



SSI Calibration Module

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The **SSI calibration module** is a tool that extends the Standard Station Interface (SSI) for **intuitive execution of instrumental calibrations** and **review of calibration results**.

- It aims to **support the complex planning, technical execution, evaluation** and **reporting** of the calibration of IMS seismic and T-phase stations.
- The SSI Calibration module also provides **a single and standard interface** that masks the heterogeneity of the hardware/software used at different IMS stations.
- Finally, the SSI Calibration module helps to **standardize the communication** through the full implementation of IMS2.0 format to dramatically ease the exchange, parsing and review of calibration messages, for both the Station Operator and PTS staff.

The module has been **deployed** at a number of stations and the PTS currently continues its **deployment** at other stations. This poster presents the SSI Calibration module and focuses on the functionalities **supporting Station Operators** during calibration activities.



The IMS **Operational Manual** includes **strict requirements** regarding calibration of IMS seismic stations:

- **On-site calibration** results are used as QC for instrument **stability**
 - “stability”: +/- 5% to the instrument nominal response in amplitude (and +/- 5° in phase)
 - QC performed over the full IMS passband
 - QC performed on a yearly basis
- **Planning** and **communication**
 - at the Network level: attribution of calibration time slots to Stations
 - at the Station level: calibration messages exchanged between SO and the IDC

Calibration activities challenges:

- **high number** of sensor-digitizer **combinations** (hardware/software/procedures/training)
- PTS **resources to train** Station Operators on calibration activities
- **variety** and **complexity** of hardware/software issues
- compliance with the OM requirements for **full frequency calibration** and sending of results at the **IMS2.0 format**
- compliance with **command and control** and **authentication** requirements while performing on-site calibration activities

SSI Calibration Module features:

- Calibration operational **process** fully supported by the calibration module
- Communication between the PTS and the Station using standardized **IMS2.0** format (including full-frequency response submission)
- Command and Control **authentication** (through SSI Authentication module)
- Define, perform, review and report on calibrations performed
- **Auto-evaluation** of the calibration results (IN_SPEC YES or NO)
- Variety of the sensor/digitizer **combinations** supported (Nanometrics Europa, Guralp D24, Quanterra Q330, MariPro DDFI)
- GUI executed locally, all communications with the workstation are using CLI commands, thus minimizing the load on GCI **bandwidth** and allowing smooth calibration of remote sites from CRF or PTS

Supported Hardware:

- Supported **digitizers**
 - Güralp DM24
 - Nanometrics Europa-T / Europa HRD
 - Quanterra Q330HR
- Tested configurations (**digitizers/sensors**)
 - DM24 + CMG-3T ; DM24 + STS-2
 - EuropaT + CMG-3T ; EuropaT + STS-2 ; EuropaT + GS13
 - Q330HR + CMG-3T ; Q330HR + STS-2



Guralp DM24



EuropaT



Q330HR



CMG-3T



STS-2



GS13

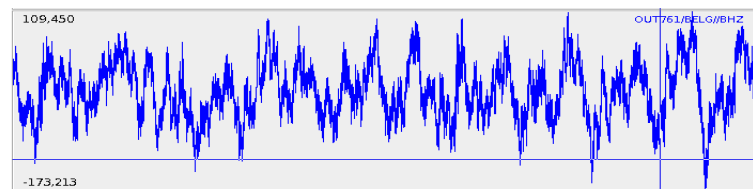
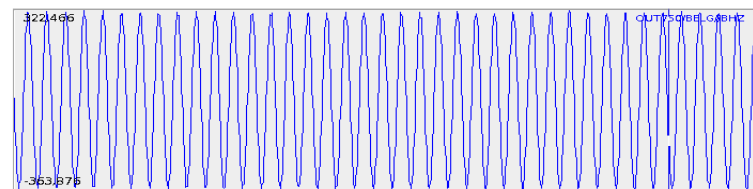
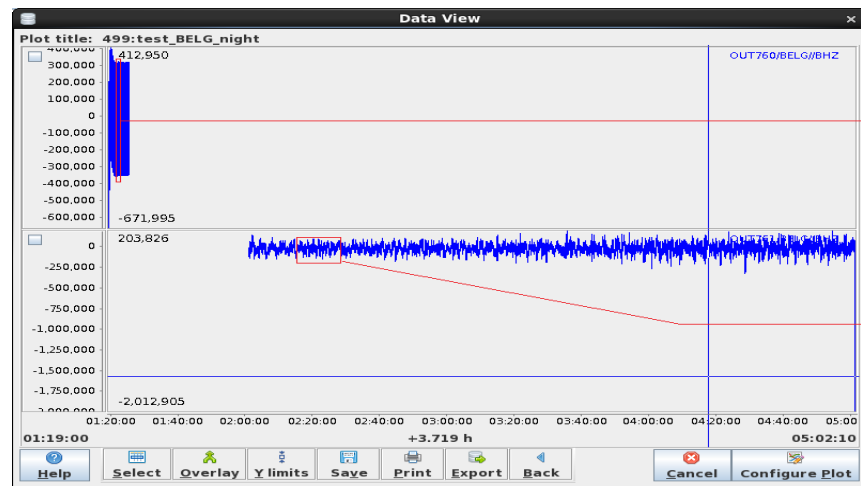
Calibration Scenario Definition and Scheduling

