Next generation FDSN identifiers preamble

Version 2018-1-3

(DRAFT IN PROGRESS)

Background and context

Adopted by the FDSN in 1987, the SEED format has become and still serves as the canonical format for passive source seismic (and other) data. For continuous data collection, archiving and delivery it has become common to handle the time series and metadata separately. This document contains a working specification for the time series identifiers used in next generation versions of the time series portion, known as miniSEED, and in metadata portion, known as StationXML.

A unique time series is identified in FDSN formats using a combination of network, station, location and channel codes. This specification describes the rules of how these identifiers are to be used.

Overview of significant changes between SEED 2.4 and this specification

- Expand length of each code as follows:
    - network: 2 => 8 characters
    - station: 5 => 8 characters
    - location: 2 => 8 characters
    - channel: 3 => 3 or 4 characters
- Expand channel codes field from 3 to 4 characters, allow both 3 and 4 code channel definitions.
    - 3 character channel codes are the same as SEED 2.4.
    - 4 character channels include a secondary instrument code.
- Allow dash “-” character, ASCII 45, in station and location codes.
- Specify a Uniform Resource Name (URN) know as an “FDSN time series identifier” constructed from a combination of the network, station, location and channel codes. This URN provides a convenient, flexible single identifier for use in FDSN formats while allowing mapping back-and-forth between the URN and the separate codes as needed.
- Define rules for temporary network code:, must end in a 4 digit year identifying the start year.
- Placeholder for definition of convention(s) for location codes.

FDSN identifiers specification (in draft)

Version 2018-1-3

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Section 1: Overview

Purpose

The International Federation of Digital Seismograph Networks (FDSN)[1] defines 4 identifiers, or codes, that, when combined, uniquely identify a time series in FDSN data formats. A unique time series is identified in FDSN formats using a combination of network, station, location and channel codes. This specification describes the rules of how these identifiers are to be used and interpreted.

Background

The Standard for the Exchange of Earthquake Data (SEED)[2] was adopted by the FDSN in the 1980s and served as the dominant standard for seismological data archiving and exchange for decades. This specification defines a format to store both time series and a rich set of related metadata. In 1992, changes in the SEED format were adopted to officially support “data only” SEED, known as miniSEED. This specification of identifiers is an expansion and enhancement of the identifiers defined in SEED version 2.4.

[1] The International Federation of Digital Seismograph Networks (FDSN): http://www.fdsn.org/
[2] FDSN SEED format: http://www.fdsn.org/publications/

Section 2: Definition of FDSN identifiers

Time series in FDSN formats are uniquely defined using four codes named network, station, location and channel. Each of these codes must be composed of the following ASCII character sets:

- Uppercase [A-Z], ASCII 65 through 90
- Numeric [0-9], ASCII 48 through 57

The station and location codes may further be composed of the following ASCII character:

- Dash “-”, ASCII 45

The codes are further defined as follows:

Network code: Uniquely identifies the owner and network operator responsible for the data. This identifier is assigned by the FDSN. Must not exceed 8 characters.

Station code: Uniquely identifies a station within a network. Must not exceed 8 characters.

Location code: Uniquely identifies a group of channels within a station, for example from a specific sensor or sub-processor. Must not exceed 8 characters.

Channel codes: A sequence of codes that identify the sensor, band and orientation that is either 3 or 4 characters. See *Section 6: Definition of channel codes* for more information.

Time series identifiers

The FDSN time series identifier is a combination of the network, station, location and channel codes into a Uniform Resource Name (URN). The pattern of the FDSN time series identifier URN is as follows:

FDSN:<network>_<station>_<location>_<channel>

where the network, station and channel codes are required to be non-empty and the location code may be empty. The 3 underscore (ASCII 95) delimiters must always be present.

Example identifiers:
FDSN:IU_COLA_00_BHZ (where network=IU, station=COLA, location=00 and channel=BHZ)
FDSN:NL_HGN__LHZ (where network=NL, station=HGN, location is empty and channel=LHZ)

The “FDSN:” portion is a namespace identifier reserved by the FDSN to identify this specification.

The formal “urn:” prefix is not included in the time series identifiers as they are already identified as URNs.

Temporary network codes

Network codes for deployments that are known to be temporary must include the 4-digit start year of the deployment at the end of the code. A prefix of 1-4 characters may then be used to describe the deployment. Other than including a start year, a temporary network code is globally unique and treated no differently than any other network code. The pattern for a temporary network code is as follows:

<1-4 characters><4-digit start year>

For example, “SEIS2018” would be a valid network code and imply that the initial deployment was in the year 2018 and is temporary.

