I. BIPM Circular T and UTCr, updates
II. GPS calibrations for UTC
III. Templates of GNSS times
IV. CCTF Task group on timescales definition

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BIPM Time Department

11th ICG Meeting

6-11 November 2016

Bureau International des Poids et Mesures

Part I: BIPM Circular T and UTCr, updates

- New form of Circular T in January 2016
- Fully clickable web version ftp://ftp2.bipm.org/pub/tai/Circular-T/cirthtm/cirt.xxx.html
- Explanatory Supplement of BIPM *Circular T* available on the ftp server at ftp://ftp2.bipm.org/pub/tai/publication/notes/.

CIRCULAR T 345 ISSN 1143-1393
2016 OCTOBER 10, 14h UTC

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The contents of the sections of BIPM *Circular T* are fully described in the document " Explanatory supplement to BIPM Circular T " available at ftp://ftp2.bipm.org/pub/tai/publication/notes/explanatory_supplement_v0.1.pdf

1 - Difference between UTC and its local realizations UTC(k) and corresponding uncertainties. From 2015 July 1, 0h UTC, *TAI-UTC* = 36 s. From 2017 January 1, 0h UTC, *TAI-UTC* = 37 s.

Date 2016 0h UTC				AUG 29	SEP 3	SEP 8	SEP 13	SEP 18	SEP 23	SEP 28	Uncertainty/ns			Notes
			MJD	57629	57634	57639	57644	57649	57654	57659	u_A	u_B	u	
Laboratory *k*							[*UTC-UTC(k)*]/ns							
AOS	(Borowiec)	123		-5.4	-4.4	-3.7	-3.6	-3.2	-2.7	-1.5	0.4	2.7	2.7	
APL	(Laurel)	123		0.1	1.1	1.4	1.1	1.4	1.8	2.7	0.3	10.9	10.9	
AUS	(Sydney)	123		739.2	757.2	779.6	796.8	811.3	834.3	862.1	0.4	5.9	5.9	
BEV	(Wien)	123		22.2	24.1	25.8	25.0	22.0	21.2	29.0	0.4	5.1	5.1	
BIM	(Sofiya)	123		4507.0	4525.1	4543.9	4571.9	4605.4	4642.5	4670.3	1.5	9.2	9.4	
BIRM	(Beijing)	123		-	1.0	0.0	-2.0	-4.6	0.9	5.4	1.5	20.0	20.1	
BY	(Minsk)	123		-3.2	-3.6	-3.8	-3.6	-4.3	-4.7	-4.5	1.5	8.6	8.8	
CAO	(Cagliari)	123		-15056.5	-15163.0	-15258.3	-15366.6	-15467.5	-15566.4	-15673.6	8.0	20.0	21.6	
CH	(Bern-Wabern)	123		3.3	3.0	3.5	3.7	4.9	4.7	4.7	0.3	1.6	1.7	
CNES	(Toulouse)	123		-0.1	-3.0	-5.1	-7.0	-4.7	-3.1	-1.9	0.4	4.1	4.1	
CNM	(Queretaro)	123		-13.4	-13.1	-10.1	-5.4	-1.1	0.6	3.2	2.5	11.1	11.4	
CNMP	(Panama)	123		-	-	-	-	-	-	-				
DFNT	(Tunis)	123		5968.2	6158.4	6354.0	6565.2	6762.7	6955.7	7160.7	0.7	20.0	20.0	
DMDM	(Belgrade)	123		20.2	9.9	8.1	3.4	7.2	-0.6	0.0	0.4	7.3	7.3	
DTAG	(Frankfurt/M)	123		135.9	128.5	125.4	120.8	126.5	135.3	129.4	0.3	7.6	7.6	
EIM	(Thessaloniki)	123		-4.3	-1.1	-8.6	-4.5	9.4	8.9	8.3	2.5	7.9	8.2	
ESTC	(Noordwijk)	123		-1.2	-1.6	-1.8	-1.2	1.0	2.8	2.8	0.4	5.5	5.5	
HKO	(Hong Kong)	123		421.6	426.2	430.3	443.4	450.5	462.2	476.5	0.4	7.3	7.3	
IFAG	(Wettzell)	123		-937.9	-943.9	-942.1	-935.2	-938.0	-929.2	-936.9	0.4	5.5	5.5	
IGNA	(Buenos Aires)	123		-	-	-	-	-	-	-				
IMBH	(Sarajevo)	123		-	-	-	-	-	-	-				
INCP	(Lima)	123		144.0	149.4	163.0	170.2	-21.6	-9.8	9.4	5.0	20.0	20.6	(1)
INPL	(Jerusalem)	123		135.5	135.9	145.8	148.3	155.4	170.0	174.5	1.5	7.7	7.9	
INTI	(Buenos Aires)	123		36.5	45.7	67.3	74.3	83.5	89.7	88.1	2.5	20.0	20.2	
INXE	(Rio de Janeiro)	123		-19.7	-14.4	-11.7	-18.4	-24.5	-24.0	-23.6	0.4	20.0	20.0	
IT	(Torino)	123		2.0	2.8	3.4	4.3	4.4	3.7	3.0	0.3	1.3	1.4	

