Sinex output implementation in the VLBI Analysis software system Calc/Solve

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Abstract:

This document describes the way how Calc/Solve writes down a listing of a VLBI solution in Sinex format.

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1 Overview

SINEX stands for "Solution INdependent EXchange format". This format was developed by Blewitt et al. (1994) http://www.dgfi.badw-muenchen.de/gps/sinex.html and http://alpha.fesg.tu-muenchen.de/iers/sinex/sinex_v2_appendix1.pdf for facilitating the task of combining several GPS solutions. Original design of Sinex format was made for solving this specific task. However, later this format evolved towards to a common machine-readable form of solution listings for other space geodesy techniques, VLBI and SLR, and attempts were made for overcoming flaws of the original design. This process of evolution is not yet completed, therefore, different software systems implement a little bit different flavors of Sinex format.

Listings in Sinex format produced by Solve contain information about stations, sources, estimates of the parameters, their covariance matrix, constraint equation, right-hand side of constraint equations and weight matrix of constraint equations. In addition to these results, a portion of the decomposed normal matrix and normal vector can be included in the listing as well. A user has control which blocks should be included in the listing. The current implementation of the Sinex format does not allow to include in the listing any parameter which was solved for. Only some type of parameters, like station position, EOP, etc can be included. However, a user has total control which parameters among the parameters of the supported type are to be included or not included in the listing.

2 Deviations from the SINEX 1.00 standard

Solve currently writes listing either in Sinex 2.10 format or in Sinex 2.20 format. Deviations from the Sinex 1.00 standard are as follows:

1) Eight new blocks were added:

```
SOLUTION/CONSTRAINT_EQUATION_INFO
SOLUTION/CONSTRAINT_EQUATION_MATRIX
SOLUTION/CONSTRAINT_EQUATION_VECTOR
SOLUTION/CONSTRAINT_WEIGHT_MATRIX
```

The purpose of these four blocks is to overcome the flaw of original design of Sinex format and provide complete information about all constraints used in the solution.

```
SOLUTION/DECOMPOSED_NORMAL_MATRIX
SOLUTION/DECOMPOSED_NORMAL_VECTOR
```

The purpose of these blocks is to provide information about transformed normal equations before applying constraints. NB: one of the three items: covariance matrix, constraint equations and decomposed normal equations is redundant: having two of them one can derive the third one.

```
NUTATION/DATA
PRECESSION/DATA
```

The purpose of this section is to provide information about used nutation/precession model and to define parameter "estimates of nutation angles".

2) SOLUTION/STATISTICS block has new items:

```
WEIGHTED SQUARE SUM OF O-C    sum { y(T) * w * y }

WRMS OF POSTFIT RESIDUALS     sum { (A*e - y)(T) * w * (A*e - y) )/Sp ( w )

where y -- the difference between the observed time delay and theoretical;
      A -- matrix of equations of conditions;
      e -- vector of the parameter adjustments;
      w -- weight matrix;
      Sp   -- stands for the mathematical operation of computing trace of
                a matrix: the sum of diagonal elements.

Summing is done over all observations used in parameter estimation.

Comment: field WEIGHTED SQUARE SUM OF O-C is not computed in global mode.

Meaning of other parameters:

NUMBER OF OBSERVATIONS          total number of used observables

NUMBER OF UNKNOWNS              total number of unknowns, including those,
                                which are not shown in the Sinex listing

SQUARE SUM OF RESIDUALS (VTPV)  sum { (A*e - y)(T) * w * (A*e - y) )

VARIANCE FACTOR                 sum { (A*e - y)(T) * w * (A*e - y) )}/
                                    ( N - M - Sp( Cov(A) * B(T) * z * B ) )

where Cov(A) -- covariance matrix of the entire solution
                (NB: Sinex listing may have only a portion of the solution)
      B -- matrix of equations of constraints;
      z -- weight matrix of constraints;
      N -- total number of equations of conditions (observables);
      M -- total number of unknowns.
```

3) The blocks which keep element of matrices do not have fields "Second Matrix Element" and "Third Matrix Element".

The purpose of this change is to facilitate the process of creation of the listing and to reduce significantly the probability of errors.

4) SOLUTION/MATRIX_APRIORI is not provided. The reason is that Solve does not operate the notion of apriori covariance matrix. And it also uses singular constraints which cannot be reduced to the form of apriori covariance matrix. Since full information about constraints is provided in other blocks, SOLUTION/MATRIX_APRIORI is considered as an obsolete block.

