

A P P E N D I X I

S I N E X

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## 1. Introduction

This document describes the Software Independent Exchange (SINEX) format. It started in early 1995 with an effort by a number of IGS participants and it was designed to be easily extended. For the new IERS structure, operational since January 1, 2001, and due to the use of SINEX by the ILRS (pilot project 'positioning and earth orientation') and the IVS as well, some extensions were made with the purpose to have a unique format description for all techniques.

## 2. Data Structure

Each SINEX line has at most 80 ASCII characters. The SINEX file is subdivided in groups of data called blocks. Each block is enclosed by a header and trailer line. Each block has a fixed format. The blocks contain information on the file, its input, the sites and the solution. All elements within a line are defined. A character field without information will have "-"s within its field and a missing numerical element will have a value of 0 within its field. Therefore the SINEX file is accessible "column-wise" as well as "line-wise". Character fields should be left hand justified whenever applicable.

The first character of each line identify the type of information that the line contains. Five characters are reserved. They have the following meaning when they are at the beginning of a line, they identify:

Character Definition

"%"	Header and trailer line,
"*"	Comment line within the header and trailer line,
"+"	Title at the start of a block
"-"	Title at the end of a block
" "	Data line within a block

No other character is allowed at the beginning of a line!

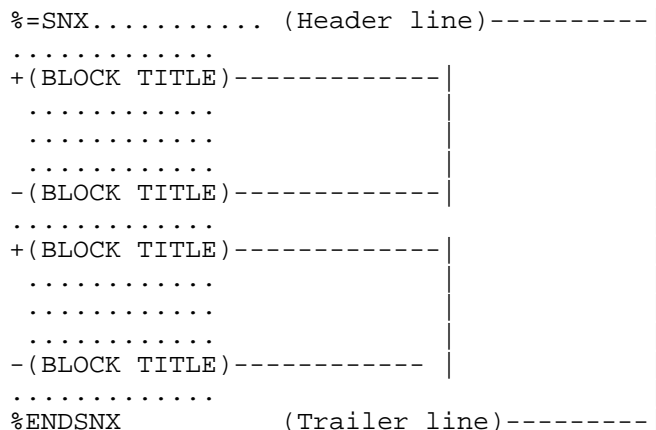
A SINEX file must start with a header line and ends with a footer line.

The following blocks are defined:

- FILE/REFERENCE
- FILE/COMMENT
- INPUT/HISTORY
- INPUT/FILES
- INPUT/ACKNOWLEDGEMENTS
- NUTATION/DATA
- PRECESSION/DATA
- SOURCE/ID
- SITE/ID
- SITE/DATA
- SITE/RECEIVER
- SITE/ANTENNA
- SITE/GPS\_PHASE\_CENTER
- SITE/ECCENTRICITY
- BIAS/EPOCHS
- SOLUTION/EPOCHS
- SOLUTION/STATISTICS
- SOLUTION/ESTIMATE
- SOLUTION/APRIORI
- SOLUTION/MATRIX\_ESTIMATE {p} {type}
- SOLUTION/MATRIX\_APRIORI {p} {type}
- SOLUTION/NORMAL\_EQUATION\_VECTOR
- SOLUTION/NORMAL\_EQUATION\_MATRIX {p}

Where:            {p}        L or U  
                  {type}   CORR or COVA or INFO

These block titles are immediately preceded by a "+" or a "-" as they mark the beginning or the end of a block. The block titles must be in capital letters. After a block has started(+) it must be ended(-) before another block can begin. The general structure is as follow:



Most fields within a SINEX line are separated by a single space. In the following sections, each SINEX line is defined by its field name, a general description and the (FORTRAN) format.

A comment line (not to be confused with the FILE/COMMENT Block) can be written anywhere within the header and the footer line. All comment lines must start with a "\*" in the first column. With the use of this character information can be hidden

from the software reading the file without deleting it from the file. A comment line is defined as follow:

C O M M E N T   D A T A   L I N E		
Field	Description	Format
Comment	Any general comment relevant to the SINEX file.	1H*,A79
		80

Some fields are found in several blocks. To keep the description short, they are described in detail here, and will be referred to in the sections with additional information added when necessary. The fields defined below will be referenced to by putting them within square brackets [] when encountered in the following sections.

