Implementation Practice of the RECOMMENDATION ITU-R TF.1153-2

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Motivation

- ➔ In the computation process of TAI different interpretions of the ITU-R TF.1153-2 for the generation of data files caused problems in the computation of TAI (according to discussions with Jiang, BIPM).
- ➔ Problems arose in the computation of 1-sec data, too (Luca Lorini and Tom Parker pointed to this problem before).
- ➔ TWSTFT network will grow in the near future to a „worldwide web". There is a need for the clarification of the implementation of ITU-R TF.1153-2.

Goal

➔ Start a discussion to identify sections of the ITU-R TF.1153-2 which need an improvement.

➔ Find solutions which are feasible and as much as compatible to the existing practice.

➔ Agreement on an unambiguous data format

➔ And hopefully, the implementation in the current and future network

To be discussed

1) Reporting results of a quadratic fit: TW, REFDELAY, CALR, and ESDVAR

2) The calibration switch „S“

3) Report of individual 1s measurements

4) Reporting measurements in (more than) one file?

5) Reporting additional data (f, P, C/N0) in a dedicated separate file

1) Reporting results of a quadratic fit: TW, REFDELAY, CALR, and ESDVAR

Latest ITU-R TF.1153-2 version (1995-1997-2003):

```
         0         0         0         0         0         0         0         0         0         1         1         1         1
         1         2         3         4         5         6         7         8         9         0         1         2         3
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
* EARTH-STAT  LI  MJD  STTIME NTL        TW        DRMS SMP ATL       REFDELAY    RSIG  CI S     CALR      ESDVAR    ESIG TMP HUM PRES
* LOC     REM          hhmmss  s         s          ns        s          s         ns              ns        ns        ns degC  %  mbar
LLLLnn LLLLnn LL MMMMM hhmmss nnn +0,nnnnnnnnnnn n,nnn nnn nnn +0,nnnnnnnnnnn n,nnn CCC i +nnnn,nnn +nnnn,nnn n,nnn +nn nnn nnnn
```

	Appendix 1	Appendix 2
TW:	+0,nnnnnnnnnnnn	_0.263265762933
REFDELAY:	+0,nnnnnnnnnnnn	_0.000001334100
CI:	CCC	002, 999
S:	i	0, 1
CALR:	+nnnn,nnn	99999.999
ESDVAR:	+nnnn,nnn	99999.999

a) sign

b) how many „9“ ?

1) Reporting results of a quadratic fit: TW, REFDELAY, CALR, and ESDVAR

a) sign

	Appendix 1	Appendix 2
TW:	+0,nnnnnnnnnnnn	_0.263265762933
REFDELAY:	+0,nnnnnnnnnnnn	_0.000001334100
CALR:	+nnnn,nnn	__296.350
ESDVAR:	+nnnn,nnn	___-3.280
		"_" = blank

Examples from the European/U.S.-files:

TW:	_0.272718043970	+0.270127016619
CALR:	_4940.160	+7018.100, 00224.040

Some stations mix both formats, e.g.

TW: +0.268384831789 and **CALR: _449.600**

1) Reporting results of a quadratic fit: TW, REFDELAY, CALR, and ESDVAR

a) sign

	Appendix 1	Appendix 2
TW:	+0,nnnnnnnnnnn	_0.263265762933
REFDELAY:	+0,nnnnnnnnnnn	_0.000001334100
CALR:	+nnnn,nnn	__296.350
ESDVAR:	+nnnn,nnn	___-3.280
		"_" = blank

Proposal:

1) Interpret „+“ in Appendix 1 as a placeholder and use „_“ or „-“ in data files.

2) Computation S/W should be tolerant to „+“ and „_“

1) Reporting results of a quadratic fit: TW, REFDELAY, CALR, and ESDVAR

b) how many „9“?

	Appendix 1	Appendix 2
CALR:	+nnnn,nnn	99999.999
ESDVAR:	+nnnn,nnn	99999.999

Examples:

CALR:	999999999
	+9999.999
	99999.999

Proposal:

We should agree on one format for uncalibrated links, e.g.

CALR:	_9999.999
ESDVAR:	_9999.999
ESIG:	9.999

2) The calibration switch „S“

	Appendix 1	Appendix 2
CI:	CCC	002, 999
S:	i	0, 1

Examples:

CI	S	CALR	
038	2	999999999	Is S=2 recommended for ranging?
035	0	999999999	
999	9	999999999	
999	0	99999.999	compatible to App. 2

Proposal:
Use S=1 (or S=0) for calibrated links, S=2 for ranging, and S=0 for uncalibrated links, never S = 9.