Mapping of previously allocated temporary network codes

Earlier temporary network codes were allocated as two-character codes, with the first character being a digit or the letters X, Y or Z. Many of these codes have been reused for different deployments in different years and are therefore not globally unique. A data owner or delegate data center may wish to convert, or provide an alias, for data using the older, 2-character codes. The mapping from the 2-character codes is strongly recommended to follow this pattern:

<2-character code><4-digit start year>

For example, the a network deployment allocated a network code of “XA” operating in the years 2002 and 2003 could be mapped to “XA2002”.

Location code convention

Location codes are used to logically group time series channels within a single station deployment. This can be for channels produced by the same sensor, channels produced in a sub-processor, many sensors deployed in a grid, etc.

[The convention(s) for location code use remains to be determined]

When used to designate many sensors deployed in a grid the convention is to identify the X-Y location of the node in the location code. For example, the node in “column” 14 and “row” 984 could use a location code of “14-986”.

Section 3: Definition of channel codes

A sequence of three or four letters is used to identify channels. Each letter describes one aspect of the instrumentation and its digitization as follows:

First - Band code, identifying the general sample rate and response band of instrument.
Second - First instrumentation code, identify the family to which the sensor belongs.
Third - *Not always present*. Second instrument code, extended sensor identification.
Last - Orientation code, indicate the directionality of the sensor measurement.

The first code in the sequence is always the band code, the second is always the first instrumentation code and the last is always the orientation code.

Two sequences are reserved for special channels: the “LOG” channel for the console log and the “SOH” channel for the main state of health channel. Subsidiary logs and state of health channels should begin with the “A” code; the instrumentation and orientation fields can then be used in any way.

Band Code

The band code specifies the general sampling rate and the response band of the instrument.

Band code	**Band type**	**Sample rate (Hz)**	**Corner period (sec)**
F	...	≥ 1000 to < 5000	≥ 10 sec
G	...	≥ 1000 to < 5000	< 10 sec
D	...	≥ 250 to < 1000	< 10 sec
C	...	≥ 250 to < 1000	≥ 10 sec
E	Extremely Short Period	≥ 80 to < 250	< 10 sec
S	Short Period	≥ 10 to < 80	< 10 sec
H	High Broad Band	≥ 80 to < 250	≥ 10 sec
B	Broad Band	≥ 10 to < 80	≥ 10 sec
M	Mid Period	> 1 to < 10	
L	Long Period	≈ 1	**miniSEED period notation**
V	Very Long Period	≈ 0.1	-10
U	Ultra Long Period	≈ 0.01	-100
R	Extremely Long Period	≥ 0.0001 to < 0.001	≥ -10000 to < -1000
P	On the order of 0.1 to 1 day[1]	≥ 0.00001 to < 0.0001	≥ -100000 to < -10000
T	On the order of 1 to 10 days[1]	≥ 0.000001 to < 0.00001	≥ -1000000 to < -100000
Q	Greater than 10 days[1]	< 0.000001	< -1000000
A	Administrative Instrument Channel	variable	N/A
O	Opaque Instrument Channel	variable	N/A

Instrument Codes and Orientation Code

The first and potentially second instrument codes specify the family to which the sensor belongs. In essence, this identifies what is being measured. Each of these instrument types are detailed in this section.

The orientation code provides a way to indicate the directionality of the sensor measurement. This code is sometimes used for a purpose other than direction, which is instrument-specific. When orthogonal directions are used, there are traditional orientations of North (N), East (E), and Vertical (Z), as well as other orientations that can readily be converted to traditional ones. These options are detailed with each instrument type. Only use N or E for the orientation when it is within 5 degrees of north or east. Use 1 or 2 when orientations are more than 5 degrees from north or east or to avoid any assumptions about the orientation and make sure the actual metadata is consulted.

Seismometer

Measures displacement/velocity/acceleration along a line defined by the the dip and azimuth.

Instrument Code

H   High Gain Seismometer
L   Low Gain Seismometer
G   Gravimeter
M   Mass Position Seismometer
N   Accelerometer*

* Historically some channels from accelerometers have used instrumentation codes of L and G. The FDSN defined the N code for accelerometers in August 2000.

