TDC Technical Memorandum
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K5 a-priori file format

Thread information is added for VDIF data.

1. A-priori file structure

A-priori file consists of "section" described by letters starting with '$' and parameters followed by the section letter. Table 1 shows the list of sections and their order in an a-priori file. $FORMAT1 and $FORMAT2 are new sections to define data format other than K5/VSSP. Any letters after '*' in a line are treated as comments.

Table 1. List of sections

```
$EXPCODE       <--- experiment title
$OBS_NUMBER    <--- scan (observation) number
$STATION1      <--- station 1 (X) information
$FORMAT1       <--- station 1 data format
$XYZ-STATION1  <--- station 1 position
$STATION2      <--- station 2 (Y) information
$FORMAT2       <--- station 2 data format
$XYZ-STATION2  <--- station 2 position
$BASEID        <--- baseline ID
$FRQ_GRP(1-4)  <--- frequency group
$FREQUENCY     <--- RF frequency
$PCAL_FREQ     <--- PCAL (phase calibration) frequency
$CLOCK         <--- clock parameters
$SOURCE        <--- radio source name
$RA            <--- radio source position (right ascension)
$DEC           <--- radio source position (declination)
$EPOCH         <--- epock of radio position
$GHA           <--- Greenwhich hour angle of radio source
$EOP           <--- earth orientation parameters
$START         <--- scan start time (UTC)
$STOP          <--- scan stop time (UTC)
$APRIORI       <--- a-prioi values (PRT, delay, delay rate, delay 2 dots, delay 3 dots)
$END           <--- end of a-priori file
```

2. Parameters at each section

$EXPCODE	section experimet code
exp_code	experiment code
$OBS_NUMBER	section scan (observation) number
n	scan #
$STATION1	section station 1 (X) information
station1_name data_file	station name and data file name
$FORMAT1	section station 1 data format (can be omitted for VSSP format)
data_format [*sampling_info*] [*thread#*]	data format *data_format*, sampling information *sampling_info* and thread information *thread#* (VDIF only) data format is VDIF|M5B|OCTAD|ADS where VDIF – VDIF format M5B – Mark-5B format OCTAD – OCTAD format ADS – ADS format

	sampling information is sampling frequency (m), # of channels (n) and AD resolution in bits (k), and described as follows. mMHz nCH $k$bit sampling information can be omitted for VDIF format but it is necessary if VDIF headder doesn't include sampling information thread number (n) starting from 0 is described as follows, THREAD-n
$XYZ-STATION1	section station 1 position
x y z	X(m) Y(m) Z(m)
$STATION2	section station 2 (Y) information
station2_name data_file	station name and data file name
$FORMAT2	section station 2 data format (can be omitted for VSSP format)
data_format [*sampling_info*] [*thread#*]	
	data format *data_format*, sampling information *sampling_info* and thread information *thread#* (VDIF only)
$XYZ-STATION2	section station 2 position
x y z	X(m) Y(m) Z(m)
$BASEID	section baseline ID
baseline_id	baseline ID (either 2 letters or 4 letters)
$FRQ_GRP(1-4)	section frequency group
n	frequency group # (1-4) or 0 0 means all 16CH processing
$FREQUENCY	section RF frequency
rf_freq side_band [*x-ch* [*y-ch* [*pol* [(*thx-thy*)]]]]	
	where *rf_freq* – RF frequency (Hz), *side_band* – sideband (U|L) *x-ch* – X data CH#、 *y-ch* – Y data CH# *pol* – polarization information (e.g., XX, YY, RR, RL, ...) '--' means no info *thx* – thread# for X data (valid for VDIF data) *thy* – thread# for Y data (valid for VDIF data) default is thread# set at $FORMAT1,2
$PCAL_FREQ	section PCAL (phase calibration) frequency
pcal_freq	PCAL frequency (Hz)
$CLOCK	section clock parameters
OFST= *c_offset*	clock offset (s). Positive value menas Y clock tic earlier than X clock tic.
RATE= *c_rate*	clock rate (s/s)
XCOF= *xc_offset*	clock offset (sec) of X station to UTC. Positive value menas X clock tic earlier than UTC clock tic.
$SOURCE	section radio source name
srcnam	radio source name (8 letters)
$RA	section radio source position (right ascension)
hour minute sec	right ascension (hour, minute, second)
$DEC	section radio source position (declination)
deg minute sec	declination (degree, minute, second)
$EPOCH	section epock of radio position
year	epoch (year)
$GHA	section Greenwhich hour angle of radio source
hour minute sec	hour angle (hour, minute, second)
$EOP	section earth orientation parameters
UT1-UTC= *ut1mutc*	UT1-UTC (s)
X_WOBB = *wobbx*	Wobbling X (arcsec)
Y_WOBB = *wobby*	Wobbling Y (arcsec)
$START	section scan start time (UTC)
yyyydddhhmmss	scan start time (UTC) (yyyy – year, ddd – total day, hh – hour, mm – minute, ss – second)
$START	section scan stop time (UTC)
yyyydddhhmmss	scan stop time (UTC) (year, total day, hour, minute, second)

