metadata request	• Obtain instrument responses from more than one data center at the same request • Find what channels are available for a certain region, epoch by type and permission
Waveform request	• Obtain mini/fullSeed data from one/multiple data centers
Qc request	• Obtain pre-computed QC parameters for certain streams of data • These QC parameters could be used together with inventory to return automatically better quality datasets
Routing request	• Maps the channel name to IP address of the ArcLink server capable of delivering real-time data

.

Metadata synchronization between EIDA primary nodes.

Inventory metadata and routing information is maintained and shared among the EIDA nodes. Each network, for which data is available within EIDA, is associated with one of the EIDA nodes. This specific EIDA node is than responsible to keep the metadata of this network up-to-date within the archive. This responsibility is

administered in one unique EIDA network table. The specific EIDA node, responsibility for a network, ensures this network metadata is kept up-to-date in the common EIDA inventory database. Regular synchronization among the nodes ensures that each node has the latest version of the common EIDA inventory database.

QC parameters (like outages or other basic QC parameters) are presently not synchronized across EIDA due to the large volume of data involved. All user requests and resulting processing and shipment information is stored in a node-dependent request data base. This information is necessary to provide overview and statistics on users, data downloaded and possible problems.

Overall EIDA status monitoring
EIDA also monitors its status through a monitoring and error reporting system, where node, data repository and meta database accessibility and request repeatability as well as meta database integrity is tested frequently. Data discovery problems are reported to the relevant EIDA node operators.

The EIDA network table and the current EIDA status are currently displayed on *http://eida.gfz-potsdam.de/eida/status)*

ArcLink Clients
Existing ArcLink clients for EIDA are presently the four EIDA web portals (see summary in section 5). A short summary of Arclink tools:

arclink_fetch	presently by far the most popular web tool and supports also on-the-fly decryption of encrypted data sets www.seiscomp3.org/wiki/doc/applications/arclink_fetch
arclinktool	a simple client for testing ArcLink servers www.seiscomp3.org/wiki/doc/applications/arclinktool

With *arclinktool* it is possible to send all types of requests directly to a specified server. However, routing is not supported with *arclinktool*.

Other ArcLink clients.
A *breq_fast* client for email requests was developed and implemented at most EIDA nodes. SeisComp3 can be configured such, that it works directly with the complete EIDA archive by connecting to an ArcLink proxy server. The ObsPy data processing framework also supports ArcLink access directly (http://docs.obspy.org/packages/obspy.arclink.html).

4. Overview of EIDA nodes

Although all EIDA nodes operate the same software, each EIDA node houses different datasets, operates different hardware, and has their own procedures for generation of waveform and metadata. As each network has evolved independently, each node is naturally quite different, nevertheless, in the MoU they each commit to providing high quality data / metadata with a high quality of service and uptime. This section summarizes the current state of each node. It is expected that now the governance structure is enacted, on-going EIDA coordination will provide common structures and transparent archive content.

The current overview was compiled from each of the six EIDA primary nodes completing a survey. The original answers from each node are provided in Appendix 3

Joint data storage capacity
The present EIDA nodes have end 2012 a storage capacity of nearly 350 TB.

Joint data holdings
The current joint data holdings are slightly less, around 300 TB. EIDA currently offers access to over 4400 stations, of which about 1500 are permanent stations and around 2800 are temporarily deployed stations. Lacking unified network codes some of the temporary data is not yet accessible through the joint EIDA system. Of the permanent stations more than 750 are broadband. Table 2 and Figures 7 and 8 provide an overview of the available data.

Table 2 *overview of currently acquired station data within EIDA. These are rough preliminary figures as stations and instruments are currently not identified separately and EIDA nodes support multiple redundancy, which still needs to be administered.*

Preliminary statistics for the EIDA key nodal members								
node	**# broad-band stations*)**	**# strong-motion stations*)**	**# short-period stations**	**# permanent network codes**	**# temporary deployment network codes *)**	**# arrays**	**# infra-sound netwrks**	**archive capacity (TB)**
ODC	230	51		61	13	3	1	40
GFZ	402	0	**xx**	25	48			100
SED	36	105	8	1				15
ReSiF	747	206	306	4	29	1		30
INGV	306	168	121	29	3			60
BGR	70			5	7	1	3	100
total								345

*) Some station data is available from multiple EIDA nodes (redundancy)

Data acquisition
Data acquisition for archiving occurs generally in realtime, using the following protocols:

- SeedLink is used at all six EIDA nodes, some integrated with SeisComp3.
- NAQS servers (Nanometrics) [INGV and ETHZ],
- SCREAM(Guralp) [ODC and ETHZ],
- RTPD (RefTek) [BGR],
- Antelope (Kinemetrics) [ODC].

