

## Playbacks in SeisComP3

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# Why Playbacks?

## Testing

- Configuration
- Development
- System resources
- Scalability

## Debugging

- Error reproduction (and –hopefully– elimination)

## Demonstration

- Press and TV
- Presentation and documentation

## Data analysis

- Automated analysis of offline field data
- Use of improved analysis tools on archive data

# What kinds of playbacks?

## Full waveform playbacks

- Testing of new waveform processing modules using old data
- Overall system performance tests
- “Elchtest” kind of high-stress tests
- Excellent “show” effect for media, visitors and presentations

## Parametric playbacks

- very light-weight, no CPU intensive waveform processing
- can be played back very quickly (seconds)
- often sufficient for debugging
- in-depth debugging/testing of e.g. scautoloc
- scautoloc with built-in playback option
- should become the basis for systematic unit testing

# “Online” vs. “Offline” Waveform Playback

## Online Playback

Behaves just like a normal “online” processing, **except**

- SeedLink acquires it's data from a FIFO
- waveform times are faked to give a real-time like behaviour
- no increased playback speed

## Offline Playback

- one module (scautopick) reads the waveforms directly
- downstream modules only receive parametric data through messaging
- database is bypassed, i.e. scmaster only acts as message hub
- “offline” because both data acquisition and database are offline
- speed depending mainly on network size, sampling rate and system resources, typically factor 100-10000

# Current Online Waveform Playback Status

- waveforms for all channels saved in a single MiniSEED file
- within the playback file MiniSEED records are sorted according to end time
- a program (msrtsimul) plays back the records via a FIFO file where data are picked up by SeedLink
- records start times are faked by adding a constant time offset as if they are real-time
- allows endless playbacks without colliding objects
- does not allow to obtain true pick and origin times (not suitable for “public” playbacks, media, TV, etc.)
- playback as if there were no feed latencies (which is usually realistic)

# Current Parametric Playback Status

- Main purpose is testing of scautoloc:
  - picks and amplitudes
  - manual and external origins
  - and later –perhaps– S picks ;-)
- based on XML created from database
- scautoloc with built-in XML playback option
- but XML could be played back through messaging, too
- playback speed based on object creation time
- convenience scripts soon to be made available to the community
- in principle it would allow to prepare a playback to send to Joachim to have a look at what might have gone wrong
- in practice this should probably not be advertised too much ;-)

# Tools in SC3 related to waveform playback

## scevtstreams + scart

### scevtstreams

extracts from the database streams used in an event location

### scart

Swiss Army knife for archive access

## scxmldump

in order to save the entire inventory corresponding to the waveforms

## make-mseed-playback.sh

All-in-one solution for playback generation from event ID to sorted mseed file (except inventory) – not in distribution

## msrtsimul

**MiniSEED** real-time **simulation** tool - the tool to play back the data into a SC3 system

## scevtstreams + scart

**scevtstreams** connects to database and prints those streams that were used in an event location:

```
$ db=mysql://sysop:sysop@geofon-proc/seiscomp3
$ scevtstreams -d $db -R -E gfz2013ahzu -L 0 -m 300 >list.txt
$ cat list.txt
2013-01-05 08:54:31;2013-01-05 09:23:37;CN.BBB..BHZ
2013-01-05 08:54:31;2013-01-05 09:23:37;CN.BBB..BHN
2013-01-05 08:54:31;2013-01-05 09:23:37;CN.BBB..BHE
2013-01-05 08:54:31;2013-01-05 09:23:37;II.KDAK.00.BHZ
2013-01-05 08:54:31;2013-01-05 09:23:37;II.KDAK.00.BH1
2013-01-05 08:54:31;2013-01-05 09:23:37;II.KDAK.00.BH2
...
```