$APRIORI	section a-prioi values
PRT=*yyyydddhhmmss*	PRT (processing reference time) (UTC) (year, total day, hour, minute, second)
TAU0= *tau*	a-priori delay (s)
TAU1= *tau1*	a-priori delay rate (s/s)
TAU2= *tau2*	a-priori delay 2-dots (s/s^2)
TAU3= *tau3*	a-priori delay 3-dots (s/s^3)
$END	end of a-priori file

3. Examples of a-priori file

Ex.1 in case of K5/VSSP format

```
** This is Apriori file made by apri_calc Ver. 2016-09-29
**     for cor, cor_all, fx_cor, and fx_cor_all
**
** SUBNET ON:  PRT is set according to each scan length
**
** Clock parameters at run are as follows,
**   Clock Offset (s) : 0.000000
**   Clock Rate (s/s) : 0.000000
**   Clock Epoch      :     0000/000 00:00:00
**
**
$EXPCODE     <--- section experiment title
KS15002
$OBS_NUMBER  <--- section scan (observation) number
1            <--- scan (observation) number
$STATION1    <--- section X station information
KASHIM11 ./R0020001.dat  <--- X station name and datafile name
$XYZ-STATION1   <--- section station X position
-3997505.701700 3276878.404550 3724240.703140 <--- X station position (X Y Z)(m)
$STATION2    <--- section Y station information
KOGANEI ./G0020001.dat   <--- Y station name and datafile name
$XYZ-STATION2   <--- section station Y position
-3941937.479090 3368150.907990 3702235.288150 <--- X station position (X Y Z)(m)
$BASEID   <--- section baseline ID
RG           <--- baseline ID (2 letters or 4 letters)
$FRQ_GRP(1-4)   <--- section frequency group
1            <--- frequency group # (1-4)
$FREQUENCY   <--- section RF frequency
7864990000.0 U    <--- RF frequency (Hz) and sideband (U|L) for CH #1
7874990000.0 U    <--- RF frequency (Hz) and sideband (U|L) for CH #2
7884990000.0 U    <--- RF frequency (Hz) and sideband (U|L) for CH #3
8014990000.0 U    <--- RF frequency (Hz) and sideband (U|L) for CH #4
$PCAL_FREQ   <--- section PCAL (phase calibration) frequency
10000.0        <--- PCAL frequency (Hz) for CH #1
10000.0        <--- PCAL frequency (Hz) for CH #2
10000.0        <--- PCAL frequency (Hz) for CH #3
10000.0        <--- PCAL frequency (Hz) for CH #4
$CLOCK          <--- section clock parameters
OFST= 0.000000  <--- clock offset (s)
RATE= 0.000000  <--- clock rate (s/s)
XCOF= 0.000000  <--- clock offset (s) of X station to UTC
$SOURCE     <--- sction radio source name
3C345       <--- radio source name
$RA         <--- section radio source position (right ascension)
16 42 58.80996700   <--- right ascension (hour, minute, second)
$DEC        <--- section radio source position (declination)
39 48 36.99406000  declination (degree, minute, second)
$EPOCH       <--- section epock of radio position
2000.0       <--- epoch (year)
$GHA         <--- section Greenwhich hour angle of radio source
16 3 23.584000    <--- hour angle (hour, minute, second)
$EOP          <--- section earth orientation parameters
UT1-UTC= 0.000000
X_WOBB = 0.000000
Y_WOBB = 0.000000
$START        <--- section scan start time (UTC)
2015002020000      <--- YYYYDDDHHMMSS
```

```
$STOP         <--- section scan stop time (UTC)
2015002020130      <--- YYYYDDDHHMMSS
$APRIORI      <--- section a-prioi values
PRT=2015002020045   <--- PRT(processing reference time) YYYYDDDHHMMSS
TAU0=  -8.744597367101878e-05 <--- a-priori delay (s)
TAU1=  -1.740376052034359e-08 <--- a-priori delay rate (s/s)
TAU2=   7.147465473084870e-13 <--- a-priori delay 2-dots (s/s^2)
TAU3=   9.254412615463208e-17 <--- a-priori delay 3-dots (s/s^3)
$END    <--- end of a-priori file
```