Consequently, experience with all major data acquisition systems is present within EIDA. This can be used advantageously to compare and provide archival services to a broad community.

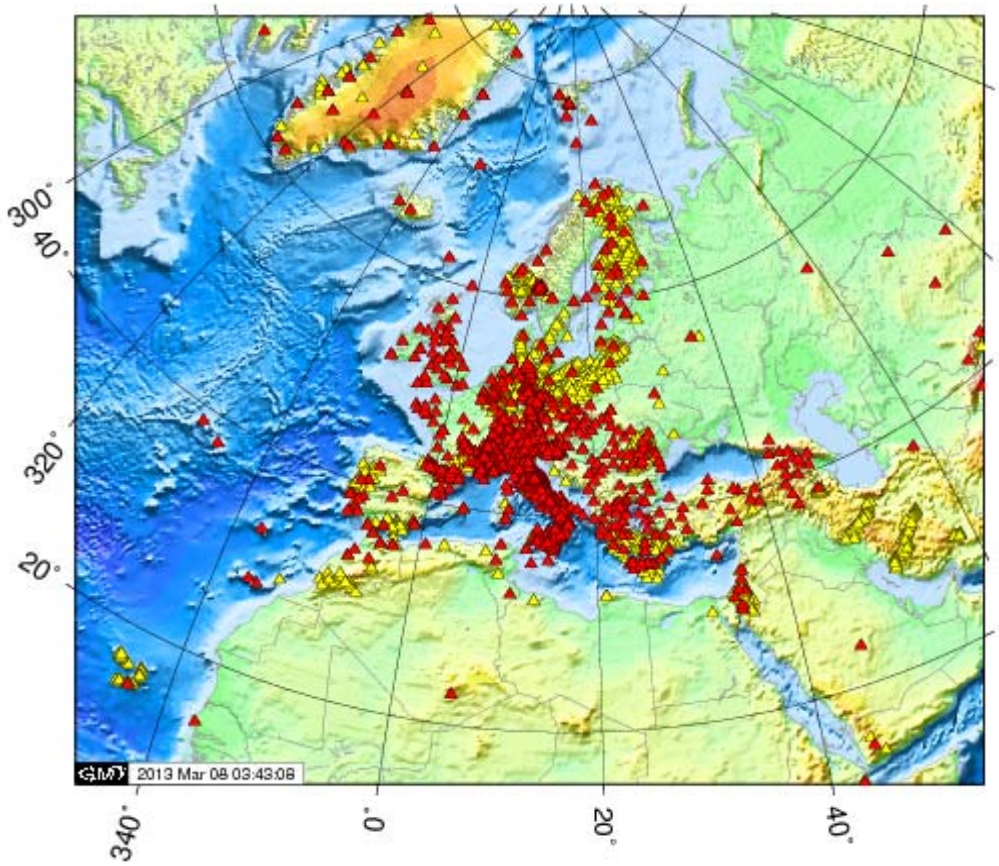

***Figure 7**. Stations in and around Europe for which data is currently available from the EIDA network of primary nodes as described in section 2. Stations in red are operational stations. Stations in yellow are temporary stations or are currently closed.*