Field	Description	Format
Time	YY:DDD:SSSS. "UTC" YY = last 2 digits of the year, if YY <= 50 implies 21-st century, if YY > 50 implies 20-th century, DDD = 3-digit day in year, SSSS = 5-digit seconds in day.	I2.2, 1H:,I3.3, 1H:,I5.5
Constraint Code	Single digit indicating the constraints: 0-fixed/tight constraints, 1-significant constraints, 2-unconstrained.	A1
Parameter Type	Type of parameter. List of allowed parameters and the units provided:  STAX - station X coordinate, m STAY - station Y coordinate, m STAZ - station Z coordinate, m VELX - station X velocity, m/y VELY - station Y velocity, m/y VELZ - station Z velocity, m/y XGC - geocenter X coordinate, m YGC - geocenter Y coordinate, m ZGC - geocenter Z coordinate, m RS_RA - radio source right ascension, rad RS_DE - radio source declin., rad RS_RAR - radio source right ascension rate, rad/y RS_DER - radio source declination rate, rad/y RS_PL - radio source parallax, rad LOD - length of day, ms UT - delta time UT1-UTC, ms XPO - X polar motion, mas YPO - Y polar motion, mas XPOR - X polar motion rate, mas/d YPOR - Y polar motion rate, mas/d NUT_LN - total nutation in longitude, rad NUT_OB - total nutation in	A6

	obliquity, rad NUTRLN - nutation rate in longitude, rad/d NUTROB - nutation rate in obliquity rad/d SAT__X - Satellite X coord., m SAT__Y - Satellite Y coord., m SAT__Z - Satellite Z coord., m SAT_VX - Satellite X velocity, m/s SAT_VY - Satellite Y velocity, m/s SAT_VZ - Satellite Z velocity, m/s SAT_RP - Radiation pressure, SAT_GX - GX scale, SAT_GZ - GZ scale, SATYBI - GY bias, m/s <sup>2</sup> TROTOT - wet + dry Tropo delay, m TRODRY - dry Tropo delay, m TROWET - wet Tropo delay, m TGNTOT - troposphere gradient in north (wet + dry), m TGNWET - troposphere gradient in north (only wet), m TGNDRY - troposphere gradient in north (only dry), m TGETOT - troposphere gradient in east (wet + dry), m TGEWET - troposphere gradient in east (only wet), m TGEDRY - troposphere gradient in east (only dry), m RBIAS - range bias, m TBIAS - time bias, ms SBIAS - scale bias, ppb ZBIAS - troposphere bias at zenith, m AXI_OF - antenna axis offset, m	
Site Code	- For stations: Call sign for a site.(It should be consistent with ITRF, see below). - For satellites: Use "PRXX" where XX is the PRN number.	A4
Point Code	- For stations: A two character code identifying physical monument within a site. Typically has a code A, but could vary if the site has more than one monument. - For bias parameters: satellite ID L1, L2 for LAGEOS-1 or -2; LC for combined LAGEOS; E1, E2 for Etalon 1 or 2; EC for combined Etalon;	A2
Solution ID	Character identifying the solution given for a point at a site. "-----" applies to all.	A4
Observation Code.	A single character indicating the technique(s) used to arrive at the solutions obtained in this SINEX file. It should be consistent with the IERS convention. This character code may be:	A1

	C-Combined techniques used. D-DORIS, L-SLR, M-LLR, P-GPS, R-VLBI.	
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Comment:

For the official IERS sites the values of the 'Site Code' are listed in [ftp://lareg.ensg.ign.fr/pub/itrf/iers\\_dir.sta](ftp://lareg.ensg.ign.fr/pub/itrf/iers_dir.sta)

'Per year' means 365.25 days in this context.

### 3. Header Line (Mandatory)

Description

The header line must be the first line in a SINEX file.

Contents:

H E A D E R L I N E		
Field	Description	Format
First Character	Single character '%' in column #1. No other character than '%' is allowed.	A1
Second Character	Single character '=' in column #2. Indicates 'resultant' solution. No other character than '=' is allowed.	A1
Document Type	Three characters 'SNX' in columns 3 to 5. Indicates that this is a SINEX document.	A3
Format Version	Four digits indicating the version of SINEX format used. '2.00' for this version.	1X,F4.2
File Agency Code	Identify the agency creating the file.	1X,A3
[Time]	Creation time of this SINEX file.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Agency Code]	Identify the agency providing the data in the SINEX file	1X,A3
[Time]	Start time of the data used in the SINEX solution Value 00:000:00000 should be avoided.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	End time of the data used in the	1X,I2.2,

	SINEX solution Value 00:000:00000 should be avoided.	1H:,I3.3, 1H:,I5.5
[Observation Code]	Technique(s) used to generate the SINEX solution	1X,A1
Number of Estimates	Number of parameters estimated in this SINEX file. Mandatory field.	1X,I5.5
[Constraint Code]	Single character indicating the constraint in the SINEX solution. Mandatory field.	1X,A1
Solution Contents	Solution types contained in this SINEX file. Each character in this field may be one of the following: S - all station parameters, i.e. station coordinates, station velocities, biases, geocenter, O - Orbits, E - Earth Orientation Parameter T - Troposphere, C - Celestial Reference Frame BLANK	5(1X,A1)
		77

Relationship with other blocks:

This line is duplicated as the resultant line of the INPUT/HISTORY block with the exception of its first character.

#### 4. FILE/REFERENCE Block (Mandatory)

Description:

This block provides information on the Organization, point of contact, the software and hardware involved in the creation of the file.