The screenshot displays the **ssiCalibView - v.2.36** application. On the left, a list of stations is shown with their GIDs (499 to 452) and labels (e.g., test BELG night). The main window shows a detailed view for station **GID: 499**, which has a **Status: Success**. Below this, a table lists the calibration scenarios for this station:

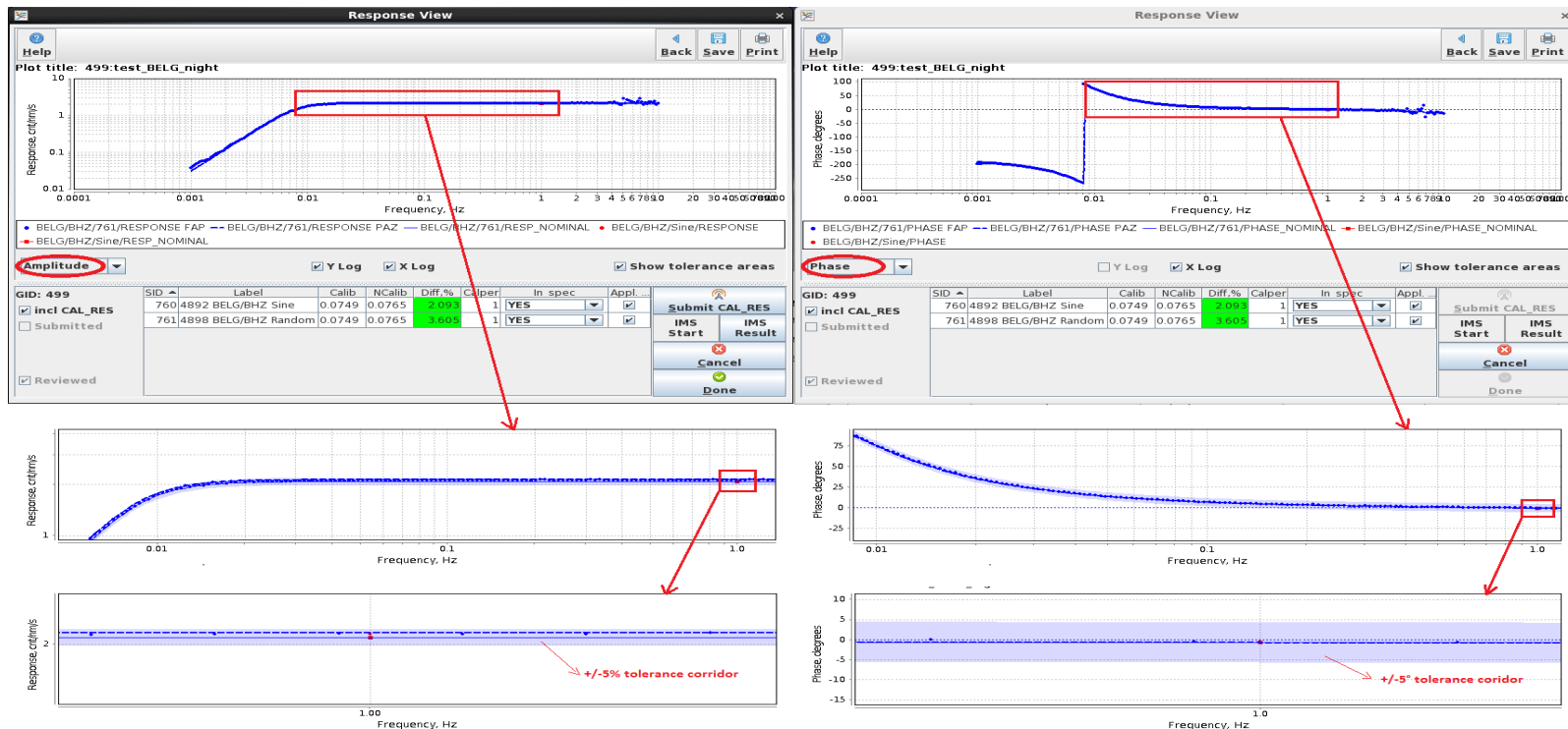
CID	Label	Scheduled Time	Started Time	Duration (s)	Status
593	belg_prb	2018/06/05 02:01	2018/06/05 02:01	10800.0	Success
592	belg_sine	2018/06/05 01:19	2018/06/05 01:19	300.0	Success

Red arrows point from the text labels **random calibration** and **sine wave calibration** to the **belg_prb** and **belg_sine** rows, respectively. The interface includes various toolbars for actions like New, Import, Export, Open caldef, Save caldef, Delete, Copy, Edit, Disable, Schedule, Stop, View data, View resp, and Adv Plot. At the bottom, it shows 'Currently shown calibrations: ALL' and buttons for Change and Exit.