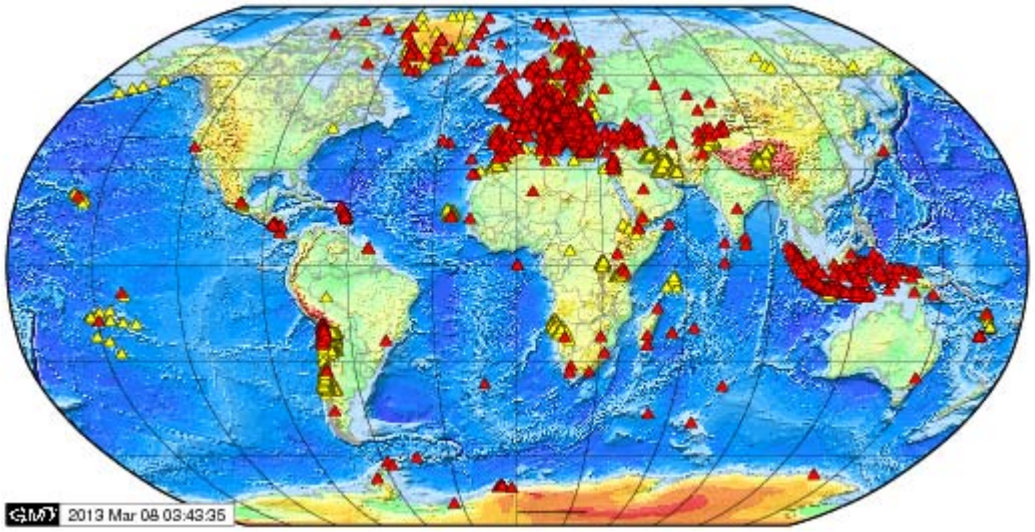

***Figure 8**. Stations with a global distribution for which data is currently available from the EIDA network of primary nodes as described in section 2. Stations in red are operational stations. Stations in yellow are temporary stations or are currently closed.*

5. Data services overview

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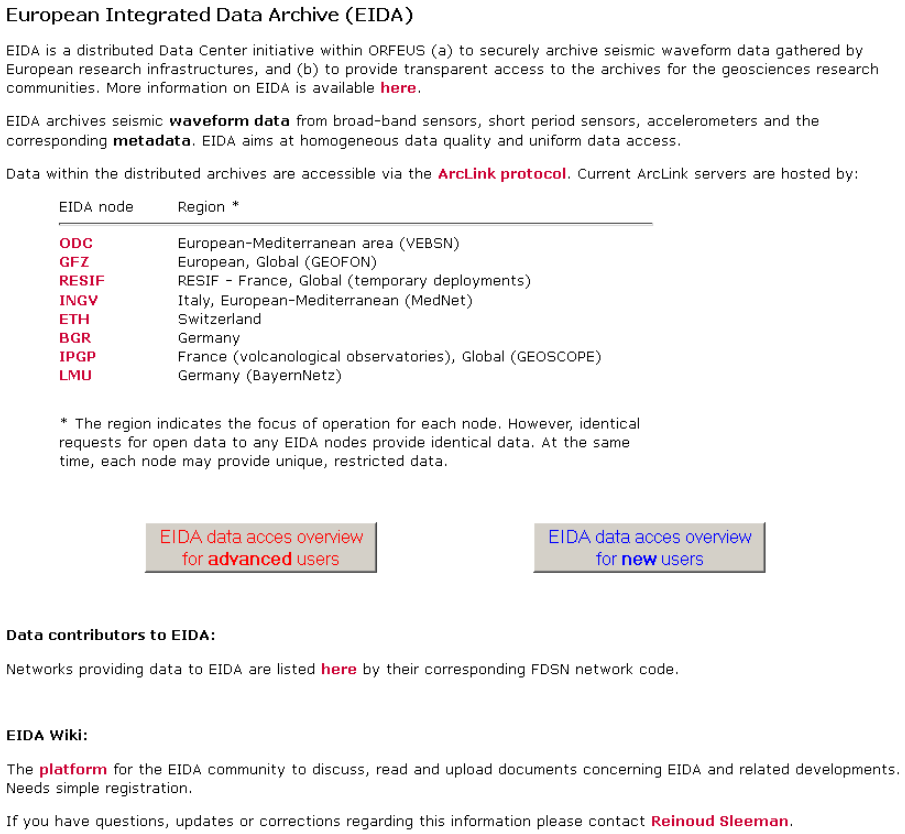
The EIDA datacenters are consolidating their archives and services. In the coming year the services are expected to become more homogeneous from a users perspective. Figures 9a and 9b present an overview of currently available services as compiled from the individual EIDA nodes. This overview is available on www.orfeus-eu.org.



European Integrated Data Archive (EIDA)

EIDA is a distributed Data Center initiative within ORFEUS (a) to securely archive seismic waveform data gathered by European research infrastructures, and (b) to provide transparent access to the archives for the geosciences research communities. More information on EIDA is available **here**.

EIDA archives seismic **waveform data** from broad-band sensors, short period sensors, accelerometers and the corresponding **metadata**. EIDA aims at homogeneous data quality and uniform data access.