Contents:

F_I_L_E_R_E_F_E_R_E_N_C_E_D_A_T_A_L_I_N_E		
Field	Description	Format
Information Type	Describes the type of information present in the next field. May take on the following values:  'DESCRIPTION' - Organization(s) gathering/altering the file contents. 'OUTPUT' - Description of the file contents. 'CONTACT' - Address of the relevant contact. e-mail 'SOFTWARE' - Software used to generate the file. 'HARDWARE' - Computer hardware on which above	1X,A18

	software was run. 'INPUT' - Brief description of the input used to generate this solution.  Any of the above fields may be and in any order.	
Information	Relevant information for the type indicated by the previous field.	1X,A60
		80

#### 5. FILE/COMMENT Block (Optional)

Description:

This block can be used to provide general comments about the SINEX data file.

Contents:

F I L E C O M M E N T D A T A L I N E		
Field	Description	Format
Comment	Any general comment providing relevant information about the SINEX file.	1X,A79
		80

#### 6. INPUT/HISTORY Block (Recommended)

Description:

This block provides information about the source of the information used to create the current SINEX file.

Contents:

I N P U T H I S T O R Y D A T A L I N E		
Field	Description	Format
File Code	Only one of the following characters is permitted: '+' - This character indicates that the information that follows identify an input solution contributing to this SINEX file. '=' - This character indicates that the information that follows identify the output solution file.	1X,A1
Document Type	Three characters 'SNX' in columns 3 to 5. Indicates that this is a SINEX document.	A3

Format Version	Four digits indicating the version of SINEX format used. '2.00' for this version.	1X,F4.2
[Agency Code]	Identify the agency creating the file.	1X,A3
[Time]	Creation time of this SINEX file.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Agency Code]	Identify the agency providing the data in the SINEX file.	1X,A3
[Time]	Start time of the data used in the SINEX solution.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	End time of the data used in the SINEX solution.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Observation Technique]	Technique(s) used to generate the SINEX solution.	1X,A1
Number of Estimates	Number of parameters estimated in this SINEX file.	1X,I5.5
[Constraint Code]	Single digit indicating the constraint in the SINEX solution.	1X,A1
Solution Contents	Solution types contained in this SINEX file. Each character in this field may be one of the following: S - all station parameters, i.e. station coordinates, station velocities, biases, geocenter, O - Orbits, E - Earth Orientation Parameter T - Troposphere, C - Celestial Reference Frame BLANK	5(1X,A1)
		77

Comment:

The final data line "=" describes the current SINEX file and match the header line with the exception of the first character.

#### 7. INPUT/FILES Block (Optional)

Description:



This block identify the input files (and the current SINEX file) and allow for a short comment to be added to describe those files.

Contents:

I_N_P_U_T_F_I_L_E_S_D_A_T_A_L_I_N_E		
Field	Description	Format
[Agency Code]	Agency creating the solution described in this data line.	1X,A3
[Time]	Time of creation of the input SINEX solution	1X,I2.2, 1H:,I3.3, 1H:,I5.5,
File Name	Name of the file containing the solution described in the current data line.	1X,A29
File Description	General description of the file referred to on this data line.	1X,A32
		80

Comments:

There must be exactly one INPUT/FILES data line for every INPUT/HISTORY data line. The final data line must describe this current SINEX file.

#### 8. INPUT/ACKNOWLEDGEMENTS Block (Optional)

Description:

This block defines the agency codes contributing to the SINEX file.

Contents:

I_N_P_U_T_A_C_K_N_O_W_L_E_D_G_M_E_N_T_S_D_A_T_A_L_I_N_E		
Field	Description	Format
[Agency Code]	Agency(ies) contributing to this SINEX file.	1X,A3
Agency Description	Description of agency code.	1X,A75
		80

#### 9. NUTATION/DATA Block (Mandatory for VLBI)

Description:

This block contains the nutation model used in the analysis procedure.

Contents:

N_U_T_A_T_I_O_N_D_A_T_A_L_I_N_E		

Field	Description	Format
Nutation Code	Code for nutation reference: IAU1980 IERS1996 IAU2000a IAU2000b	1X,A8
Comments	General description of the nutation model used	1X,A70
		80

COMMENT:

It must be a generally accepted model which is accessible to all users.

#### 10. PRECESSION/DATA Block (Mandatory for VLBI)

Description:

This block contains the precession model used in the analysis procedure.

Contents:

P_R_E_C_E_S_S_I_O_N   D_A_T_A   L_I_N_E		
Field	Description	Format
Precess. Code	Code for precession reference: IAU1976 IERS1996	1X,A8
Comments	General description of the nutation model used	1X,A70
		80

COMMENT:

It must be a generally accepted model which is accessible to all users.

#### 11. SOURCE/ID (Mandatory for VLBI)

Description:

This block contains information about the radio sources estimated in the analysis, especially the names used in ICRF and for IERS.

Contents:

R_A_D_I_O   S_O_U_R_C_E   D_A_T_A   L_I_N_E		
Field	Description	Format
Source Code	Call sign for a source	1X,A4
IERS des.	IERS designation of the radio source	1X,A8

ICRF des.	ICRF designation of the radio source	1X,A16
Comments	Comments or other names of the radio source	1X,A68
		80

## 12. SITE/ID Block (Mandatory)

### Description:

This block provides general information for each site containing estimated parameters.