2.1 New block SOLUTION/CONSTRAINT_EQUATION_INFO

S_O_L_U_T_I_O_N__C_O_N_S_T_R_A_I_T__I_N_F_O__B_L_O_C_K		
Field	Description	Format
Constraint Equation Row Index	Row index for the constraint equation matrix. It must match the index of the constraint equation.	1X,I5
Constraint Equation Identifier	Identifier of the constraint	1X,A8
Constraint Equation Sub-index	Index of vector constraint. 1 for scalar constraint.	1X,I5
Constraint Equation Description	Description of the constraint	1X,A40

This block provides description of constraint equations. Matrix of constraint equations has dimension N_cns * N_par, where N_cns -- the number of constraint equations, N_par -- number of estimated parameters. The first field of the CONSTRAINT_EQUATION_INFO keeps the index of the constraint, the second field keeps constraint identifier. Currently, the following constraint identifiers are supported:

```
   NNT_POS  -- net rotation on station position. This vector constraint defines
               three equations:
               1:  sum { Delta_X } = const
               2:  sum { Delta_Y } = const
               3:  sum { Delta_Y } = const
               where Delta_X, Delta_Y, Delta_Z are X, Y and Z component of
               the adjustment to station position.

   NNR_POS  -- net rotation on station position. This vector constraint defines
               three equations:
               1:  sum { Phi_X } = const
               2:  sum { Phi_Y } = const
               3:  sum { Phi_Y } = const
               where Phi_X, Phi_Y and Phi_Z are the components of the vector
               of a small rotation defined as
               Phi = ( r x Delta r )/ |r|^2 * R_e
                   here
                     r       -- vector of station coordinate;
                     Delta r -- vector of adjustments to station position
                     R_e     -- Earth's equatorial radius.
               Units: dimensionless
```

```
NNT_VEL  -- net rotation on station velocity. This vector constraint defines
            three equations:
            1:  sum { Delta_X } = const
            2:  sum { Delta_Y } = const
            3:  sum { Delta_Y } = const
            where Delta_X, Delta_Y, Delta_Z are X, Y and Z component of
            the adjustment to station position.

NNR_VEL  -- net rotation on station velocity This vector constraint defines
            three equations:
            1:  sum { Phi_X } = const
            2:  sum { Phi_Y } = const
            3:  sum { Phi_Y } = const
            where Phi_X, Phi_Y and Phi_Z are the components of the vector
            of a small rotation defined as
            Phi = ( r x Delta v )/ |r|^2 * R_e
                here
                  r       -- vector of station coordinates;
                  Delta r -- vector of adjustments to station velocity;
                  R_e     -- Earth's equatorial radius.

            Units: 1/yr

NNR_SRC  -- net rotation on source coordinates
            1:  sum { Phi_X } = const
            2:  sum { Phi_Y } = const
            3:  sum { Phi_Y } = const
            where Phi_X, Phi_Y and Phi_Z are the components of the vector
            of a small rotation

EOP_XPL  -- constraint on X pole coordinate
EOP_YPL  -- constraint on Y pole coordinate
EOP_UT1  -- constraint on UT1 angle
EOR_XPL  -- constraint on X pole rate
EOR_YPL  -- constraint on Y pole rate
EOR_UT1  -- constraint on UT1 rate

VEL_U    -- constraint on Up    topocentric coordinate of station velocity
VEL_E    -- constraint on East  topocentric coordinate of station velocity
VEL_N    -- constraint on North topocentric coordinate of station velocity
VEL_X    -- constraint on X  coordinate of station velocity
VEL_Y    -- constraint on Y  coordinate of station velocity
VEL_Z    -- constraint on Z  coordinate of station velocity

STA_U    -- constraint on Up    topocentric coordinate of station position
STA_E    -- constraint on East  topocentric coordinate of station position
STA_N    -- constraint on North topocentric coordinate of station position
STA_X    -- constraint on X  coordinate of station position
STA_Y    -- constraint on Y  coordinate of station position
STA_Z    -- constraint on Z  coordinate of station position


BLC_VAL  -- constraint on baseline clocks
```

```
DCL_ORG  -- constraint on declination of the set of certain sources
GRD_OFF  -- constraint on atmosphere path delay gradient offset
NUT_OFF  -- constraint on offset of nutation in longitude and nutation in
                           obliquity
OAT_RAT  -- constraint on rate of changes of atmosphere path delay
OCL_RAT  -- constraint on clock drift
RAS_ORG  -- constraint on right ascension of the set of certain sources
SRC_COO  -- constraint on source right ascension and declination
STA_ORG  -- constraint on position of certain stations
STA_TIE  -- constraint on differences in position of several sites
VEL_DIR  -- constraint on horizontal projection of the differences
            in velocities of two stations
VEL_ORG  -- constraint on velocities of certain stations
VEL_SET  -- constraint on linear combination of velocity components
VEL_TIE  -- constraint on differences in velocities of several sites
VEL_VER  -- constraint on vertical component of station velocity

Constraints on segmented parameters

STA_PWC  -- constraint on site velocity in the the case when site position
            is modeled by linear spline
GRD_RAT  -- constraint on atmosphere path delay gradient rate
ATM_RAT  -- constraint on atmosphere path delay rate between segments
CLO_RAT  -- constraint on clock rate between segments
UT1_RAT  -- constraint on UT1 rate in the case of linear spline
                           EOP parametrization
XPL_RAT  -- constraint on X pole coordinate in the case of linear spline
                           EOP parametrization
YPL_RAT  -- constraint on Y pole coordinate in the case of linear spline
                           EOP parametrization
```

