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QuakeML–XML concepts for a European seismological data exchange infrastucture

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We report on the progress of the development of QuakeML. QuakeML is a flexible, extensible and modular XML representation of seismological data which is intended to cover a broad range of fields of application in modern seismology. QuakeML is an open standard and is developed by a distributed team in a transparent collaborative manner. The first part of the standard, QuakeML Part 1, which covers a basic seismic event description, has been subjected to a Request for Comments process. The standardization process for inventory information (part 2) and resource metadata (part 3) is also under way. The flexible approach of QuakeML allows further extensions of the standard in order to represent waveform data, macroseismic information, probability density functions, moment tensors, slip distributions, shake maps, and others.

QuakeML is developed in parallel with a UML representation of its data model. This allows an elaborate software development strategy which uses the UML class model together with a custom UML profile as the basis for furher automated code generation. With this technique, a library of C++ classes is generated which can be serialized either to XML (QuakeML) or to SQL for persistent storage in a relational database. The XML Schema description is created automatically from the UML model with the help of tagged values, which describe the mapping from UML class attributes to XML representation. The library approach makes it easy for application developers to include QuakeML support in their products, since no own source code has to be written. Serialization of objects to and from QuakeML format will be supported by the API. It is possible to use the QuakeML library from other object-oriented programming

languages, e.g., Java and Python, using wrappers.

QuakeML is tightly woven into SeisComP 3 as its internal data exchange format. SeisComP 3 is a software package for real-time networked seismographic systems, which is currently developed by the GFZ Potsdam, and which uses the same code development paradigm. Furthermore, new versions of ZMAP and ArcLink are currently adapted to QuakeML.

The QuakeML language defintion is supplemented by a concept to provide resource metadata and facilitate metadata exchange between distributed data providers. For that purpose, we propose a URI-based format for unique, location-independent identifiers of seismological resources which are assigned by approved naming authorities. QuakeML Part 3 defines a RDF vocabulary for resource metadata description, covering the resource's identity, curation, content, temporal availability, data quality, and associated services. We propose to set up a network of registry institutions which offer web services for resolving resource identifiers into corresponding RDF/XML metadata descriptions, and additionally provide means for resource discovery by offering services for searches against resource metadata.

We are confident that—in combination with further standardization efforts—the concept of QuakeML can contribute to facilitate data exchange and interoperability of seismological data providers in Europe and world-wide.

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