Output Signal Review



Calibration Results Interpretation



Disclaimer: The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO

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IMS2.0 calibrate result message

```

BEGIN IMS2.0
MSG_TYPE DATA
MSG_ID 201807090733220000
REF_ID
TIME_STAMP 2018/07/09 07:33:22
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074884
CALPER 1.000000
CAL2 BELG BHZ 7.48839579e-02 1.000 40.00000 2018/06/05 01:19
FAP2 1 C 0 0.000 1
1.00000 1.33540000e+01 89
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074859
CALPER 1.000000
CAL2 BELG BHZ 7.48587995e-02 1.000 40.00000 2018/06/05 02:01
FAP2 1 C 0 0.000 256
0.00100 2.35879000e-04 -106
0.00104 2.69874000e-04 -106
0.00107 3.03870000e-04 -106
0.00111 3.37866000e-04 -106
0.00116 3.71862000e-04 -106
0.00120 4.05859000e-04 -106
0.00124 4.39855000e-04 -106
0.00129 4.73852000e-04 -106
0.00134 5.07848000e-04 -106
0.00138 5.41845000e-04 -106
0.00144 5.75841000e-04 -106
0.00149 6.09838000e-04 -107
0.00154 6.43835000e-04 -108
0.00160 6.77832000e-04 -108
0.00166 7.11829000e-04 -109
0.00172 7.45826000e-03 -109
0.00178 7.79823000e-03 -110
0.00185 8.13820000e-03 -110
0.00192 8.47817000e-03 -110
0.00199 8.81814000e-03 -112
0.00206 9.15811000e-03 -112
0.00214 9.49808000e-03 -113
0.00221 9.83805000e-03 -114
0.00230 1.01780000e-03 -114
0.00238 1.05180000e-03 -115
0.00247 1.08580000e-03 -116
0.00256 1.11980000e-03 -118
0.00265 1.15380000e-03 -119

```

Output format: **FAP**

```

BEGIN IMS2.0
MSG_TYPE DATA
MSG_ID 201807090734390000
REF_ID
TIME_STAMP 2018/07/09 07:34:39
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074884
CALPER 1.000000
CAL2 BELG BHZ 7.48839579e-02 1.000 40.00000 2018/06/05 01:19
FAP2 1 C 0 0.000 1
1.00000 1.33540000e+01 89
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074455
CALPER 1.000000
CAL2 BELG BHZ 7.44550824e-02 1.000 40.00000 2018/06/05 02:01
PAZ2 1 V 1.22179160e+09 0 0.000 5 3
-3.66858415e-02 -3.64541899e-02
-3.66858415e-02 -3.64541899e-02
-5.02654800e+02 0.00000000e+00
-1.00530960e+03 0.00000000e+00
-1.13997340e+03 0.00000000e+00
0.00000000e+00 0.00000000e+00
0.00000000e+00 0.00000000e+00
0.00000000e+00 0.00000000e+00
STOP

```

Output format: **PAZ**

• 2020 results:

- Additional digitizer model supported by the SCM (Quanterra **Q330M+**)
- Q330M+ calibration testing with Streckeisen **STS2.5** and Güralp **CMG3T**
- Increase of **full-frequency** results sent to the PTS in **IMS2.0** format (+ around 10 stations)
- Support for **large seismic arrays** calibration (e.g. NOA 42-element array full-frequency responses sent for the first time)



• Perspectives (on-going)

- Support of an additional digitizer model (Nanometrics **Centaur**)
- Centaur calibration testing with Nanometrics **Trillium120** and Güralp **CMG3T**



- The purpose of On-site Calibration is to ensure **stability of measurement system responses over time**.
- The SSI Calibration Module is contributing to:
 - Increase the number of Stations sending **full-frequency** results in **IMS2.0** format
 - **Standardize** practices when performing a calibration task and sending results to the PTS
 - **Standardize** the **validation** of these results at the PTS
 - **Reduce** the number of technical issues (due to diversity of equipment / software / calibration results format)
 - Enhance PTS capability to provide **support** and perform calibration remotely on the SO behalf (troubleshooting, delegated calibration)
- Any SO can be supported for the installation, configuration and testing of the SCM.
Please contact us!