Constraint equation sub-index is 1 for scalar constraint, like EOP_XPL and runs over components of vector constraints, like NNT_POS (1,2,3 in this example).

2.2 New block SOLUTION/CONSTRAINT_EQUATION_MATRIX

This block keep matrix of constraint equations. Equations are organized by rows. Zero elements are omitted.

S_O_L_U_T_I_O_N C_O_N_S_T_R_A_I_T E_Q_U_A_T_I_O_N B_L_O_C_K		
Field	Description	Format
Constraint equation row Index	Row index for the constraint equation matrix. It must match the index of the constraint	1X,I5

	equation.	
Constraint equation column index	Column index for the Constraint Equation. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5
Constraint matrix element	Matrix element at the location (row index, column index).	1X,E21.14

2.3 New block SOLUTION/CONSTRAINT_EQUATION_VECTOR

This block keeps the right-hand side of constraint equations.

S_O_L_U_T_I_O_N C_O_N_S_T_R_A_I_T V_A_L_U_E B_L_O_C_K

Field	Description	Format
Constraint Equation Row	Row index for the constraint equation vector. It must match the index of the constraint equation.	1X,I5
Right hand side value	Value of right hand part of the constraint equation.	1X,E21.15
Sigma	Reciprocal weight which is ascribed to this constraint equation.	1X,E21.15
		48

2.4 New block SOLUTION/CONSTRAINT_WEIGHT_MATRIX

This block contains the elements of the weight matrix of constraint equations. Zero elements are omitted.

CONSTRAINT WEIGHT MATRIX		
Field	**Description**	**Format**
Row index of the weight matrix of constraint equations	Row index for the weight constraint matrix. It matches the index of the constraint equation.	1X,I5
Column index of the weight matrix of constraint equations	Column index for the weight constraint matrix. It matches the index of the constraint equation	1X,I5
Weight matrix of constraint equations element	Matrix element at the location (row index, column index).	1X,E21.14

2.5 New block SOLUTION/DECOMPOSED_NORMAL_MATRIX BLOCK

This block contains decomposed normal equations for the subset of parameters described in the SOLUTION/ESTIMATE block. In the case if the SOLUTION/ESTIMATE block described all parameters adjusted in the solution, decomposed normal matrix is equivalent to the full normal matrix. In the case if the SOLUTION/ESTIMATE block describes only a subset of parameters, then the decomposed normal matrix D_ii is defined as

$$D_{ii} = N_{ii} - N_{ei}^{T} * (C_{ee} + N_{ee})^{-1} * N_{ei}$$ where

```
      N_ii -- the block of normal matrix which corresponds to the
              equations included in the SOLUTION/ESTIMATE list;
      N_ee -- the block of normal matrix which corresponds to omitted
              parameters;
      N_ei -- the block of normal matrix which corresponds to the product
              of equations of conditions of the omitted parameters and
              parameters included in the SOLUTION/ESTIMATE list.
      C_ee -- the block of normal matrix of constraints which corresponds
              to omitted parameters;
```

Solve computes D_ii as $D_{ii} = (V_{ii})^{-1} - C_{ii}$ where

```
      V_ii -- covariance matrix of the parameters mentioned in
              SOLUTION/ESTIMATE list;
      C_ii -- the block of normal matrix of constraints which corresponds
              to the parameters in SOLUTION/ESTIMATE list.

      It is assumed that C_ei = 0
```

C_ei -- the block of normal matrix of constraints which corresponds to the product of equations of constraints of the omitted parameters and parameters from the SOLUTION/ESTIMATE list.

