SeisComP Introduction

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Outline

1. GITEWS

2. SeisComP
   - Overview
   - BMKG, Jarkarta/Indonesia
   - Architecture
   - Modules
   - GUIs
SeisComP3 - background

- SeisComP3 is developed in the scope of the GITEWS (German Indonesian Tsunami Early Warning) project
- GITEWS project was running from 2005 to 2010, follow up project is PROTECTS
- Total budget of 50 Mio EUR for GITEWS and 10 Mio EUR for PROTECTS
SeisComP Overview

- Software package handling
  - acquisition
  - archiving
  - processing
  - analysis
  - quality control

  of seismological data

- Graphical user interfaces for
  - visualization of waveforms and station status
  - event visualization
  - state-of-health monitoring
  - manual analysis

- Emphasis on simplicity and speed

- Developed in the context of tsunami warning
SeisComP Evolution

- Originally designed as acquisition and archiving software for GEOFON\(^1\)
- **2001** SeedLink as core acquisition protocol and software becomes a de-facto standard in Europe
- **2003** Development of simple automatic analysis tools (after Algerian earthquake)
- **2005**
  - global associator/locator
  - interactive analysis using Seismic Handler (SeisComP2)
  - ArcLink server as distributed waveform and meta-data server

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\(^1\)http://geofon.gfz-potsdam.de
SeisComP Evolution

- **2006** Development of the 3rd generation of SeisComP within GITEWS project
- **2007** Installation at BMKG, Jakarta/Indonesia in May 2007
- **2008** Major release SeisComP3 Barcelona (first public release)
- **2009** Major release SeisComP3 Erice
- **2010** Major release SeisComP3 Potsdam
- **2011** Major release SeisComP3 Zurich
- **2012** Major release SeisComP3 Seattle

Seattle version is stable, 11 major updates since release.
SeisComP Main Features

- Distributed processing
- SeedLink for data acquisition
- SeisComP3XML, a branch of QuakeML\(^2\) for database schema and communication protocol
- Automatic 2 level P- and S-picker (STA/LTA and AIC)
- Automatic location modules supporting different velocity models and locators
- Magnitudes: MLv, ML, Md, mb, mB, Mw(mB), Mwp, Mw(Mwp), Mjma, Ms(BB)
- Graphical user interfaces
  - Real-time traces
  - Network/station status
  - Event visualization
  - Event and waveform analysis
  - State-of-health monitoring
  - Data quality monitoring

\(^2\) http://www.quakeml.org
SeisComP Main Features

- Use of de-facto standards for waveform and parameter exchange (QuakeML, SeedLink, ArcLink, FDSN web services)
- Interprocess communication between modules builds on TCP/IP
- Database support for MYSQL, SQLite3, PostgreSQL
- Scripting interface for Python
Operator’s desk with a 4 monitor system connected to the processing server (new warning room)
SeisComP3 users

- ~30 tsunami warning centers
- ~60 universities
- ~50 earthquake monitoring centers
- ~50 research centers
- ~10 commercial companies
**Retrieves** waveform data from remote stations, archives it and delivers it to clients on request  
Modules: **SeedLink**, **slarchive** and **ArcLink**

**Processes** waveform data automatically and emits derived parameters such as picks, amplitudes, magnitudes, hypocenters and events  
Modules: **scmaster**, **scautoloc**, **scautopick**, **scamp**, **scmag** and **scevent**

**Provides** graphical user interfaces to analyse and verify results and waveforms interactively either in realtime or as post event analysis  
Modules: **scrttv**, **scmv**, **scolv** and **scesv**
SeisComP3 components

- **SeedLink**
- **ArcLink**

**Acquisition**

**Processing**
- **autopick**
- **autoloc**
- **QC**
- **event associator**

**Analysis**
- **Map View**
- **Trace View**
- **Locator View**
- **Event View**

**Event**
- **M 3.5**
- **M 3.5 (A)**
- **M 3.4 (M)**

**SeisComP3**

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**SeedLink** collects waveform data from stations through plugins. Many plugins for various digitizers are available. **SeedLink** is a TCP server and delivers TCP data streams to remote clients on port 18000 (configurable).

**slarchive** stores the waveforms in an archive (SDS structure).

**ArcLink** provides the archived data as a TCP server to local/remote clients on port 18001 (configurable).
**Waveform server** provides real time data with SeedLink and archived data with ArcLink. **Master** is messaging server\(^a\) which handles meta data exchange between SC3 modules and stores objects in a database. Connections are excepted from TCP clients on port 4803. **EventTool** associates origins (locations) to events and chooses the best location and magnitude among all candidates.

\(^a\)based on Spread toolkit [http://www.spread.org](http://www.spread.org)
SeisComP3 processing & interactive system

Automatic and interactive system each running on a dedicated computer. Both systems are connected to the same messaging and waveform server.
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>seedlink</td>
<td>Real time data acquisition</td>
</tr>
<tr>
<td>slinktool</td>
<td>SeedLink query interface</td>
</tr>
<tr>
<td>slarchive</td>
<td>Storing waveform data in SDS structure</td>
</tr>
<tr>
<td>arclink</td>
<td>Retrieval of archived waveform data</td>
</tr>
<tr>
<td>arclinktool</td>
<td>ArcLink query interface</td>
</tr>
</tbody>
</table>
### SeisComP3 processing modules