3) Report of individual 1s measurements

```
*       A4926610.56B
*       UTC (LAB A) – CLOCK     = – 0.000000123456 49266 101000
*       CLOCK – 1PPSREF         =  0.000000012345
*       1PPSREF – 1PPSTX        = + 0.000000001234 49266 102059
*       DATA = 1PPSTX – 1PPSRX
49266   105616 0.270924666406
49266   105617 0.270924663805
49266   105618 0.270924660170
49266   105619 0.270924657628
49266   105620 0.270924654270
49266   105621 0.270924651106
```

Different Labs report the individual 1s data in a different way. The format was defined for the MITREX modem with an external TIC. Now, most Labs are equipped with new SATRE v.3 modems, whose 1s data are time stamped with *hhmmss* but represent an average over the second beginning at *hhmmss* and are thus related to hhmmss.5.(Luca and Tom pointed to the problem previously.

The problem came up with the SATRE generation v.3 and has been encountered and observed by several colleague, recently the USNO-PTB data as evaluated at USNO suffered from the problem.

3) Report of individual 1s measurements

At present, three different practices exist (to my knowledge):

1) MITREX	**correct**
2) SATRE v.3 „raw“	**wrong time stamp**
3) SATRE v.3 „averaged“	**no raw data, noise reduced**
	One more 1s measurment point is needed.

Examples:

2) INRiM, PTB

3) NIST

4) Reporting measurements in (more than) one file?

At present, there is only a limited number of stations operating more than one TWSTFT stations. In the near future the number of stations is expected to be increased.

Example: PTB

• Ku-band for Europe and U.S.:	data recorded at PTB and provided in TWPTBmj.day files on PTB's ftp server (PTB01).
• X-band USNO-PTB:	clock offset data recorded and processed by USNO and PTB separately. Data are provided by USNO to BIPM in a „free“ format.
• Ku-band NICT-PTB:	Data provided by NICT to BIPM. File name TWPTBmj.day but with station number PTB03.

4) Reporting measurements in (more than) one file?

It is not practicable to generate one file with all data, as it maight have been the idea of the ITU-R TF.1153-2 authors due to the following reasons:

- The data are processed and provided at different sites.

2) The data-format is not compatible, e.g. the USNO-PTB X-band data are clock-offset data, but the regular Ku-band data are indiviual measurements.

Solution:

A definition for file names which allows to generate more than one individual data files for different stations: e.g.

TWPTBmj.day	TWUSNOmj.day
TWPTCmj.day	TWUSNPmj.day
...	...

But this is not covered by the present ITU-R TF.1153-2.

4) Reporting measurements in (more than) one file?

Comment on X-band data USNO-PTB:

Clock offset data recorded and processed by USNO and PTB separately. Data are provided by USNO to BIPM in a „free“ format.

In Appendix 3 to Annex of ITU-R TF.1153-2 a format for reporting combined measurments (clock offset data) is defined.

The formats for 1s measurements and combined measurements are not compatible, but both have the same file name format.

There shoud be an unambiguous identifier:

e.g. TC*LLLL*mj.day „C“ = combined

5) Recording of additional data provided by SATRE modem

SATRE modem provides additional information in data output, such as Rx-frequency, power, signal/noise

Joseph Achkar suggested to extend the „ITU“-format to enable reporting and subsequent analysis of these data.

An alternative solution:

two files for each station

1) classic „ITU“-format file TW*LLLL*mj.day
2) receive parameter file RP*LLLL*mj.day

Last year at the CCTF WG meeting, I presented a first draft format.

In the meantime Luca Lorini started to provide additional data on INRiM‘s FTP-site.

We should agree on a single format.