Section 4 on [UTC-GNSS times]

- New section 4 provides only the values for the relations of UTC and TAI with predictions of UTC(k) disseminated by GNSS (as decided at the 20th Meeting of the CCTF). The relations of UTC and TAI with the GNSS System Times are published on the ftp server.

4 - Relations of UTC and TAI with predictions of UTC(k) disseminated by GNSS.

[UTC-UTC(USNO)_GPS] = C_0', [TAI-UTC(USNO)_GPS] = 36 s + C_0'
[UTC-UTC(SU)_GLONASS]= C_1', [TAI-UTC(SU)_GLONASS]= 36 s + C_1'

For this edition of circular, σ_0'= 1.0 ns, σ_1'= 6.8 ns

2016	0h UTC	MJD	C_0'/ns	N_0	C_1'/ns	N_1'
	AUG 29	57629	0.0	89	255.0	82
	AUG 30	57630	0.8	90	250.5	90
	AUG 31	57631	0.0	88	247.1	87
	SEP 1	57632	-0.7	89	243.2	79
	SEP 2	57633	-0.6	89	240.3	89
	SEP 3	57634	0.1	90	238.6	56
	SEP 4	57635	1.2	89	237.6	82
	SEP 5	57636	1.2	89	237.5	82
	SEP 6	57637	0.4	89	237.4	78
	SEP 7	57638	-0.3	90	236.8	89
	SEP 8	57639	-0.9	88	236.5	85
	SEP 9	57640	-1.9	77	235.2	80
	SEP 10	57641	-2.8	89	240.5	84
	SEP 11	57642	-0.9	90	255.0	79
	SEP 12	57643	-1.3	89	262.9	87
	SEP 13	57644	-1.4	86	261.4	81
	SEP 14	57645	0.1	89	254.7	69