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>scmast</td>
<td>TCP/IP messaging server</td>
</tr>
<tr>
<td>scautopick</td>
<td>Automatic P detector/picker</td>
</tr>
<tr>
<td>scautoloc</td>
<td>Automatic locator</td>
</tr>
<tr>
<td>screloc</td>
<td>Automatic relocator</td>
</tr>
<tr>
<td>scamp</td>
<td>Amplitude calculation</td>
</tr>
<tr>
<td>scmag</td>
<td>Magnitude calculation</td>
</tr>
<tr>
<td>scevent</td>
<td>Event associator</td>
</tr>
<tr>
<td>scqc</td>
<td>Quality parameters of waveforms</td>
</tr>
<tr>
<td>scevtlog</td>
<td>Logging of event states</td>
</tr>
<tr>
<td>scdb</td>
<td>Database storage of parametric data</td>
</tr>
<tr>
<td>scvoice</td>
<td>Acoustic alerts</td>
</tr>
<tr>
<td>scalert</td>
<td>Custom alarms</td>
</tr>
</tbody>
</table>
## SeisComP3 analysis modules

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>scrttv</td>
<td>Real time trace viewer</td>
</tr>
<tr>
<td>scmv</td>
<td>Map viewer showing the overall situation</td>
</tr>
<tr>
<td>scolv</td>
<td>Revision of processing results and manual picker</td>
</tr>
<tr>
<td>scesv</td>
<td>Event summary viewer</td>
</tr>
<tr>
<td>scqcv</td>
<td>Waveform quality viewer</td>
</tr>
<tr>
<td>scheli</td>
<td>Helicorder</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>scconfig</td>
<td>GUI for configuration of SeisComP3</td>
</tr>
<tr>
<td>wsfdsn</td>
<td>FDSN webservice implementation</td>
</tr>
<tr>
<td>import_inv</td>
<td>Wrapper for inventory converter</td>
</tr>
<tr>
<td>inv2dlsv</td>
<td>Inventory to dataless Seed converter</td>
</tr>
<tr>
<td>invextr</td>
<td>Extracts or removes networks, stations or channels from an inventory XML file</td>
</tr>
<tr>
<td>scinv</td>
<td>Inventory XML merger</td>
</tr>
<tr>
<td>stationconf</td>
<td>Station metadata configurator (the old way)</td>
</tr>
<tr>
<td>scsohlog</td>
<td>State-of-health logging</td>
</tr>
<tr>
<td>scchkcfg</td>
<td>Checks seiscomp configuration for case-sensivity issues</td>
</tr>
<tr>
<td>scdispatch</td>
<td>Sends simple SeisComP3 objects</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td><code>scart</code></td>
<td>Export/import waveforms from/into archive</td>
</tr>
<tr>
<td><code>scbulletin</code></td>
<td>Create event bulletins</td>
</tr>
<tr>
<td><code>scmm</code></td>
<td>Message and performance monitor</td>
</tr>
<tr>
<td><code>scevtls</code></td>
<td>List available events</td>
</tr>
<tr>
<td><code>scevtstreams</code></td>
<td>Extract stream information from events</td>
</tr>
<tr>
<td><code>scimex</code></td>
<td>Import/export for earthquake parameters</td>
</tr>
<tr>
<td><code>scimport</code></td>
<td>Message relaying</td>
</tr>
<tr>
<td><code>scm</code></td>
<td>state-of-health monitor</td>
</tr>
<tr>
<td><code>scxmldump</code></td>
<td>Dumping event parameters to XML</td>
</tr>
<tr>
<td><code>sczip</code></td>
<td>SeisComP3 file (de)compressor</td>
</tr>
</tbody>
</table>
SeisComP3 MapView

Ground motion legend

Triggering station

Station showing the recent ground motion
SeisComP3 MapView

- **Associated Station**
- **Epicenter**
- **Spreading S-Wave**
- **Spreading P-Wave**
- **Earthquake Information (F10)**

Associated Station

Epicenter

Spreading S-Wave

Spreading P-Wave

Earthquake Information (F10)
SeisComP3 EventSummaryView

- Prefered magnitude + depth
- OriginTime + Time ago
- Magnitude information
- Hypocenter information
- Epicenter with MT (optional)
SeisComP3 OriginLocatorView

- Event summary
- Distance residual plot
- Phase table
- Import picks
- ManualPicker
- Commit solution
SeisComP3 OriginLocatorView

Azimuth residual plot

Choose Locator

Choose velocity profile
SeisComP3 OriginLocatorView

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SeisComP3 OriginLocatorView

Moveout plot

Jujuy Province, Argentina

Time: 2011-09-29 07:52:21
Depth: 302 km +/- 10 km

Min. Dist.: 1.8 km
EventID: -
Agency: GEMPA
Author: weber@webertink.pt
Evaluation: confirmed (M)
Method: LOCASAT
Earth model: lasp91
Updated: 2011-11-05 13:35:22

Profile: lasp91
Fix depth: 302 km
Distance cutoff: 1000 km

Scolv
File Edit View Settings Help

Location Magnitudes Event Events

Santa Cruz
La Paz
Cochabamba

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First motion plot

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SeisComP3 OriginLocatorView

- Zoom trace at bottom
- Align traces
- Choose filter
- Apply
- Sort traces
- Post picker
- Time scale
- Color coded timing quality
Choose component

Pick P/S

Show stations in distance of x

Picks (red/green)

Theoretical arrivals (blue)
http://www.seiscomp3.org