Introduction to the key features of SeisComP3

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Outline

1. GEMPA

2. SeisComP
   - Overview
   - BMKG, Jarkarta/Indonesia
   - Architecture
   - Modules
   - GUIs
Commercial spin-off of GFZ Potsdam

9 employees (2 seismologists, 4 software engineers, 2 system administrators, 1 web developer)

Offering solutions for tsunami early warning, local earthquake and geothermal monitoring

Customers are tsunami warning centers, earthquake services and energy industry
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
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

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

2014 Major release SeisComP3 Jakarta

Completely open source!
SeisComP World-wide Distribution

World-wide SeisComP installations (last updated March, 2014)

- 30 tsunami warning centers
- 60 universities
- 10 commercial companies

- 50 earthquake monitoring centers
- 50 research centers
- 25 CTBTO NDC using it in daily operation
SeisComP Main Features

- Distributed processing
- SeedLink for data acquisition
- SeisComP3XML, a branch of QuakeML 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

http://www.quakeml.org

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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 components

**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

Acquisition

SeedLink
ArcLink

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)

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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).
SeisComP3 processing system

**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)
Automatic and interactive system each running on a dedicated computer. Both systems are connected to the same messaging and waveform server.
## SeisComP3 acquisition modules

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

<table>
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<tr>
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<tbody>
<tr>
<td>scrttv</td>
<td>Real time trace view</td>
</tr>
<tr>
<td>scmv</td>
<td>Map view 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 view</td>
</tr>
<tr>
<td>scqcv</td>
<td>Waveform quality view</td>
</tr>
<tr>
<td>scheli</td>
<td>Helicorder plots</td>
</tr>
</tbody>
</table>
## SeisComP3 utilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<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>
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<tr>
<td>scart</td>
<td>Export/import waveforms from/into archive</td>
</tr>
<tr>
<td>scbulletin</td>
<td>Create event bulletins</td>
</tr>
<tr>
<td>scmm</td>
<td>Message and performance monitor</td>
</tr>
<tr>
<td>scevtls</td>
<td>List available events</td>
</tr>
<tr>
<td>scevtstreams</td>
<td>Extract stream information from events</td>
</tr>
<tr>
<td>scimex</td>
<td>Import/export for earthquake parameters</td>
</tr>
<tr>
<td>scimport</td>
<td>Message relaying</td>
</tr>
<tr>
<td>scm</td>
<td>State-of-health monitor</td>
</tr>
<tr>
<td>scxmldump</td>
<td>Dumping event parameters to XML</td>
</tr>
<tr>
<td>sczip</td>
<td>SeisComP3 file (de)compressor</td>
</tr>
</tbody>
</table>
## ENIAB utilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>css2inv</td>
<td>Converts station information from the IDC schema to SeisComP3 XML</td>
</tr>
<tr>
<td>inv2css</td>
<td>Converts station information from SeisComP3 XML to the IDC schema</td>
</tr>
<tr>
<td>css2proc</td>
<td>Converts IDC results to SeisComP3 XML</td>
</tr>
<tr>
<td>proc2css</td>
<td>Converts SeisComP3 results to IDC schema</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>CAPS</td>
<td>Multi format acquisition server</td>
</tr>
<tr>
<td>GDS with GIS</td>
<td>Dissemination server with image generator</td>
</tr>
<tr>
<td>QuakeLink</td>
<td>Real-time event information streaming</td>
</tr>
<tr>
<td>scanloc</td>
<td>Cluster search based locator using P- and S-phases</td>
</tr>
<tr>
<td>ccloc</td>
<td>Crosscorrelation locator (alpha version)</td>
</tr>
<tr>
<td>sceval</td>
<td>Origin evaluator based on station distribution comparison</td>
</tr>
<tr>
<td>VORTEX</td>
<td>Volcano monitoring supporting RSAM and SSAM</td>
</tr>
<tr>
<td>automt/mtv</td>
<td>Automatic and interactive moment tensor calculation</td>
</tr>
<tr>
<td>WEBGUIs</td>
<td>Browser based GUIs replacing scrttv, scmtv, scesv, scolv</td>
</tr>
<tr>
<td>SMP</td>
<td>Station metadata portal</td>
</tr>
<tr>
<td>SMGUI</td>
<td>Strong motion GUI</td>
</tr>
<tr>
<td>WebConfig</td>
<td>Browser based version of scconfig</td>
</tr>
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### SeisComP3 GUIs

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SeisComP3 MapView

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Epicenter

Associated Station

Spreading S-Wave

Spreading P-Wave

Earthquake Information (F10)
SeisComP3 TraceView

- Enable/disable streams
- Pick
- Stream information
- Time scale
SeisComP3 TraceView

Enable/disable streams

Pick

Stream information

Time scale
SeisComP3 EventSummaryView

2011-11-07 11:59:32 UTC
1 hours and 5 minutes ago
Afghanistan-Tajikistan Border Region

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

Type: Value +/- Count
M: 5.5 - 225
MLv: 6.7 0.17 5
Mw(mB): 5.4 0.40 126
mB: 5.8 0.20 126
mb: 5.6 0.26 225

Latitude: 36.55 °N +/- 2 km
Longitude: 71.17 °E +/- 1 km
Depth: 210 km +/- 1 km
RMS Count: 328
RMS Residual: 1.0
Agency: GFZ
Status: manual
First Location: Q.T. + 5m 17s
This Location: Q.T. +46m 15s
EventID: gftp2011wvr

Focal Mechanism
Latitude: 36.55 °N
Longitude: 71.12 °E
Depth: 210 km
SeisComP3 OriginLocatorView

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

Choose Locator
Choose velocity profile
Azimuth residual plot
SeisComP3 OriginLocatorView

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SeisComP3 OriginLocatorView

Polar plot
First motion plot

SeisComP3 OriginLocatorView

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SeisComP3 OriginLocatorView

- Choose filter
- Choose amplitude type
- Start amplitude calculation
- Apply
- Pick Amplitudes
- End time of Amplitude window
- Start time of Amplitude window
SeisComP3 OriginLocatorView

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

Pick P/S

Show stations in distance of x

Picks (red/green)

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