Data within the distributed archives are accessible via the **ArcLink protocol**. Current ArcLink servers are hosted by:

EIDA node	Region *
ODC	European-Mediterranean area (VEBSN)
GFZ	European, Global (GEOFON)
RESIF	RESIF - France, Global (temporary deployments)
INGV	Italy, European-Mediterranean (MedNet)
ETH	Switzerland
BGR	Germany
IPGP	France (volcanological observatories), Global (GEOSCOPE)
LMU	Germany (BayernNetz)

* The region indicates the focus of operation for each node. However, identical requests for open data to any EIDA nodes provide identical data. At the same time, each node may provide unique, restricted data.

EIDA data acces overview for **advanced** users

EIDA data acces overview for **new** users

Data contributors to EIDA:

Networks providing data to EIDA are listed **here** by their corresponding FDSN network code.

EIDA Wiki:

The **platform** for the EIDA community to discuss, read and upload documents concerning EIDA and related developments. Needs simple registration.

If you have questions, updates or corrections regarding this information please contact **Reinoud Sleeman**.

***Figure 9**. ORFEUS web site overview of the EIDA services (page 1)*

EIDA and VEBSN data access for advanced users

If you are unfamiliar with these servives please click **here** for more information.

Data within the distributed archives are accessible via the **ArcLink protocol**. Current ArcLink servers are hosted at:

EIDA node	ArcLink server	Port	Region *
ODC	eida.knmi.nl	18002	European-Mediterranean area (VEBSN)
GFZ	eida.gfz-potsdam.de	18002	European, Global (GEOFON)
RESIF	eida.resif.fr	18001	France, Global (IPGP:GEOSCOPE)
INGV	-	-	Italy, European-Mediterranean (MedNet)
ETH	eida.ethz.ch	18001	Switzerland
BGR	-	-	Germany

* Identical requests for open data to all EIDA nodes provide identical data. The region here indicates the focus of operation for each node. Each node may also provide unique, restricted data.

Direct data retrieval by a client. Requires installation of client software.

arclink_fetch	a client that can be used to request data by a single command
porsche	a command-line webservice client to download data directly to your disk
joque	an event catalogue based webservice client to download data directly
obspy	the Python Toolbox for seismology has a build-in ArcLink **client module**
wavesdownloader	the WavesDownloader toolbox

Data portal (interactive access)

www.seismicportal.eu	portal for exploring EMSC earthquake data and EIDA waveform data

Web interfaces (interactive access)

Continuous data

ODC	eida.orfeus-eu.org	planned
GFZ	**eida.gfz-potsdam.de**	all EIDA data and GEOFON restricted data; access to GFZ and NEIC catalogue
INGV	**eida.rm.ingv.it**	all EIDA data and INGV restricted data
RESIF	eida.resif.fr	planned
ETHZ	**eida.ethz.ch**	all EIDA data; ETHZ restricted data available from arclink.ethz.ch
BGR	eida.bgr.de	planned

Preselected event data

ODC	**Wilber**	Wilber interface to EIDA event data M > 4.5 (Europe), M > 5.5 (Global)

Direct FTP access

waveforms ftp	direct ftp access to event waveform data from all EIDA stations; M > 4.5 (Europe), M > 5.5 (Global); mini-SEED files
metadata ftp	direct ftp access to metadata from all EIDA stations (dataless SEED)

E-mail based access

breqfast	e-mail based request service

Webservices

seismolink	webservice for metadata and waveform data (SOAP, REST)
fdsnws-station	webservice for RESIF metadata
fdsnws-dataselect	webservice for RESIF time series

EIDA station information

station map	station map, current status based on metadata end-time.
stations (Google Maps)	station map, current status based on metadata end-time (test version).
station list	EIDA station list, based on inventory.
station database	ORFEUS database with station information, only for data providers.
station metadata	direct ftp access to metadata from all EIDA stations (dataless SEED)

***Figure 9b**. ORFEUS web site overview of the EIDA services (page 2)*

6 On-going work and long-term vision

The governance structure for the EIDA community has only recently been agreed on and established under the umbrella of ORFEUS. Now the EIDA community work on consolidating the current EIDA primary nodes as a joint data archival and services organization. In the mean time the EMB is already looking forward to the future, i.e. extending the EIDA community and EIDA within EPOS.