Orientation Code

Z N E Traditional (Vertical, North-South, East-West), when with 5 degrees of true directions
A B C Triaxial (Along the edges of a cube turned up on a corner)
T R   For formed beams or rotated components (Transverse, Radial)
1 2 3 Orthogonal components but non traditional orientations
U V W Optional components

Dip/Azimuth: Ground motion vector
Signal Units: M, M/S, M/S**2, (for G & M) M/S**2 (usually)

Tilt Meter

Measures tilt from the horizontal plane. Azimuth is typically N/S or E/W.

Instrument Code

A

Orientation Code

N E Traditional

Dip/Azimuth: Ground motion vector
Signal Units: Radians

Creep Meter

Measures the absolute movement between two sides of a fault. Traditionally this has been done by means of fixing a metal beam on one side of the fault and measuring its position on the other side, but can also done with light beams, triangulation wires and other techniques.

The orientation and therefore the dip and azimuth would be perpendicular to the measuring beam, which would be along the average travel vector for the fault. Position/negative travel would be arbitrary, but would be noted in the dip/azimuth.

Instrument Code
B

Orientation Code
Unkonwn

Dip/Azimuth: Along the fault or wire vector
Signal Units: M

Calibration Input

Usually only used for seismometers or other magnetic coil instruments. This signal monitors the input signal to the coil to be used in response evaluation. Usually tied to a specific instrument. Sometimes all instruments are calibrated together, sometimes horizontals are calibrated separately from verticals.

Instrument Code
C

Orientation Code
A B C D For when there are only a few cal sources for many devices.
Blank if there is only one calibrator at a time or, Match Calibrated Channel (is. Z, N or E).

Pressure

A barometer, or microbarometer that measures pressure. Used to measure the atmospheric pressure or sometimes for state of health monitoring down hole. This includes infrasonic and hydrophone measurements.

Instrument Code
D

Orientation Code
O Outside
I Inside
D Down Hole
F Infrasound
H Hydrophone
U Underground

Dip/Azimuth: Not applicable
Signal Units: Pa (Pascals)

Electronic Test Point

Used to monitor circuitry inside recording system, local power or seismometer. Usually for power supply voltages, or line voltages.

Instrument Code

E

Orientation Code

Designate as desired, make mnemonic as possible, use numbers for test points, etc.

Dip/Azimuth: Not applicable
Signal Units: V, A, Hz, Etc.

Magnetometer

Measures the magnetic field at the sensor location. They measure the part of the field vector that is aligned with the measurement coil. Many magnetometers are three axis. The instrument will typically be oriented to local magnetic north. The dip and azimuth should describe this in terms of the geographic north.

Example: Local magnetic north is 13 degrees east of north in Albuquerque. So if the magnetometer is pointed to magnetic north, the azimuth would be + 103 for the E channel. Some magnetometers do not record any vector quantity associated with the signal, but record the total intensity. So, these would not have any dip/ azimuth.

Instrument Code

F

Orientation Code

Z N E   Magnetic

Dip/Azimuth: Not applicable
Signal Units: T (Teslas)

Humidity

Absolute/relative measurements of humidity. Temperature recordings may also be needed for meaningful results.

Instrument Code

I

Orientation Code

O   Outside environment
I   Inside building
D   Down hole
1 2 3 4 Cabinet sources
All other letters for mnemonic source types.

Dip/Azimuth: Not applicable
Signal Units: %

Rotational Sensor

Measures solid-body rotations about an axis, commonly given in "displacement" (radians), velocity (radians/second) or acceleration (radians/second**2).

Instrument Code

J   High Gain Seismometer

Orientation Code

Z N E   Traditional (Vertical, North-South, East-West)
A B C   Triaxial (Along the edges of a cube turned up on a corner)
T R   For formed beams (Transverse, Radial)
1 2 3   Orthogonal components but non traditional orientations
U V W   Optional components

Dip/Azimuth: Axis about which rotation is measured following right-handed rule.
Signal Units: rad, rad/s, rad/s**2 – following right-handed rule

Temperature

Measurement of the temperature at some location. Typically used for measuring:

1. Weather   - Outside temperature
2. State of Health - Inside recording building
                    - Down hole
                    - Inside electronics

Instrument Code

K

Orientation Code

O   Outside environment
I   Inside building
D   Down hole
1 2 3 4 Cabinet sources
All other letters available for mnemonic types.

Signal Units: degrees C or degrees K

Water Current

Measurement of the velocity of water in a given direction. The measurement may be at depth, within a borehole or a variety of other locations.