### Contents:

S I T E I D D A T A L I N E		
Field	Description	Format
[Site Code]	Call sign for a site.	1X,A4
[Point Code]	Physical monument used at a site	1X,A2
Unique Monument Identification	Unique alpha-numeric monument identification. For ITRF purposes, it is a nine character DOMES/DOMEX number (five/six digits, followed by the single letter 'M' or 'S', followed by four/three digits)	1X,A9
[Observation Code]	Observation technique(s) used.	1X,A1
Station Description	Free-format description of the site, typically the town and/or country.	1X,A22
Approximate Longitude	Approximate longitude of the site in degrees(E/+), minutes and seconds.	1X,I3, 1X,I2, 1X,F4.1
Approximate Latitude	Approximate latitude of the site in degrees(NS/+), minutes and seconds.	1X,I3, 1X,I2, 1X,F4.1
Approximate Height	Approximate height of the site in metres.	1X,F7.1
		75

### Comments:

For DOMES numbers and station description as well as for Site Codes please refer to [ftp://lareg.ensg.ign.fr/pub/itrf/iers\\_dir.sta](ftp://lareg.ensg.ign.fr/pub/itrf/iers_dir.sta)

If a DOMES number is not available (e.g. for a new station), please ask Zuheir Altamimi for a DOMES number (altamimi@ensg.ign.fr).

Use the minus sign for negative approximate longitude or latitude only in the "degrees" component and don't repeat it in the "minutes" and "seconds" component.

Following the ISO6709 specification, the range of longitude should be [-180° +180°[.

### 13. SITE/DATA Block (Optional)

Description:

This block gives the relationship between the estimated station parameters in the SINEX file and in the input files.

Contents:

S_I_T_E    D_A_T_A    L_I_N_E		
Field	Description	Format
[Site Code]	Site Code for solved station coordinates.	1X,A4
[Point Code]	Point Code for solved station coordinates.	1X,A2
[Solution ID]	Solution number to which the input in this data line is referred to.	1X,A4
[Site Code]	Site Code from an input SINEX file	1X,A4
[Point Code]	Point code from an input SINEX file.	1X,A2
[Solution ID]	Solution Number for a Site/Point from an input SINEX file.	1X,A4
[Observation Code]	Observation Code for a Site/Point/Solution Number from an input SINEX file.	1X,A1
[Time]	Time of start of data for the input SINEX file.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Time of end of data for the input SINEX file.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Agency Code]	Creation Agency Code for the input SINEX file.	1X,A3
[Time]	Creation time for the input SINEX file.	1X,I2.2, 1H:,I3.3, 1H:,I5.5

Comment:

Times must refer to observation epochs.

#### 14. SITE/RECEIVER Block (Mandatory for GPS)

Description:

List the receiver used at each site during the observation period of interest.

Contents:

S_I_T_E R_E_C_E_I_V_E_R D_A_T_A L_I_N_E		
Field	Description	Format
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site for which some parameters are estimated.	1X,A2
[Solution ID]	Solution Number at a Site/Point code for which some parameters are estimated.	1X,A4
[Observation Code]	Identification of the observation technique used.	1X,A1
[Time]	Time since the receiver has been operating at the Site/Point. Value 00:000:00000 indicates that the receiver has been operating at least since the "File Epoch Start Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Time until the receiver is operated at a Site/Point. Value 00:000:00000 indicates that the receiver has been operating at least until the "File Epoch End Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Receiver Type	Receiver Name & model.	1X,A20
Receiver Serial Number	Serial number of the receiver. Takes on value '-----' if unknown.	1X,A5
Receiver Firmware	Firmware used by this receiver during the epoch specified above. Takes on value '-----' if unknown.	1X,A11
		80

Comments:

- For IGS standard receiver names please refer to [ftp://igsb.jpl.nasa.gov/igsb/station/general/rcvr\\_ant.tab](ftp://igsb.jpl.nasa.gov/igsb/station/general/rcvr_ant.tab)

15. SITE/ANTENNA Block (Mandatory for GPS)

Description:

List of antennas used at each site used in the SINEX file.

Contents:

S_I_T_E A_N_T_E_N_N_A D_A_T_A L_I_N_E		
Field	Description	Format
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site for which some parameters are estimated.	1X,A2
[Solution ID]	Solution Number at a Site/Point code for which some parameters are estimated.	1X,A4
[Observation Code]	Identification of the observation technique used.	1X,A1
[Time]	Time since the antenna has been installed at the Site/Point. Value 00:000:00000 indicates that the antenna has been installed at least since the "File Epoch Start Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Time until the antenna is installed at a Site/Point. Value 00:000:00000 indicates that the antenna has been installed at least until the "File Epoch End Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Antenna Type	Antenna name & model.	1X,A20
Antenna Serial Number	Serial number of the antenna. Takes on value '-----' if unknown.	1X,A5
		68

Comments:

- For IGS standard antenna names please refer to [ftp://igsb.jpl.nasa.gov/igsb/station/general/rcvr\\_ant.tab](ftp://igsb.jpl.nasa.gov/igsb/station/general/rcvr_ant.tab)

16. SITE/GPS\_PHASE\_CENTER Block (Mandatory for GPS)

Description:

List of GPS phase center offsets for the antennas described in the Site Antenna block. The offset is given from the Antenna Reference Point (ARP) to the L1 and L2 phase centers respectively.