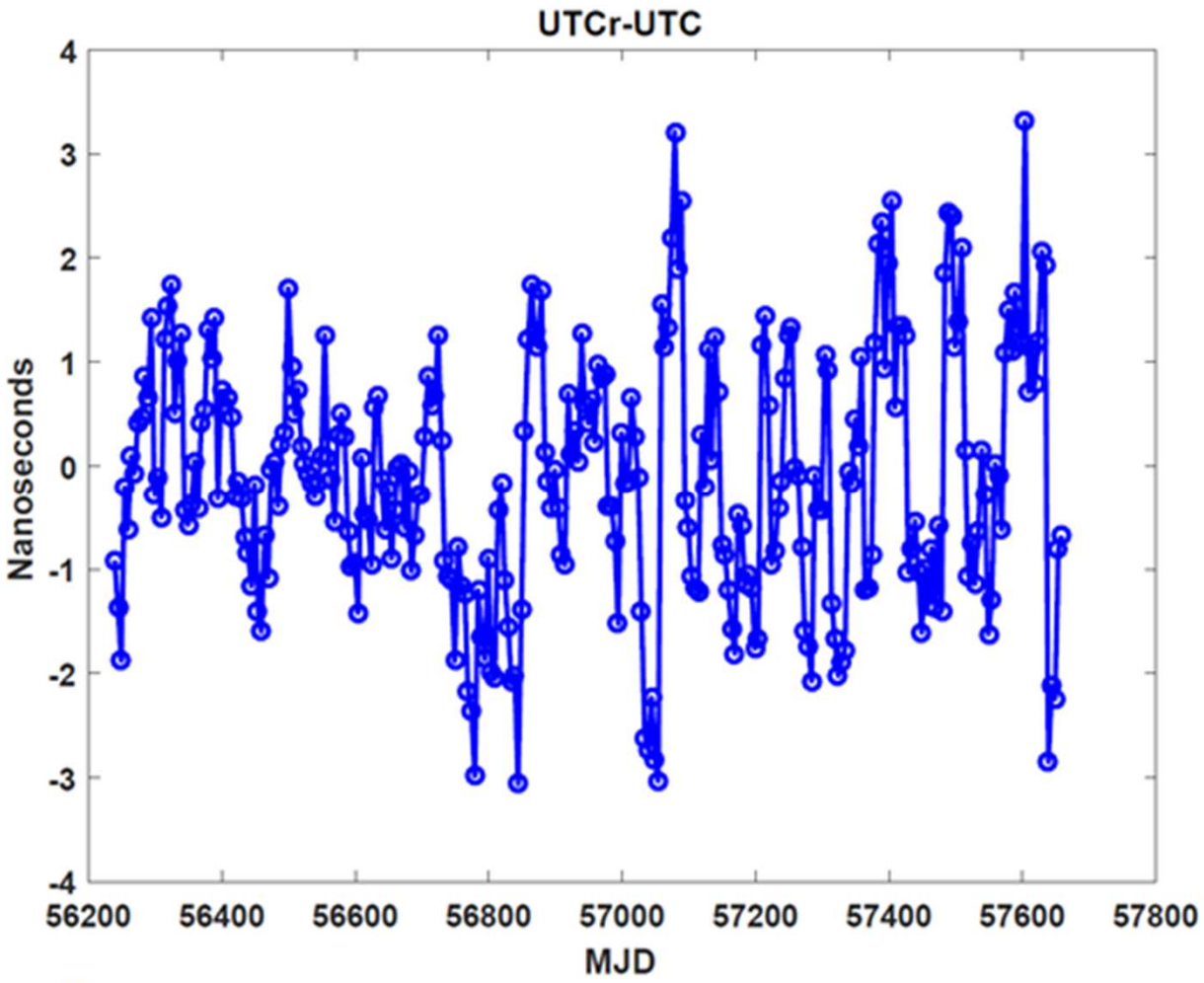
Section 5 on Time links

- New section 5 provides
  - more detailed information on the equipment used;
  - more reliable calibration uncertainties, and traceability to the original info.

5 - Time links used for the computation of TAI, calibrations information and corresponding uncertainties.