Instrument Code

O

Orientation Code

Unknown

Dip/Azimuth: Along current direction
Signal Units: M/S

NOTE: The special, administrative codes of "SOH" and "LOG" do <u>not</u> denote water current and should be avoided when using the "O" instrument code.

Geophone

Very short period seismometer, with natural frequency 5 - 10 Hz or higher.

Instrument Code

P

Orientation Code

Z N E Traditional

Dip/Azimuth: Ground Motion Vector
Signal Units: M, M/S, M/S**2

Electric Potential

Measures the Electric Potential between two points. This is normally done using a high impedance voltmeter connected to two electrodes driven into the ground. In the case of magnetotelleuric work, this is one parameter that must be measured.

Instrument Code

Q

Orientation Code

Unknown

Dip/Azimuth: Not applicable
Signal Units: V - Volts

Rainfall

Measures total rainfall, or an amount per sampling interval

Instrument Code

R

Orientation Code

Z N E Traditional

Dip/Azimuth: Not applicable
Signal Units:

Linear Strain

Dip/Azimuth are the line of the movement being measured. Positive values are obtained when stress/distance increases and negative when they decrease.

Instrument Code

S

Orientation Code

Z N E   Vertical, North-South, East-West

Dip/Azimuth: Along axis of measurement
Signal Units: M/M

Tide

Measurement of depth of water at monitoring site. Not to be confused with lunar tidal filters or gravimeter output.

Instrument Code
T

Orientation Code
Z   Always vertical

Dip/Azimuth: Always vertical
Signal Units: M - Relative to sea level or local ocean depth

Bolometer

Infrared instrument used to evaluate average cloud cover. Used in astronomy to determine observability of the sky.

Instrument Code
U

Orientation Code
Unknown

Dip/Azimuth: Not applicable
Signal Units:

Volumetric Strain

Instrument Code
V

Orientation Code
Unknown

Dip/Azimuth: Not applicable
Signal Units: M**3/M**3

Wind

Measures the wind vector or velocity. Normal notion of dip and azimuth does not apply.

Instrument Code
W

Orientation Code
S   Windspeed
D   Wind direction vector, relative to geographic north

Dip/Azimuth: Not applicable
Signal Units:

Derived or generated channel

Time series derived from observational data or entirely generated by a computer.

Instrument Code

X

Orientation Code

Similar to the observable data that was modified or the observable equivalent for generated time series (synthetics). See Orientation Codes for the corresponding observed channel.

Further Usage

In order to document the provenance of the data, information must be available in the metadata for this channel that documents the algorithms, processes, or systems that modified or generated the time series. A channel comment, providing a Uniform Resource Locator (URL), must be included in the metadata. The information available at the URL must identify the processes that were applied to modify or generate the time series. This information must reference the FDSN web site (http://www.fdsn.org/x-instrument/).

Non-specific instruments

For instruments not specifically covered by an existing instrument code the Y instrument code can be used.

Instrument Code

Y

Orientation Code

Instrument specific.

Further Usage

In order to document the instrument type and provenance of the data, information must be available in the metadata for this channel that documents the instrument that was used to generate the time series. A channel comment, providing a short description of the instrument, the type of measurement it makes and a Uniform Resource Locator (URL) referencing the FDSN web site (http://www.fdsn.org/y-instrument) that fully describes the instrumentation.

Synthesized Beams

This is used when forming beams from individual elements of an array.

Instrument Code

Z

Orientation Code

I   Incoherent beam
C   Coherent beam
F   FK beam
O   Origin beam
D   Wind direction vector, relative to geographic north

Dip/Azimuth: Ground motion vector
Signal Units: M, M/S, M/S**2

Example channels

Here are some typical channel sequences for a seismic station:

Channel	Description
EHZ,EHN,EHE	3-components of a short period seismometer at 100 sps
BHZ,BHN,BHE	3-components of a broad band seismometer at 20 sps
LHZ,LHN,LHE	3-components of a high gain seismometer at 1 sps
VHZ,VHN,VHE	3-components of a high gain seismometer at 0.1 sps
BCI	broadband calibration signal
ECI	short period calibration signal
LOG	console log
ACE	administrative clock error

NOTE: Log records have a channel identifier code of “LOG” and a sample rate of zero. The number of samples field is the number of characters in the record (including the carriage return and line feed that terminates each line). A common convention is for log messages to be packed into records until a message falls into a new minute.