Contents:

G P S P H A S E C E N T E R D A T A L I N E		
Field	Description	Format
Antenna Type	Antenna name & model.	1X,A20
Antenna Serial Number	Serial number of the antenna. Takes on value '-----' if the phase center offsets apply to all antennas of the same type.	1X,A5
L1 Phase Center Up Offset	Up(+) offset from the ARP to the L1 phase center in meters.	1X,F6.4
L1 Phase Center North Offset	North(+) offset from the ARP to the L1 phase center in meters.	1X,F6.4
L1 Phase Center East Offset	East(+) offset from the ARP to the L1 phase center in meters.	1X,F6.4
L2 Phase Center Up Offset	Up(+) offset from the ARP to the L2 phase center in meters.	1X,F6.4
L2 Phase Center North Offset	North(+) offset from the ARP to the L2 phase center in meters.	1X,F6.4
L2 Phase Center East Offset	East(+) offset from the ARP to the L2 phase center in meters.	1X,F6.4
Antenna Calibration model	Name of the antenna model used in the correction of the observations for phase center variations.	1X,A10
		80

Comments:

For IGS purposes see the IGS Central Bureau Information System for ARPs and antenna phase center offsets:

directory: igs/bureau/station/general/  
files: antenna.gra and rcv\_ant.tab

If the phase center offsets for one antenna type (antenna name and the given model) are the same for all antenna serial numbers, it is enough to store only one data line (with '-----' for the 'Antenna Serial Number') in this block for each antenna type that appears in the SITE/ANTENNA block.

#### 17. SITE/ECCENTRICITY Block (Mandatory)

Description:

List of antenna eccentricities from the Marker to the Antenna Reference Point (ARP) or to the intersection of axis.

Contents:

S_I_T_E _ E_C_C_E_N_T_R_I_C_I_T_Y _ D_A_T_A _ L_I_N_E		
Field	Description	Format
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site for which some parameters are estimated.	1X,A2
[Solution ID]	Solution ID at a Site/Point code for which some parameters are estimated.	1X,A4
[Observation Code]	Identification of the observation technique used.	1X,A1
[Time]	Time since the antenna has been installed at the Site/Point. Value 00:000:00000 indicates that the antenna has been installed at least since the "File Epoch Start Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Time until the antenna is installed at a Site/Point. Value 00:000:00000 indicates that the antenna has been installed at least until the "File Epoch End Time".	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Eccentricity Reference System	Reference system used to describe vector distance from monument benchmark to the antenna reference point or intersection of axis: 'UNE' - Local reference system Up, North, East. 'XYZ' - Cartesian Reference System X, Y, Z. All units are in meters.	1X,A3
Up / X Eccentricity	Up / X offset from the marker to the Antenna reference point (ARP).	1X,F8.4
North / Y Eccentricity	North/Y offset from the marker to the Antenna reference point (ARP).	1X,F8.4
East / Z Eccentricity	East/Z offset from the marker to the Antenna reference point (ARP).	1X,F8.4
		72

Comments:

- At the moment the local ties used in the ITRF2000 primary combination are only available throughout a login/password ftp access. To get access to these values please contact Zuheir Altamimi (altamimi@ensg.ign.fr).



- An older (March 23, 1999) listing of the official values for IERS sites is available at  
ftp://lareg.ensg.ign.fr/pub/itrf/iers.ecc
- For GPS (antenna heights) you can refer to the daily generated IGS SINEX template:  
ftp://igsb.jpl.nasa.gov/pub/station/general/igs.snx
- For VLBI solutions you can use  
http://gemini.gsfc.nasa.gov/solve\_save/ECCDAT.ecc
- The official IIRS eccentricity files (in SINEX format) are  
ftp://cddisa.gsfc.nasa.gov/pub/slocc/ecc\_une.snx  
for eccentricities in Up, North, East  
and  
ftp://cddisa.gsfc.nasa.gov/pub/slocc/ecc\_xyz.snx  
for eccentricities in X, Y, Z

#### 18. SOLUTION/EPOCHS Block (Mandatory)

Description:

List of solution epoch for each Site Code/Point Code/Solution Number/Observation Code (SPNO) combination.