S_O_L_U_T_I_O_N D_E_C_O_M_P_O_S_E_D N_O_R_M_A_L M_A_T_R_I_X		
Field	Description	Format
Decomposed normal matrix row index	Row index for the normal matrix. It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5
Decomposed normal matrix column index	Column index for the normal matrix It must match the parameter index in the SOLUTION/ESTIMATE block for the same parameter.	1X,I5
Decomposed normal matrix element	Matrix element at the location (row index, column index).	1X,E21.14

2.6 New block SOLUTION/DECOMPOSED_NORMAL_VECTOR BLOCK

This block contains decomposed right hand parts of normal equations for the subset of parameters described in the SOLUTION/ESTIMATE block. In the case if the SOLUTION/ESTIMATE block describes all parameters adjusted in the solution, the decomposed normal vector is equivalent to the full normal vector. In the case if the SOLUTION/ESTIMATE block describes only a subset of parameters, then the decomposed normal vector d_i is defined as

d_i = n_i - N_ei(T) * (C_ee + N_ee){-1} * n_e where

n_i -- the block of normal vector which corresponds to the equations listed in the SOLUTION/ESTIMATE;
n_e -- the block of the normal vector which corresponds to the omitted parameters;
N_ee -- the block of normal matrix which corresponds to omitted parameters;
N_ei -- the block of normal matrix which corresponds to the product of equations of conditions of the omitted parameters and parameters from the SOLUTION/ESTIMATE list.
C_ee -- the block of normal matrix of constraints which corresponds to omitted parameters;

```
Solve computes  d_i  as   d_i = D_i * e_i   where

      e_i  -- vector of the estimates of the parameters from the
              SOLUTION/ESTIMATE list.
```

Field	Description	Format
Estimated Parameter Index	Index of the estimated parameter.	1X,I5
Element of decomposed normal vector	Element of the decomposed normal (Row Number , Column Number). (Row Number , Column Number).	1X,E21.14
		28

Table: SOLUTION DECOMPOSED NORMAL VECTOR

2.7 New block NUTATION/DATA

This block describes which apriori nutation model is used and what is the reference model to which the nutation angles are referred.

Field	Description	Format
[Nutat. Code]	Code for nutation reference NONE REN2000 IAU1980 IERS1996 IAU2000a IAU2000b	1X,A8
[Nut. Usage]	Usage flag: APR or REF APR means that the previous field kept the nutation model used for apriori. REF means that the previous field kept the nutation model used as a reference.	1X,A3

Table: NUTATION DATA LINE

	NONE means that the total nutation angles are presented	
Comments		1X,A66
		80

2.8 New block PRECESSION/DATA

This block describes the apriori precession constant which was used.

N_U_T_A_T_I_O_N___D_A_T_A___L_I_N_E

Field	Description	Format
[Prec. Code]	Code for nutation reference NONE IAU1980 IAU2000	1X,A8
Comments		1X,A70
		80

Nutation angles can be presented either as nutation in obliquity and nutation in longitude in accordance to Newcomb-Andoyer formalism or as nutation X, nutation Y in accordance to Ginot-Capitaine formalism. Contrary to claims of Dr. Capitaine, both approaches are equivalent.

2.9 New block SOURCE/ID

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 name	IERS name of the radio source	1X,A8

ICRF name	ICRF name of the radio source	1X,A16
IAU name	IAU J2000.0 name of the radio source	1X,A10
IVS name	IVS name of the radio source	1X,A8
Comments	Comments or other names of the radio source	1X,A29
		80

3 Deviations from the SINEX 2.10 standard

Sinex listing in 2.20 format has different names for parameters in accordance to an anonymous document circulated in 2008 known as "Proposal 2".

4 Implementation in Solve

Solve normally produces the listing in its own so-called "spool-format". In addition to the spool listing, Solve has a limited ability to generate listings in Sinex format. It can write the listing in Sinex format when it runs in batch mode. Description of the keyword Sinex in the control language can be found in
http://gemini.gsfc.nasa.gov/solve_root/help/solve_guide_03.html#section3.13

When a user requests to apply specific constraints, Solve does not modify normal matrix immediately. Procedures of imposing constraints collect all constraint equation coefficients, weights, right hand part equations as well as constraint description in an intermediate data structure. After collecting all information about constraints Solve "applies" constraints by modifying normal matrix and normal matrix. If a Sinex output option is specified, then Solve passes this intermediate data structure to the routine which writes listing down and, thus, this subroutine has access to full information about the constraints.