5) Recording of additional data provided by SATRE modem

: „ITU“ file TWPTB54.357

* EARTH-STAT		LI	MJD	STTIME	NTL	TW	DRMS	SMP	ATL	REFDELAY	RSIG	CI	S	CALR	ESDVAR	ESIG	TMP	HUM	PRES
* LOC	REM			hhmmss	s	s	ns		s	s	ns			ns	ns	ns	degC	%	mbar
PTB01	PTB01	07	54357	000700	119	0.272735810544	0.349	120	119	0.000001162151	0.018	038	2	999999999	999999999	99999	8	98	1011
PTB01	OCA01	07	54357	001000	119	0.270774843768	0.252	120	119	0.000001162186	0.011	035	0	999999999	788.600	1.000	8	98	1011
PTB01	IT02	07	54357	001300	119	0.271129613991	0.334	120	119	0.000001162275	0.017	096	1	-37.600	781.100	0.100	8	98	1011
PTB01	ROA01	07	54357	001600	119	0.266511085985	0.549	120	119	0.000001162277	0.017	087	1	4940.160	788.600	1.000	8	98	1010
PTB01	OP01	07	54357	001900	119	0.270528056054	2.527	60	108	0.000001162311	0.010	103	1	6964.800	781.100	0.100	8	98	1010
PTB01	NPL01	07	54357	002200	119	0.270422176309	2.220	30	29	0.000001162264	0.014	100	1	-872.700	781.100	0.100	8	98	1010
PTB01	VSL01	07	54357	002500	119	0.271446035425	0.440	120	119	0.000001162251	0.016	107	1	-53.300	781.100	0.100	8	98	1010
PTB01	SP01	07	54357	002800	119	0.273946562460	0.498	120	119	0.000001162238	0.015	106	1	-168.900	781.100	0.100	8	98	1010
PTB01	CH01	07	54357	003700	119	0.271280690269	0.331	120	119	0.000001162304	0.019	109	1	-149.500	780.000	0.100	8	98	1010
PTB01	IPQ01	07	54357	004000	119	0.266224366843	0.275	120	119	0.000001162265	0.016	999	9	999999999	781.100	0.100	8	98	1010
PTB01	USNO01	09	54357	004600	119	0.262798421817	0.156	120	119	0.000001162432	0.012	082	1	-688.060	1136.900	0.500	8	98	1010
PTB01	NIST01	09	54357	004900	119	0.268400742085	0.358	120	119	0.000001162344	0.020	085	1	-449.600	1136.900	0.500	8	98	1010

: „parameter“ file RPPTB54.357

mean / SD / min / max

* EARTH-STAT		MJD	STTIME	NTL	SMP	FREQ-AVE	F-SIG	FREQ-MIN	FREQ-MAX	P-AVE	P-SIG	P-MIN	P-MAX	N-AVE	N-SIG	N-MIN	N-MAX
* LOC	REM		hhmmss	s		Hz	Hz	Hz	Hz	dBm	dBm	dBm	dBm	dBHz	dBHz	dBHz	dBHz
PTB01	PTB01	54357	000700	120	120	69999879.324	0.585	69999878.367	69999880.880	-52.7	0.419	-53.5	-52.0	52.0	0.340	51.4	52.9
PTB01	OCA01	54357	001000	120	120	70000672.149	0.400	70000671.368	70000673.057	-52.4	0.300	-52.8	-51.8	52.5	0.314	52.0	53.1
PTB01	IT02	54357	001300	120	120	70000379.848	0.442	70000379.045	70000380.849	-51.8	0.104	-52.1	-51.7	53.1	0.222	52.8	53.6
PTB01	ROA01	54357	001600	120	120	70000748.715	1.574	70000745.731	70000751.252	-52.1	0.211	-52.7	-51.6	52.6	0.204	52.2	53.2
PTB01	OP01	54357	001900	120	60	70000246.992	9.813	70000172.393	70000248.973	-54.8	0.130	-55.1	-54.5	50.6	0.144	50.4	50.9
PTB01	NPL01	54357	002200	120	30	70000250.268	0.251	70000249.805	70000250.748	-66.1	0.084	-66.2	-65.9	36.6	0.072	36.6	36.8
PTB01	VSL01	54357	002500	120	120	70000252.286	0.446	70000251.485	70000253.555	-52.5	0.076	-52.6	-52.3	52.5	0.135	52.2	52.8
PTB01	SP01	54357	002800	120	120	70000257.395	0.944	70000255.430	70000259.383	-54.0	1.267	-56.5	-50.8	51.2	1.123	48.9	54.2
PTB01	CH01	54357	003700	120	120	70000263.784	0.835	70000262.676	70000266.009	-53.6	0.169	-54.0	-53.3	51.7	0.208	51.3	52.1
PTB01	IPQ01	54357	004000	120	120	70000276.681	0.974	70000274.610	70000278.244	-52.2	0.121	-52.4	-52.0	52.9	0.095	52.8	53.1
PTB01	USNO01	54357	004600	120	120	70000294.392	0.559	70000293.346	70000295.632	-51.8	0.069	-51.9	-51.7	60.5	0.095	60.2	60.6
PTB01	NIST01	54357	004900	120	120	69999888.271	0.420	69999887.195	69999889.108	-58.5	0.169	-58.8	-58.0	52.7	0.169	52.4	53.2

Rx IF-frequency Rx power Rx C/N0

Conclusion

➔ At present, the practice of data recording does not follow the standard ITU-R IF.1153-2.

➔ The ITU-R IF.1153-2 itself is not fully consistent.

➔ An increasing network requires more disciplined work

➔ If the CCTF WG on TWSTFT agrees, I would like to collect comments and suggestions for a draft revision of the ITU-R IF.1153-2, for an input document for the next ITU WP7A meeting which is scheduled for 1 – 3 April 2008.

➔ We will provide a Word Document of the REC to interested parties who commit to submit their proposed changes by end of November 2007.

➔ Please, give me your comments and suggestions, now, later, or during the next weeks.