Contents:

SOLUTION EPOCHS DATA LINE		
Field	Description	Format
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site for which some parameters are estimated.	1X,A2
[Solution ID]	Solution Number at a Site/Point code for which some parameters are estimated.	1X,A4
[Observation Code]	Identification of the observation technique used.	1X,A1
[Time]	Start time for which the solution identified (SPNO) has observations	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	End time for which the solution identified (SPNO) has observations	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Mean time of the observations for which the solution (SPNO) is derived.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
		54

#### 19. BIAS/EPOCHS Block (Mandatory if bias parameters are included)

Description:

List of epochs of bias parameters for each Site Code/Point Code/Solution Number/Bias Type (SPNB) combination for which a bias parameter is solved.

Contents:

B I A S E P O C H S D A T A L I N E		
Field	Description	Format
[Site Code]	Site code for which some biases are estimated (station ID)	1X,A4
[Point Code]	satellite ID for which some biases are estimated: e.g. L1, L2 for LAGEOS-1 and -2 respectively	1X,A2
[Solution ID]	sequential number of the bias for this particular station (if just one bias is solved for a particular station, this parameter remains "1").	1X,A4
Bias Type	Specification of the type of bias: R - range bias T - time bias S - scale bias Z - troposphere bias at zenith	1X,A1
[Time]	Epoch of 1st observation of the solution identified (SPNB)	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Epoch of last observation of the solution identified (SPNB)	1X,I2.2, 1H:,I3.3, 1H:,I5.5
[Time]	Weighted mean time of the observations for which the solution (SPNB) is derived.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
		54

20. SOLUTION/STATISTICS Block (Recommended if available)

Description:

Statistical information about the solution contained in the SINEX file.

Contents:

S O L U T I O N S T A T I S T I C S L I N E		
Field	Description	Format
Information Type	Describes the type of information present in the next field. May take on the following values:	1X,A30

	'NUMBER OF OBSERVATIONS' # of observations used in the adjustment. 'NUMBER OF UNKNOWNNS' # of unknowns solved in the adjustment. 'SAMPLING INTERVAL (SECONDS)' Interval in seconds between successive observations. 'SQUARE SUM OF RESIDUALS (VTPV)' Sum of squares of residuals. (V'PV); V - resid. vector; P - weight matrix 'PHASE MEASUREMENTS SIGMA' Sigma used for the phase measurements. 'CODE MEASUREMENTS SIGMA' Sigma used for the code (pseudo-range) measurements. 'NUMBER OF DEGREES OF FREEDOM' # of observations minus the # of unknowns (df) 'VARIANCE FACTOR' Sum of squares of residuals divided by the degrees of freedom (V'PV/df). Equivalent to Chi-squared/df. 'WEIGHTED SQUARE SUM OF O-C' Sum of squares of the vector 'observed minus computed': (o-c)'P(o-c) with P - weighth matrix	
Information	Relevant information for the type indicated by the previous field.	1X,F22.15
		54

Comments:

The mentioned 'Information Types' may be in any order but the name of the fields should be identical to the names listed above.

Note that the NUMBER OF UNKNOWNNS contains all parameters of the adjustment, i.e., not only the parameters stored in the SINEX file but as well all the pre-eliminated parameters.

The NUMBER OF OBSERVATIONS should contain only the real observations and not the pseudo-observations used for constraining.

In principle the estimated variance-covariance matrix should be normalized / multiplied by the VARIANCE FACTOR of this statistic block.

21. SOLUTION/ESTIMATE Block (Mandatory)

Description:

Estimated parameters.

Contents:

S_O_L_U_T_I_O_N E_S_T_I_M_A_T_E D_A_T_A L_I_N_E		
Field	Description	Format

Estimated Parameters Index	Index of estimated parameters. values from 1 to the number of parameters.	1X,I5
[Parameter Type]	Identification of the type of parameter.	1X,A6
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site or the satellite ID for which some parameters are estimated.	1X,A2
[Solution ID]	Solution ID at a Site/Point code for which some parameters are estimated.	1X,A4
[Time]	Epoch at which the estimated parameter is valid. For bias parameters the beginning of the pass (identical to the BIAS/EPOCHS block).	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Parameter Units	Units used for the estimates and sigmas. The notations are: m (metres), m/y (metres per year), m/s2 (metres per second**2), ppb (parts per billion), ms (milliseconds), msd2 (milliseconds per day**2), mas (milli-arc-seconds), ma/d (milli-arc-seconds / day), rad (radians), rd/y (radians per year), rd/d (radians per day).	1X,A4
[Constraint Code]	Constraint applied to the parameter.	1X,A1
Parameter Estimate	Estimated value of the parameter.	1X,E21.15
Parameter Standard Deviation	Estimated standard deviation for the parameter.	1X,E11.6
		80

Comments:

For the demanded units of the estimated parameters and their standard deviation please refer to the list of possible parameter types (2. Data Structure).  
'Per year' means 365.25 days in this context.

## 22. SOLUTION/APRIORI Block (Mandatory)

Description:

Apriori information for estimated parameters, either the used apriori values for the adjustment or the parameters of a Helmert Transformation for applied inner constraints with the constraint given in the field 'Standard Deviation'.