Link	Type	Equipment	Cal_ID1	/ Cal_ID2	u_{Stb}/ns	u_{Cal}/ns	u_{Ag}/ns	Al/ns	YYMM
APL /PTB	GPSPPP	AP__ /PT02	NA_Al	/ 1001-2014	0.3	11.2	10	24.3	1511
AUS /PTB	GPSPPP	AU01 /PT02	1002-2010	/ 1001-2014	0.3	5.8	3		
BIM /PTB	GPS MC	BM37 /PT07	2004-2008	/ 1005-2008	1.5	9.2	6		
BIRM/PTB	GPS MC	BIRM /PT07	NC	/ 1005-2008	1.5	20.0			
BY /PTB	GPS MC	BY46 /PT07	NA	/ 1005-2008	1.5	8.6	5		
CAO /PTB	GPS MC	CA__ /PT07	NC	/ 1005-2008	8.0	20.0			
CNES/PTB	GPSPPP	CS22 /PT02	1101-2016	/ 1001-2014	0.3	4.0	0		
CNM /PTB	GPS MC	CN00 /PT07	NA_Al	/ 1005-2008	2.5	11.2	10	-27.3	0804
CNMP/PTB	NL								
DFNT/PTB	GPS P3	DN__ /PT02	NC_Al	/ 1001-2014	0.7	20.0		10.3	1507
DMDM/PTB	GPSPPP	ZM68 /PT02	NA	/ 1001-2014	0.3	7.3	2		
DTAG/PTB	GPSPPP	DT01 /PT02	NA	/ 1001-2014	0.3	7.6	3		
EIM /PTB	GPS MC	EI__ /PT07	1011-2007	/ 1005-2008	2.5	7.8	6		
ESTC/PTB	GPSPPP	ES04 /PT02	1012-2012	/ 1001-2014	0.3	5.4	2		
HKO /PTB	GPSPPP	HKO2 /PT02	NA_Al	/ 1001-2014	0.3	7.3	2	11.6	1509
IFAG/PTB	GPSPPP	IF13 /PT02	1011-2011	/ 1001-2014	0.3	5.4	2		
IGNA/PTB	NL								
IMBH/PTB	NL								
INCP/PTB	GPS MC	CP__ /PT07	NC	/ 1005-2008	5.0	20.0			
INPL/PTB	GPS P3	IL02 /PT02	NA_Al	/ 1001-2014	1.5	7.7	3	-46.8	1212
INTI/PTB	GPS MC	IN__ /PT07	NC	/ 1005-2008	2.5	20.0			

Rapid UTC (UTCr)



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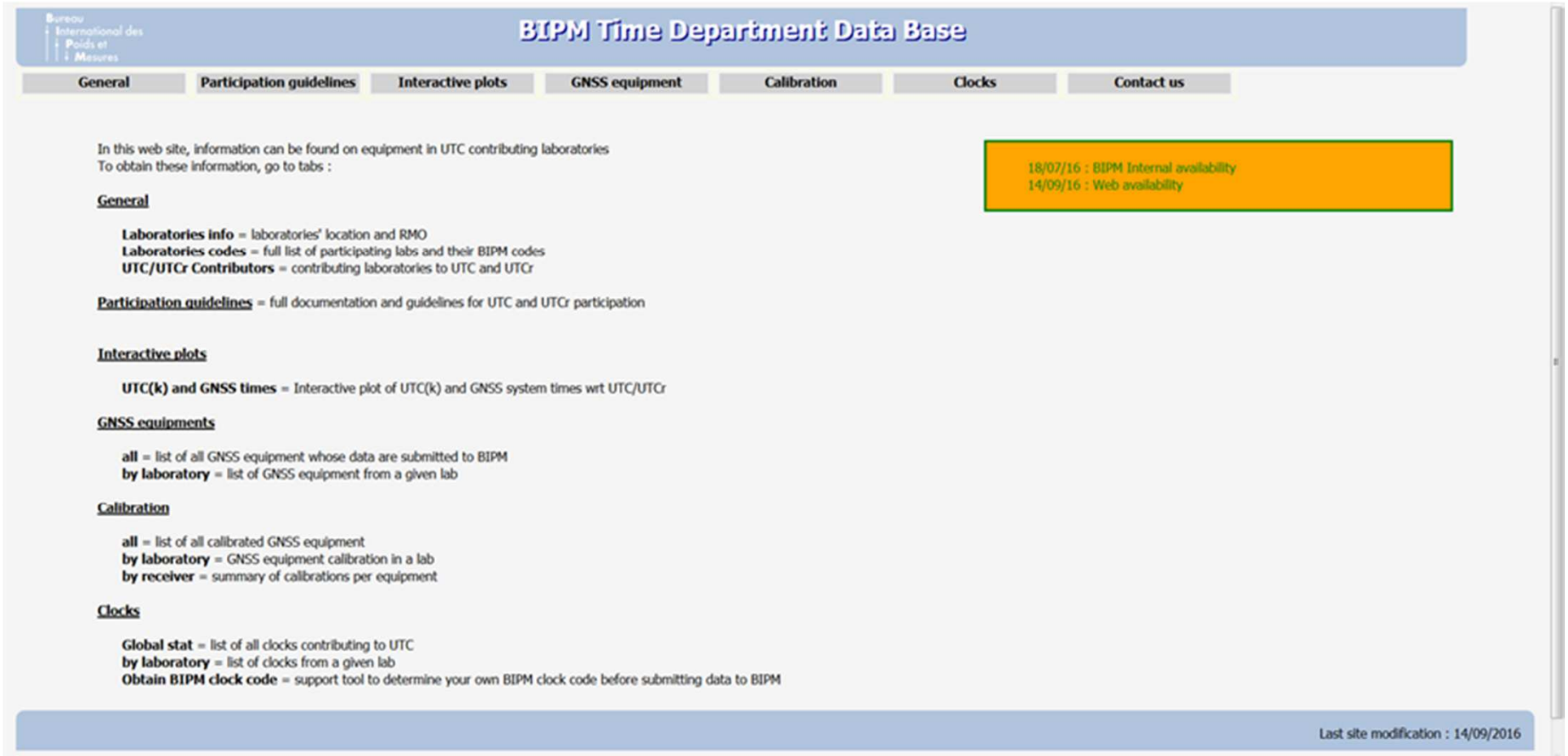
Uninterrupted weekly publication since July 2013
46 participants
~ 70% of the clocks in UTC
Difference [*UTC-UTC*r] is minimized (steering to UTC after publication of *BIPM Circular T*)