Ex.2 in case of VDIF format data

```
** This is Apriori file made by apri_calc Ver. 2016-09-29
**     for cor, cor_all, fx_cor, and fx_cor_all
**
** SUBNET ON:  PRT is set according to each scan length
**
** Clock parameters at run are as follows,
**   Clock Offset (s) : 0.000000
**   Clock Rate (s/s) : 0.000000
**   Clock Epoch      :     0000/000 00:00:00
**
**
$EXPCODE
KS15002
$OBS_NUMBER
1
$STATION1
KASHIM11 ./R0020001.dat
$FORMAT1    <--- section X station data format
VDIF        <--- set VDIF format
$XYZ-STATION1
-3997505.701700 3276878.404550 3724240.703140
$STATION2
KOGANEI ./G0020001.dat
$FORMAT2    <--- section X station data format
VDIF        <--- set VDIF format
$XYZ-STATION2
-3941937.479090 3368150.907990 3702235.288150
$BASEID
RG
$FRQ_GRP(1-4)
0             <--- '0' mean all channels
$FREQUENCY       * RFfreq U|L <pickup ch# for station1>  <pickup ch# for station2>
7864990000.0 U   <--- RF frequency (Hz) and sideband (U|L) for CH #1 (up to CH #16)
7874990000.0 U
7884990000.0 U
8014990000.0 U
8114990000.0 U
8244990000.0 U
8504990000.0 U
8544990000.0 U
8564990000.0 U
8574990000.0 U
2214990000.0 U
2224990000.0 U
2234990000.0 U
2264990000.0 U
2294990000.0 U
2304990000.0 U   <--- RF frequency (Hz) and sideband (U|L) for CH #16
$PCAL_FREQ
10000.0    <--- PCAL frequency (Hz) for CH #1 (up to CH #16)
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
```

```
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0    <--- PCAL frequency (Hz) for CH #1 (up to CH #16)

$CLOCK
OFST= 0.000000
RATE= 0.000000
XCOF= 0.000000

$SOURCE
3C345

$RA
16 42 58.80996700

$DEC
39 48 36.99406000

$EPOCH
2000.0

$GHA
16 3 23.584000

$EOP
UT1-UTC= 0.000000
X_WOBB = 0.000000
Y_WOBB = 0.000000

$START
2015002020000

$STOP
2015002020130

$APRIORI
PRT=2015002020045
TAU0=  -8.744597367101878e-05
TAU1=  -1.740376052034359e-08
TAU2=   7.147465473084870e-13
TAU3=   9.254412615463208e-17

$END
```

Ex.3 in case of Mark-5B format data

```
** This is Apriori file made by apri_calc Ver. 2016-09-29
**     for cor, cor_all, fx_cor, and fx_cor_all
**
** SUBNET ON:  PRT is set according to each scan length
**
** Clock parameters at run are as follows,
**   Clock Offset (s) : 0.000000
**   Clock Rate (s/s) : 0.000000
**   Clock Epoch      :     0000/000 00:00:00
**
**

$EXPCODE
KS15002

$OBS_NUMBER
1

$STATION1
KASHIM11 ./R0020001.dat

$FORMAT1
M5B 16MHz 16CH 1bit  <--- set Mark-5B format and sampling information

$XYZ-STATION1
-3997505.701700 3276878.404550 3724240.703140

$STATION2
KOGANEI ./G0020001.dat

$FORMAT2
M5B 16MHz 16CH 1bit  <--- set Mark-5B format and sampling information
```

```
$XYZ-STATION2
-3941937.479090 3368150.907990 3702235.288150

$BASEID
RG

$FRQ_GRP(1-4)
0

$FREQUENCY
7864990000.0 U
7874990000.0 U
7884990000.0 U
8014990000.0 U
8114990000.0 U
8244990000.0 U
8504990000.0 U
8544990000.0 U
8564990000.0 U
8574990000.0 U
2214990000.0 U
2224990000.0 U
2234990000.0 U
2264990000.0 U
2294990000.0 U
2304990000.0 U

$PCAL_FREQ
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0

$CLOCK
OFST= 0.000000
RATE= 0.000000
XCOF= 0.000000

$SOURCE
3C345

$RA
16 42 58.80996700

$DEC
39 48 36.99406000

$EPOCH
2000.0

$GHA
16 3 23.584000

$EOP
UT1-UTC= 0.000000
X_WOBB = 0.000000
Y_WOBB = 0.000000

$START
2015002020000

$STOP
2015002020130

$APRIORI
PRT=2015002020045
TAU0=  -8.744597367101878e-05
TAU1=  -1.740376052034359e-08
TAU2=   7.147465473084870e-13
TAU3=   9.254412615463208e-17

$END
```