## scevtstreams + scart

**scart** reads the output of **scevtstreams** and requests data for the time windows and streams from the data source, which is normally an Arlink server:

```
$ srv=arlink://geofon-acqui.gfz-potsdam.de:18001
```

```
$ scart --list list.txt -I $srv archive
```

```
$ du archive
```

```
428 archive/2013/CK/ASHT/HHN.D
```

```
352 archive/2013/CK/ASHT/HHZ.D
```

```
428 archive/2013/CK/ASHT/HHE.D
```

```
1212 archive/2013/CK/ASHT
```

```
172 archive/2013/CK/OTUK/HHN.D
```

```
156 archive/2013/CK/OTUK/HHZ.D
```

```
176 archive/2013/CK/OTUK/HHE.D
```

```
508 archive/2013/CK/OTUK
```

```
...
```

```
# optionally
```

```
scart -dv --list list.txt archive | scmssort -uE > sorted.mseed
```

# scevtstreams + scart

## Advantages

- Simple playback generation using existing SC3 utilities
- Possibility of filter the stream list e.g. by using grep
- Flexibility of scart especially w.r.t. different data sources
- Possibility to create a SDS single-event archive
- Optionally create a multiplexed, sorted mseed file

## Disadvantages

- Restriction to streams used in event location
- What if we want to test new analysis methods using unpicked streams?
- Generation of sorted, multiplexed file requires additional invocation of scart

# Online Waveform Playback Generation

The following is an “all-in-one” alternative to the playback generation using `scevtstreams` and `scart`. It includes also streams that were not picked. At the beginning of the Shell script `make-mseed-playback.sh` as well as the corresponding Python script `make-mseed-playback.py` some settings need to be hardcoded once, i.e. Arclink server and time windows.

The invocation is simply:

```
$ cd sc3stuff/playback/mseed $  
./make-mseed-playback.sh gfz2013ahzu
```

where you have to replace `gfz2013ahzu` with the correct event ID. This will generate a single, multiplexed file containing all waveforms: `gfz2013ahzu-M7.5.sorted-mseed`

# Online Waveform Playback Configuration

The screenshot shows the 'SeisComP3 - system configuration' window. The title bar indicates the window is titled 'SeisComP3 - system configuration'. The menu bar contains 'File' and 'Edit'. The main window is titled 'Configuration / seedlink' and has a subtitle 'Real-time waveform server implementing the SeedLink protocol.' The left sidebar contains a tree view with categories: Information, System, Inventory, Modules, and Bindings. Under 'Modules', the 'seedlink' module is selected. The right pane shows configuration options for 'seedlink'. A yellow tooltip is visible over the 'msrtsimul' checkbox, containing the text: 'If activated Seedlink uses the mseedfiffo to read records and only the mseedfiffo\_plugin is started. This command is useful to playback historic data by eg msrtsimul.' The configuration options include: 'window\_extraction\_trusted' (checked), 'msrtsimul' (checked), and 'info' (info level provided to arbitrary hosts).

SeisComP3 - system configuration

File Edit

## Configuration / seedlink

Real-time waveform server implementing the SeedLink protocol.

- Acquisition
  - arlink
  - arlinkproxy
  - caps
  - seedlink**
  - slarchive
- GUI
  - scesv
  - scmv
  - scolv
  - scqcv
  - scrttv
- Inventory
  - import\_inv
  - invextr
- Messaging
  - scmaster
- Processing
  - scamp
  - scautoloc
  - scautoloc2

Can be enabled or disabled. Required for slinktool ...

**window\_extraction\_trusted**  
Same as window\_extraction for trusted IP addresses.

**msrtsimul**  
If activated Seedlink uses the mseedfiffo to read records ...

info  
streams  
Info level provided to arbitrary hosts.

If activated Seedlink uses the mseedfiffo to read records and only the mseedfiffo\_plugin is started. This command is useful to playback historic data by eg msrtsimul.

# Online Waveform Playback Configuration

SeisComP3 - system configuration

File Edit

## Configuration / seedlink

Real-time waveform server implementing the SeedLink protocol.