Solve allows a user to specify which items among ESTIMATES, COVARIANCES, CONSTRAINTS, DECOMPOSED_NORMAL_EQUATIONS or all of them are to be included in the listing together with mandatory blocks. Solve allows a user to specify which parameters are to be included in the output. Currently, Solve does not allow to include any parameter in the listing, but only one from the pre-defined list of supported parameter.

4.1 Syntax of INCLUDE_PARAM and EXCLUDE_PARAM lists

INCLUDE_PARAM and EXCLIDE_PARAM files contain the parameter lists. List consists of one or more lines with Solve intrinsic 20-characters long parameter names. The lines which starts from # are considered as comments. Wild-card symbols * and ? can be included.

Solve check the name of each estimated parameter against INCLUDE_PARAM list. If the name matches with at least one line (except comment) then the name is flagged as "included". After that Solve check each parameter against EXCLUDE_PARM list. If it matches with at least one line (except comment) then it is flagged as "excluded". All parameters which are flagged as "included" and are not flagged as "excluded" will be included in the Sinex output.

The list of intrinsic parameter names:

Parameters which can be put in the listing in Sinex format:

```
ssssssss X COMPONENT   X-coordinate of station position at reference epoch
ssssssss Y COMPONENT   Y-coordinate of station position at reference epoch
ssssssss Z COMPONENT   Z-coordinate of station position at reference epoch
ssssssss X VELOCITY    X-coordinate of station velocity
ssssssss Y VELOCITY    Y-coordinate of station velocity
ssssssss Z VELOCITY    Z-coordinate of station velocity
ssssssss Xyymmdd-COO   X-coordinate of station position at epoch yymmdd
ssssssss Yyymmdd-COO   Y-coordinate of station position at epoch yymmdd
ssssssss Zyymmdd-COO   Z-coordinate of station position at epoch yymmdd
ssssssss Xyymmdd-POS   X-coordinate of station position at epoch yymmdd
ssssssss Yyymmdd-POS   Y-coordinate of station position at epoch yymmdd
ssssssss Zyymmdd-POS   Z-coordinate of station position at epoch yymmdd
ssssssss AXIS OFFSET   axis offset of the ssssssss station
X WOBBLE 0yymmddhhmm   X-coordinate of pole position at epoch  yymmddhhmm
X WOBBLE 1yymmddhhmm   Time derivative of X pole coordinate at yymmddhhmm
Y WOBBLE 0yymmddhhmm   Y-coordinate of pole position at epoch  yymmddhhmm
Y WOBBLE 1yymmddhhmm   Time derivative of Y pole coordinate at yymmddhhmm
UT1-TAI  0yymmddhhmm   UT1 angle at epoch yymmddhhmm
UT1-TAI  1yymmddhhmm   First time derivative of UT1 angle at epoch yymmddhhmm
LONGITUDE NUTATION     Nutation in longitude
OBLIQUITY NUTATION     Nutation in obliquity
qqqqqqqq RIGHT ASCEN   Right ascension at J2000.0 epoch
qqqqqqqq DECLINATION   Declination at J2000.0 epoch
qqqqqqqq RIGHT ASC V   Proper motion in right ascension
qqqqqqqq DEC VELO      Proper motion in declination
```

Other parameters which the current version of Solve cannot put in the listing in Sinex format:

```
ssssssssA0yymmddhhmm   Atmosphere path delay at epoch  yymmddhhmm
ssssssssa0yymmddhhmm   Atmosphere path delay at epoch  yymmddhhmm
ssssssssC0yymmddhhmm   Global clock offset at epoch  yymmddhhmm
ssssssssC1yymmddhhmm   Global clock rate at epoch  yymmddhhmm
ssssssssC2yymmddhhmm   Global clock rate drift at epoch  yymmddhhmm
ssssssss--ssssssss C   baseline dependent clocks
ssssssssNGyymmddhhmm   Atmosphere gradient in north direction
ssssssssEGyymmddhhmm   Atmosphere gradient in east  direction
X WOBBLE 2yymmddhhmm   Second time derivative of X pole coordinate at yymmddhhmm
Y WOBBLE 2yymmddhhmm   Second time derivative of Y pole coordinate at yymmddhhmm
UT1-TAI  2yymmddhhmm   Second time derivative of UT1 angle at epoch yymmddhhmm
Gamma                  Relativistic PPN parameter gamma


where
"ssssssss"    stands for the IVS station name
"qqqqqqqq"    stands for the IVS source name
"yyddmmhhss"  stands for time epoch like 980729113459 -- July 29, 1998 11 hours
              34 minutes 59 seconds.
```