The next technical steps for EIDA

Current issues
The compiled overview of the different EIDA nodes indicate a number of issues necessary to be addressed in the near future:

- Data access: a transparent overview of the data holdings and its access. This should provide the user with a simple and clear pathway to find data.
- Documentation: technical documentation of ArcLink and related software
- Request statistics: a common set of request statistics
- Metadata: one common up-to-date set of metadata

These issues are some of the topics taken up by the EMB and its technical group.

Arclink and possible alternative solutions
Although EIDA currently uses ArcLink as the underlying software, the community is aware there are existing limitations and alternative options. The EMB will continue to evaluate whether the optimal system can be built by extending ArcLink functionality or by migrating to new software.

Extending EIDA dataservices beyond seismological waveform data
The EIDA community currently only shares seismological waveform data. It is possible other time-series data may be archived and distributed across this system.

Extension of EIDA community

The current EIDA setup includes 6Primary Nodes and 2 Secondary Nodes. The EIDA community is expected to grow in the coming years, as more seismic networks decide to openly contribute their waveform archives to the European system, but wish to retain management of their own data archives. New EIDA Primary Nodes must be approved by the ORFEUS Board, and requirements include they must be from an ORFEUS member nation and demonstrate they

1) represent a wider community nationally or regionally,
2) can meet the requirements to produce and curate high quality data and metadata, and
3) can deliver a robust IT platform with high uptime.

In addition to nodes providing regional broadband seismic data, new Primary Nodes may join providing particular datasets, such as data from mobile experiments, strong motion data, or volcanic networks. The governance structure can accommodate a wide range in the number of EIDA Nodes. Appendix 2 summarizes the guidelines for a new EIDA Primary Node.

EIDA and EPOS

EPOS aims to provide a long-term and coherent platform for Research Infrastructures in the solid Earth sciences across Europe. EPOS expects to move from the design phase to the construction phase within the next years.

Seismology will be a core part of EPOS, and hence the functions provided by EIDA are a fundamental component of EPOS. The current plan for seismology in EPOS includes a small number of coordinating 'pillars' under which all relevant services will be governed. One of these pillars will focus on waveform data. Hence the existing organization with a distributed set of EIDA nodes governed under ORFEUS is likely to continue into EPOS. Hosting a Primary Node will be an EPOS core service, and will thus be recognized formally at the national EPOS level.

Currently available documentation

ArcLink	www.seiscomp3.org/wiki/doc/applications/arclink
Arclink_fetch	www.seiscomp3.org/wiki/doc/applications/arclink_fetch
Arclinktool	www.seiscomp3.org/wiki/doc/applications/arclinktool
Obspy.arclink	http://docs.obspy.org/packages/obspy.arclink.html
Wavesdownloader	http://webservices.rm.ingv.it/wavesdownloader/

Appendices

Appendix 1.EIDA Mou + appendix
Appendix 2. Guidelines Joining EIDA primary nodes
Appendix 3 (a - f) Technical description of six current EIDA primary nodes

Glossary

Antelope – full scale data acquisition, management and analysis system (BRTT)
BGR - Bundesanstalt für Geowissenschaften und Rohstoffe
CNRS - Centre National de la Recherche scientifique
EIDA – European Integrated waveform Data Archive
EMB – EIDA Management Board
EPOS – European Plate Observing System (ESFRI initiative)
ETC – EIDA Technical Committee
ETHZ – Eidgenössische Technische Hochschule Zürich
GEOFON – GFZ international broadband seismograph network
Geoscope – IPGP international broadband seismic network
GFZ – GeoForschungsZentrum
INGV – Istituto Nazionale di Geofisica e Vulcanologia
INSU – Institut National des Science de l'Univers
IPGP – Institut de Physique du Globe de Paris
IRIS – Incorporated Research Institutions for Seismology (US)
IRIS DMC – IRIS Data Management Center
KNMI – Koninklijk Nederlands Meteorologisch Instituut
MoU – Memorandum of Understanding
NAQS – Nanometrics data server
ODC – ORFEUS Data Center
ORFEUS – Observatories and Research Facilities for European Seismology
ReSif – Réseau Sismologique et Geodesigue Français
RTPD – RefTek communication protocol
SCREAM – Guralp communication protocol
SeedLink – data communication protocol
SeisComP3 - full scale data acquisition, management and analysis system (GFZ)
SOP – Standard Operating Procedures
TCP – Transmission Control Protocol