**Acquisition**  
arlink  
arlinkproxy  
...

Can be enabled or disabled. Required for slinktool ...

**Inventory**  
scqcv  
scrttv  
...

**Inventory**  
import\_inv  
invextr  
...

**Messaging**  
scmaster  
...

**Processing**  
scamp  
scautoloc  
scautoloc2

if activated seedlink uses the mseedfio to read records and only the mseedfio\_plugin is started. This command is useful to playback historic data by eg msrtsimul.

info  
streams  
Info level provided to arbitrary hosts.

**Only the acquisition needs to be modified**  
in order to work with the `msrtsimul` utility

# Online Waveform Playback Start

Nothing easier than that!

```
$ mseed=gfz2013ahzu-M7.5.sorted-mseed  
$ msrtsimul --jump 25 $mseed
```

Remarks:

- The playback file contains 30 min of data in advance of origin time.
- We want to reduce this to 5 min, so we jump to 25 min past the start of the playback.
- Other (less frequently used) options include
  - verbose
  - speed factor

# Offline Playback – Concepts and Limitations

- Process data from file(s) as fast as system resources allow
- Often months or years of archived data
- No SeedLink – only scautopick reads waveform data (from file).
- Therefore no scamp – only those amplitudes produced by scautopick
- But we do have a modular system – and modules need to “talk”.
- This is why messaging is still required.
- Database I/O is a bottleneck – disable database in scmaster!
- Clients connect to messaging ad hoc - and disconnect when done.
- One module (sceplug) grabs all generated messages and dumps the objects as XML.
- No place for waveform processing modules besides scautopick
- Processing is incremental: scautoloc sends intermediate solutions.

# Offline Waveform Playback Configuration

SeisComP3 - system configuration

File Edit

## System

The current status of the system

Information: Update Start Stop Restart Check Enable module(s) Disable module(s) Update configuration

All commands (such as 'start', 'stop') will affect all modules which rows are currently selected. If no row is selected, all modules are affected. You can clear the row selection with ESC.

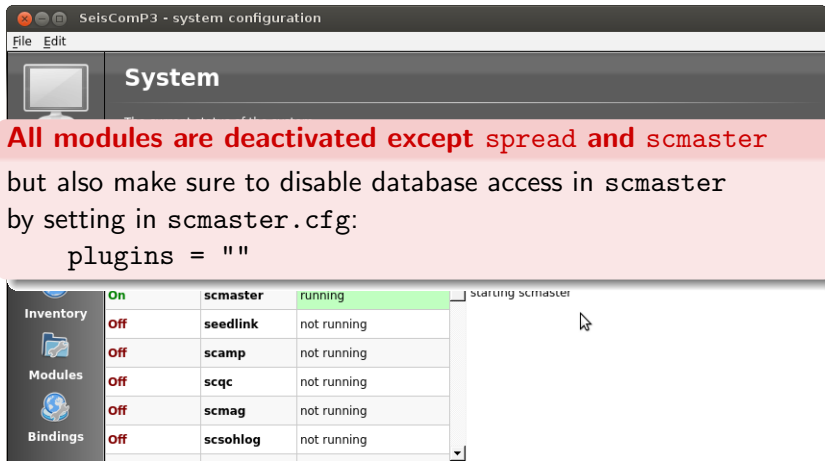
Auto	Module	Status
On	spread	running
On	scmaster	running
Off	seedlink	not running
Off	scamp	not running
Off	scqc	not running
Off	scmag	not running
Off	scsohlog	not running

Idle

```
$ seiscomp start
starting spread
starting scmaster
```



# Offline Waveform Playback Configuration



The screenshot shows the 'System' configuration window in SeisComP3. A red callout box highlights the configuration state: 'All modules are deactivated except spread and scmaster but also make sure to disable database access in scmaster by setting in scmaster.cfg: plugins = ""'. Below the callout, a table lists the status of various modules. The 'scmaster' module is shown as 'running', while others are 'not running'. A terminal window on the right shows the command 'starting scmaster'.