Contents:

S O L U T I O N   A P R I O R I   D A T A   L I N E		
Field	Description	Format
Parameter Index	Index of apriori parameters.	1X,I5
[Parameter Type]	Identification of the type of parameter. For apriori values of estimated parameters see parameter list above; For inner constraints: TX - Translation in X-direction    m TY - Translation in Y-direction    m TZ - Translation in Z-direction    m RX - Rotation around X-axis        mas RY - Rotation around Y-axis        mas RZ - Rotation around Z-axis        mas SC - Scale                            ppb TXR - Rate for translation in X-direction    m/y TYR - Rate for translation in Y-direction    m/y TZR - Rate for translation in Z-direction    m/y RXR - Rate for rotation around X-axis        mas/y RYR - Rate for rotation around Y-axis        mas/y RZR - Rate for rotation around Z-axis        mas/y SCR - Rate for scale                ppb/y	1X,A6
[Site Code]	Site code with apriori parameter estimate. ---- for inner constraints	1X,A4
[Point Code]	Point Code with apriori parameter estimate. -- for inner constraints	1X,A2
[Solution ID]	Solution ID at a Site/Point code with apriori parameter estimate. ---- for inner constraints	1X,A4
[Time]	Epoch at which the apriori parameter or the inner constraint is valid.	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Parameter Units	Units used for the aprioris and sigmas. For the demanded units look at SOLUTION/ESTIMATE block. For the inner constraints the units should be: m     for translations,	1X,A4

	mas for rotations, ppb for scale, m/y for translation rates, ma/y for rotation rates, pb/y for scale rates	
[Constraint Code]	Constraint applied to the parameter. If inner constraints are applied: 1 for contributing stations	1X,A1
Parameter Apriori	Apriori value of the parameter or transformation parameter for the inner constraint.	1X,E21.15
Parameter Standard Deviation	Apriori standard deviation for the parameter or applied inner constraint.	1X,E11.6
		80

Comments:

If inner constraints are applied to the solution (i.e. parameters like TX, TY, TZ, RX,... are included) the stations contributing to these inner constraints should be listed with a '1' in the field 'Constraint Code' in this SOLUTION/APRIORI block.

### 23. SOLUTION/MATRIX\_ESTIMATE Block (Mandatory)

Description:

The Estimate Matrix can be stored in an Upper or Lower triangular form. Only the Upper or Lower portion needs to be stored because the matrix is always symmetrical.

The matrix contents can be:

CORR - Correlation Matrix

COVA - Covariance Matrix

INFO - Information Matrix (of Normals), i.e. COVA<sup>(-1)</sup>

The distinction between the form and its contents is given by the title block which must take one of the following forms:

```
SOLUTION/MATRIX_ESTIMATE L CORR
SOLUTION/MATRIX_ESTIMATE U CORR
SOLUTION/MATRIX_ESTIMATE L COVA
SOLUTION/MATRIX_ESTIMATE U COVA
SOLUTION/MATRIX_ESTIMATE L INFO
SOLUTION/MATRIX_ESTIMATE U INFO
```

Contents:

<u>SOLUTION/MATRIX_ESTIMATE DATA LINE</u>		
<u>Field</u>	<u>Description</u>	<u>Format</u>
Matrix Estimate Row Number	Row index for the Matrix Estimate. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5
Matrix Estimate Column Number	Column index for the Matrix Estimate. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5

First Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number ).	1X,E21.14
Second Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number + 1 ).	1X,E21.14
Third Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number + 2 ).	1X,E21.14
		78

Comment:

The Matrix Estimate Row/Column Number correspond to the Estimated Parameters Index in the SOLUTION/ESTIMATE block.

If the CORR matrix is used, standard deviations must be stored in the diagonal elements instead of 1.000.

Missing elements in the matrix are assumed to be zero (0); consequently, zero elements may be omitted to reduce the size of this block.

NOTE: The same scale (variance) factor MUST be used for both MATRIX\_ESTIMATE and MATRIX\_APRIORI, as well as for the standard deviations in the ESTIMATE and APRIORI Blocks. This scale factor should be stored as 'Variance Factor' in the SOLUTION/STATISTICS block.

If you use the INFO type this block should contain the constrained normal equation matrix of your least square adjustment.

#### 24. SOLUTION/MATRIX\_APRIORI Block (Recommended/Mandatory)

Description:

The Apriori Matrix can be stored in an Upper or Lower triangular form. Only the Upper or Lower portion needs to be stored because the matrix is always symmetrical. Mandatory if any significant constraint have been applied to the SOLUTION/ESTIMATE.