Ex.4 in case of VSSP format and VDIF format data

```
** This is Apriori file made by apri_calc Ver. 2016-09-29
**     for cor, cor_all, fx_cor, and fx_cor_all
**
** SUBNET ON:  PRT is set according to each scan length
**
** Clock parameters at run are as follows,
**   Clock Offset (s) : 0.000000
**   Clock Rate (s/s) : 0.000000
**   Clock Epoch      :     0000/000 00:00:00
**
**

$EXPCODE
KS15002

$OBS_NUMBER
1

$STATION1
KASHIM11 ./R0020001.dat

$XYZ-STATION1
-3997505.701700 3276878.404550 3724240.703140

$STATION2
KOGANEI ./G0020001.dat

$FORMAT2
VDIF         <--- set VDIF format for Y station (X station is defalut data format VSSP)

$XYZ-STATION2
-3941937.479090 3368150.907990 3702235.288150

$BASEID
RG

$FRQ_GRP(1-4)
3

$FREQUENCY
8564990000.0 U  1  9   <--- RF frequency for X station CH# and Y station CH#
8574990000.0 U  2 10
2214990000.0 U  3 11
2224990000.0 U  4 12

$PCAL_FREQ
10000.0
10000.0
10000.0
10000.0

$CLOCK
OFST= 0.000000
RATE= 0.000000
XCOF= 0.000000

$SOURCE
3C345

$RA
16 42 58.80996700

$DEC
39 48 36.99406000

$EPOCH
2000.0

$GHA
16 3 23.584000

$EOP
UT1-UTC= 0.000000
X_WOBB = 0.000000
Y_WOBB = 0.000000

$START
2015002020000

$STOP
2015002020130

$APRIORI
PRT=2015002020045
TAU0=  -8.744597367101878e-05
TAU1=  -1.740376052034359e-08
TAU2=   7.147465473084870e-13
```

```
TAU3=   9.254412615463208e-17
$END
```

Ex.5 in case of VGOS data (VDIF format) –including polarization information–

```
** This is Apriori file made by apri_calc Ver. 2019-06-16
**     for cor, cor_all, fx_cor, and fx_cor_all
**
** (X clock offset wrt UTC is not reflected to a-priori values)
**
** SUBNET ON:  PRT is set according to each scan length
**
** Clock parameters at run are as follows,
**   Clock Offset (s) :   -4.212500000000000e-04
**   Clock Rate (s/s) : 0.000000
**   Clock Epoch      :     0000/000 00:00:00
**
**

$EXPCODE
v9715a

$OBS_NUMBER
80

$STATION1
SESHAN13 D:\data\CheckAtSHAO\v9715a\sv/v9715asv_no0080_1.10sec.vdif

$FORMAT1
VDIF 64MHz 8CH 2bit

$XYZ-STATION1
-2831686.993000 4675733.639000 3275327.641000

$STATION2
TIANMA13 D:\data\CheckAtSHAO\v9715a\tv/v9715atv_no0080_1.10sec.vdif

$FORMAT2
VDIF 64MHz 8CH 2bit

$XYZ-STATION2
-2826837.140000 4679223.144000 3274511.526000

$BASEID
SVTV

$FRQ_GRP(1-4)
1 2

$FREQUENCY
3480400000.0 L  1  1  XY     <== polarization information XY
3448400000.0 L  2  2  XY
3384400000.0 L  3  3  XY
3320400000.0 L  4  4  XY
3224400000.0 L  5  5  XY
3096400000.0 L  6  6  XY
3064400000.0 L  7  7  XY
3032400000.0 L  8  8  XY

$PCAL_FREQ
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0

$CLOCK
OFST= 0.000000
RATE= 0.000000
XCOF= 0.000000

$SOURCE
3C273B

$RA
12 29 6.69972950

$DEC
2 3 8.59828500

$EPOCH
```

```
2000.0

$GHA
15 59 50.752000

$EOP
UT1-UTC= 0.000000
X_WOBB = 0.000000
Y_WOBB = 0.000000

$START
2019196085700

$STOP
2019196085730

$APRIORI
PRT=2019196085715
TAU0=  -4.230495720005300e-04
TAU1=  -1.445886059562836e-09
TAU2=   1.006184911623976e-14
TAU3=   7.823024635496742e-18

$END
```

4. A-priori file for special processing

By editing parameter at $FREQUENCY, we can change the number of processing channels, and/or channel allocation between X and Y stations. When the number of channels is changed at $FREQUENCY, the number of channels at $PCAL_FREQ should be changed to keep the number of channels same.

Ex.1 change 16CH data to 6CH data and change CH# of Y station

```
$FREQUENCY
7864990000.0 U 1 6
7874990000.0 U 2 5
7884990000.0 U 3 4
8014990000.0 U 4 3
8114990000.0 U 5 2
8244990000.0 U 6 1

$PCAL_FREQ
10000.0
10000.0
10000.0
10000.0
10000.0
10000.0
```