On	scmaster	running	starting scmaster
Off	seedlink	not running	
Off	scamp	not running	
Off	scqc	not running	
Off	scmag	not running	
Off	scsohlog	not running	

# Offline Waveform Playback Start

We use the `playback.sh` script available on the SeisComP3 wiki\*

```
$ mseed=gfz2013ahzu-M7.5.sorted-mseed
$ xml=gfz2013ahzu.xml
$ ./playback.sh $mseed $xml
```

Remarks:

- The playback file is one multiplexed file as for online playback
- The resulting XML file can be visualized e.g. with `scbulletin` or `scolv`:

```
$ scbulletin -3 -i gfz2013ahzu.xml
$ scolv --offline --inventory-db sc3-inventory.xml
      -I gfz2013ahzu-M7.5.sorted-mseed
```

[\*] <http://www.seiscomp3.org/wiki/recipes/playbacks/offline/messaging>

# XML Playback Creation

```
$ ./make-xml-playback.sh "gfz2013ahzu" "Alaska Mw7.5"  
time window: 2013-01-05 08:38:19.916 ... 2013-01-05 09:28:19.916  
loaded 1378 picks  
loaded 4786 amplitudes  
loaded 23 origins  
$ ls -l gfz2013ahzu  
total 14368  
-rw-rw-r-- 1 saul saul    123894 Jan 10 14:21 bulletin  
-rw-rw-r-- 1 saul saul      27 Jan 10 14:21 comment.txt  
-rw-rw-r-- 1 saul saul 14547229 Jan 10 14:21 objects.xml  
-rw-rw-r-- 1 saul saul    31824 Jan 10 14:21 station-locations.txt
```

# XML Playback with Autoloc

In the previous slide it was described how to **create** an XML playback. Here is how we **run** it from scautoloc:

```
$ ./run-xml-playback-autoloc.sh gfz2013bbpt
```

The main point here is to generate a log file rather than to send any objects to the messaging. The log file can then be used for testing the configuration (or debugging the autoloc source code if you are really keen). It could also form the basis for systematic unit testing.

## XML Playback into Messaging

Two slides before it was described how to **create** an XML playback. Here is how we send the objects to the messaging on a remote host. Before doing this, edit the script and at the beginning specify the correct target host (st127 in this example).

```
$ ./run-xml-playback-messaging.sh gfz2013bbpt
[...]  
17:43:47 [info] user "" connected successfully to st127  
17:43:47 [info] Setting message encoding to binary  
17:43:47 [info] Starting message thread  
Sent Pick 20130116.021855.01-IU.DAV.00.BHZ  
Sent Pick 20130116.021848.26-IU.TIXI.00.BHZ  
Sent Pick 20130116.021855.55-BS.PLD..BHZ  
Sent Amplitude 20130116.021855.55-BS.PLD..BHZ.snr  
Sent Amplitude 20130116.021855.01-IU.DAV.00.BHZ.snr  
[...]
```

# Summary

- Several types of playback possibilities available in SC3
- Playback generation and configuration no “black magic” any more
- Some helper scripts are available on **github** under `https://github.com/jsaul/sc3stuff`
  - `make-mseed-playback.sh`
  - `make-xml-playback.sh`
  - `run-xml-playback-autoloc.sh`
  - `run-xml-playback-messaging.sh`
- For more help on offline playbacks, including the script on the previous slide, see:  
`http://www.seiscomp3.org/wiki/recipes/playbacks/...`  
`.../offline/messaging`

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- Several types of playback possibilities available in SC3
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- For more help on offline playbacks, including the script on the previous slide, see:  
<http://www.seiscomp3.org/wiki/recipes/playbacks/...>  
[.../offline/messaging](http://www.seiscomp3.org/wiki/recipes/playbacks/.../offline/messaging)

**Please learn and use playbacks!**

They can make life a lot easier and can be lots of fun!