The matrix contents can be:

CORR - Correlation Matrix

COVA - Covariance Matrix

INFO - Information Matrix (of Normals), i.e. COVA<sup>(-1)</sup>

The distinction between the form and its contents is given by the title block which must take one of the following forms:

SOLUTION/MATRIX\_APRIORI L CORR

SOLUTION/MATRIX\_APRIORI U CORR

SOLUTION/MATRIX\_APRIORI L COVA

SOLUTION/MATRIX\_APRIORI U COVA

SOLUTION/MATRIX\_APRIORI L INFO

SOLUTION/MATRIX\_APRIORI U INFO

Contents:

SOLUTION/MATRIX_APRIORI DATA LINE		
Field	Description	Format
Matrix Apriori Row Number	Row index for the Matrix Apriori. It must match the parameter index in the SOLUTION/APRIORI block for the same parameter.	1X,I5
Matrix Apriori Column Number	Column index for the Matrix Apriori. It must match the parameter index in the	1X,I5

	SOLUTION/APRIORI block for the same parameter.	
First Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number ).	1X,E21.16
Second Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number + 1 ).	1X,E21.16
Third Matrix Estimate Element	Matrix element at the location ( Row Number , Column Number + 2 ).	1X,E21.16
		78

Comment:

The Matrix Apriori Row/Column Number correspond to the Apriori Parameters Index in the SOLUTION/APRIORI block. If the apriori constraint matrix is diagonal and no loss of significant digits occurs by using the Parameter Standard Deviation in the SOLUTION/APRIORI block, then, this block becomes redundant.

If the CORR matrix is used, Standard deviations must be stored in the diagonal elements instead of 1.000.

Missing elements in the matrix are assumed to be zero (0); consequently, zero elements may be omitted to reduce the size of this block.

NOTE: The same scale (variance) factor MUST be used for both MATRIX\_ESTIMATE and MATRIX\_APRIORI, as well as for the standard deviations in the ESTIMATE and APRIORI Blocks. This scale factor should be stored as 'Variance Factor' in the SOLUTION/STATISTICS block.

If you use the INFO type this block should contain the normal equation matrix of the constraints applied to your solution in SOLUTION/ESTIMATE.

## 25. SOLUTION/NORMAL\_EQUATION\_VECTOR Block (Mandatory for normal equations)

Description:

If the SINEX file shall provide the normal equation directly this block is mandatory and contains the vector of the right hand side of the unconstrained (reduced) normal equation.

Contents:

SOLUTION_N O R M A L _ E Q U A T I O N _ V E C T O R DATA LINE		
Field	Description	Format
Estimated Parameters Index	Index of estimated parameters. Values from 1 to the number of parameters. It must match the parameter index in the block SOLUTION/ESTIMATE for the same parameter.	1X,I5
[Parameter Type]	Identification of the type of parameter.	1X,A6
[Site Code]	Site code for which some parameters are estimated.	1X,A4
[Point Code]	Point Code at a site or the satellite ID for which some	1X,A2



	parameters are estimated.	
[Solution ID]	Solution ID at a Site/Point code for which some parameters are estimated.	1X,A4
[Time]	Epoch at which the estimated parameter is valid. For bias parameters the beginning of the pass (identical to the BIAS/EPOCHS block).	1X,I2.2, 1H:,I3.3, 1H:,I5.5
Parameter Units	see SOLUTION/ESTIMATE	1X,A4
[Constraint Code]	Constraint applied to the parameter.	1X,A1
Right hand side of normal equation	Value of the right hand side of the normal equation for the corresponding parameter.	1X,E21.15
		68

Comment:

The indices correspond to the indices of the SOLUTION/ESTIMATE block.

## 26. SOLUTION/NORMAL\_EQUATION\_MATRIX Block (Mandatory for normal equations)

Description:

This block is mandatory if the normal equation is to be provided directly in the SINEX file.

The block should contain the original (reduced) normal equation matrix (i.e., without constraints).

The normal equation matrix can be stored in an Upper or Lower triangular form. Only the Upper or Lower portion needs to be stored because the matrix is always symmetrical. The distinction between the forms is given by the title block which must take one of the following forms:

SOLUTION/NORMAL\_EQUATION\_MATRIX L  
SOLUTION/NORMAL\_EQUATION\_MATRIX U

Contents:

SOLUTION_N O R M A L _ E Q U A T I O N _ M A T R I X _ DATA_LINE		
Field	Description	Format
NEQ-Matrix Row Number	Row index for the normal equation matrix. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5
NEQ-Matrix Column Number	Column index for the normal equation matrix. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5

First Matrix Element	Matrix element at the location ( Row Number , Column Number ).	1X,E21.14
Second Matrix Element	Matrix element at the location ( Row Number , Column Number + 1 ).	1X,E21.14
Third Matrix Element	Matrix element at the location ( Row Number , Column Number + 2 ).	1X,E21.14
		78

Comment :

The NEQ-Matrix Row/Column Number correspond to the Estimated Parameters Index in the SOLUTION/ESTIMATE block.

Missing elements in the matrix are assumed to be zero (0); consequently, zero elements may be omitted to reduce the size of this block.

## 27. Footer Line (Mandatory)

Description:

Marks the end of the SINEX file.

Contents:

F_O_O_T_E_R_L_I_N_E		
Field	Description	Format
End of SINEX	The seven characters %ENDSNX at the beginning of the last line mark the end of the SINEX file.	A7
		7