4.2 Examples of INCLUDE_PARAM and EXCLUDE_PARAM lists

1. daily_inc.bsc

```
#
# -- Include parameters which will be put in Sinex listing
#
#    The following parameters are to be included in the Sinex listing:
#
#    1) Station coordinates
#    2) pole coordinates
#    3) UT1
#    4) rate of change of pole coordinates
#    5) rate of change of UT1
#    6) daily nutation angles
#
?????????X COMPONENT
?????????Y COMPONENT
?????????Z COMPONENT
?????????X??????-COO
?????????Y??????-COO
?????????Z??????-COO
?????????X??????-POS
?????????Y??????-POS
?????????Z??????-POS
X WOBBLE 0*
X WOBBLE 1*
Y WOBBLE 0*
Y WOBBLE 1*
```

```
UT1-TAI  0*
UT1-TAI  1*
LONGITUDE NUTATION
OBLIQUITY NUTATION

2. daily_exc.bsc
#
# -- Exclude parameters which will be put in Sinex listing
#
#    Nothing to exclude
#

3. daily_esc_notigo.bsc

#
# -- Exclude parameters which will be put in Sinex listing
#
#    All parameters related to station TIGOCONC are excluded
#
#    (NB: no common constraint equations with other stations can be
#         imposed if computation of the decomposed normal matrix is required )
#
TIGOCONC*
```

4.3 Treatment of station with discontinuous motion

It is an empirical fact that some stations has a quasi-instant motion due to seismic events, rails repair and other reasons of instability of VLBI site positions.

It is an analyst who determines the appropriate model for handing such stations. In the case if an analyst trusts to results of the measurements of such a motion by an independent technique, f.e. results of local survey before and after rails repairing, then position of the station is modeled by one parameter, and the motion of the station is described by the set of eccentricity values at the epochs before and after the motion.

If an analyst does not trust to independent measurements, or such measurements are unavailable, f.e. in the case of seismic motion, then coordinates of such station are described by a model

```
X = a1*B0(t0,t1) + a2*B0(t1,t2) + ... + b*(t-tref)

where B0 -- a basis spline of the 0-th order on the range t0, t1
            ( it is 1 at the range [t0, t1], and 0 otherwise )
      tref -- reference epoch;
      t0   -- epoch of the first observations;
      t1, t2 ... -- epoch of discontinuities.
```

Parameters a1, a2 ... have the same parameter name STAX, STAY, STAZ, but they are distinguished by sub-index 1,2... in the field SBIN

```
(former name SOLN). This field is used in sections
SITE/EPOCHS, SITE/APRIORI, SITE/ESTIMATES. If the station did not have
discontinuity in the motion than SBIN always has the value 1.

  The modern approach is to model non-liner site position with B-spline
or order 0,1,2,3. Sinex format does not allow to put in the listing
estimates of B-spline of order higher than 0.
```

4.4 Restrictions

```
  The current implementation (2002.10.04) cannot write the listing in
     Sinex format in several cases:

  1) Constraint NO_NET_TRANSLATION  is not supported. Use
     NO_NET_TRANSLATION_POSITION instead of that.

  2) Suppressions

     VELOCITIES         NO
     STATIONS           NO
     SOURCES            NO
     PROPER_MOTIONS     NO

  3) Solve cannot put in the listing site position modeled by linear spline.

  4) Currently, Solve can include in Sinex listing global parameters if it
     runs in global mode and local parameters if it runs in independent mode.
     It cannot include local parameters if it runs in global mode. This
     restriction may be lifted in the future.

  5) Solve cannot include in the listing in Sinex format second and higher
     order UT1 and polar motion time derivatives.

  6) Solve cannot include user parameters in the listing in Sinex format,
     but can include user constraints.

  7) No common constraints between included and not included parameters can
     be imposed if computation of decomposed normal matrix is required.
     Solve will issue a warning if a constraint equation has non-zero
     elements for the parameters from both groups of included and not
     included parameters in the case if computation of a decomposed normal
     matrix is required, and will issue an error message and stop if the
     decomposed normal matrix is to be included in the sinex listing.
```

Questions and comments about this guide should be sent to:

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