-3.1 ns ≤ [UTC-UTCr] ≤ +3.3 ns
Mean -0.1 ns
STD 1.2 ns

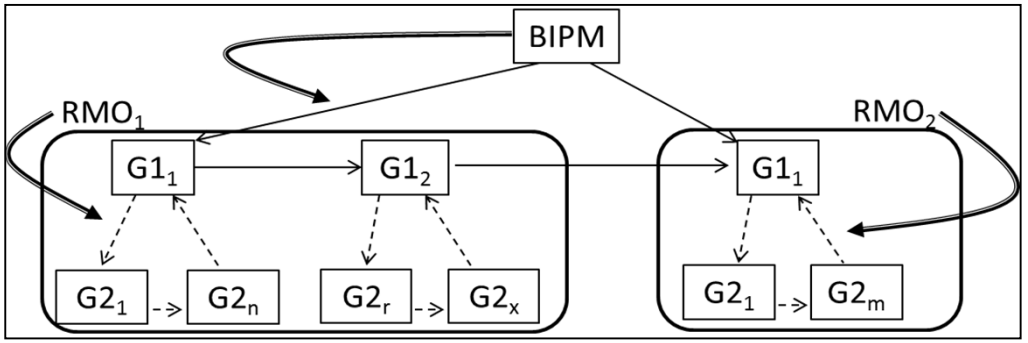
New Time Department database

- Provides information on UTC/UTCr and participating laboratories
- http://webtai.bipm.org/database/html/



Part II: GPS calibrations for UTC

- Maintain the calibration of the time transfer facilities in laboratories contributing to UTC.
- Use the calibration trips contributed by RMOs and individual laboratories in a consistent and optimal manner.
- Optimize the set of u_B uncertainties for UTC.
- Two groups of laboratories
  - Group 1: Calibration trips regularly carried out by the BIPM
  - Group 2: Other laboratories. Calibration trips for group 2 are performed under responsibility of the RMOs.
  - Group 1 laboratories are proposed by the RMOs. About 10 G1 labs (list may evolve with time).



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Status of calibrations

- 2014 Group 1 trip: Results published, used since September 2015.
- 2016 Group 1 trip under way
  - Stability from 2014 to 2016 below 1 ns for all visits so far.

- Group 2 trips started
  - About 20 laboratories calibrated or in the process of being calibrated.

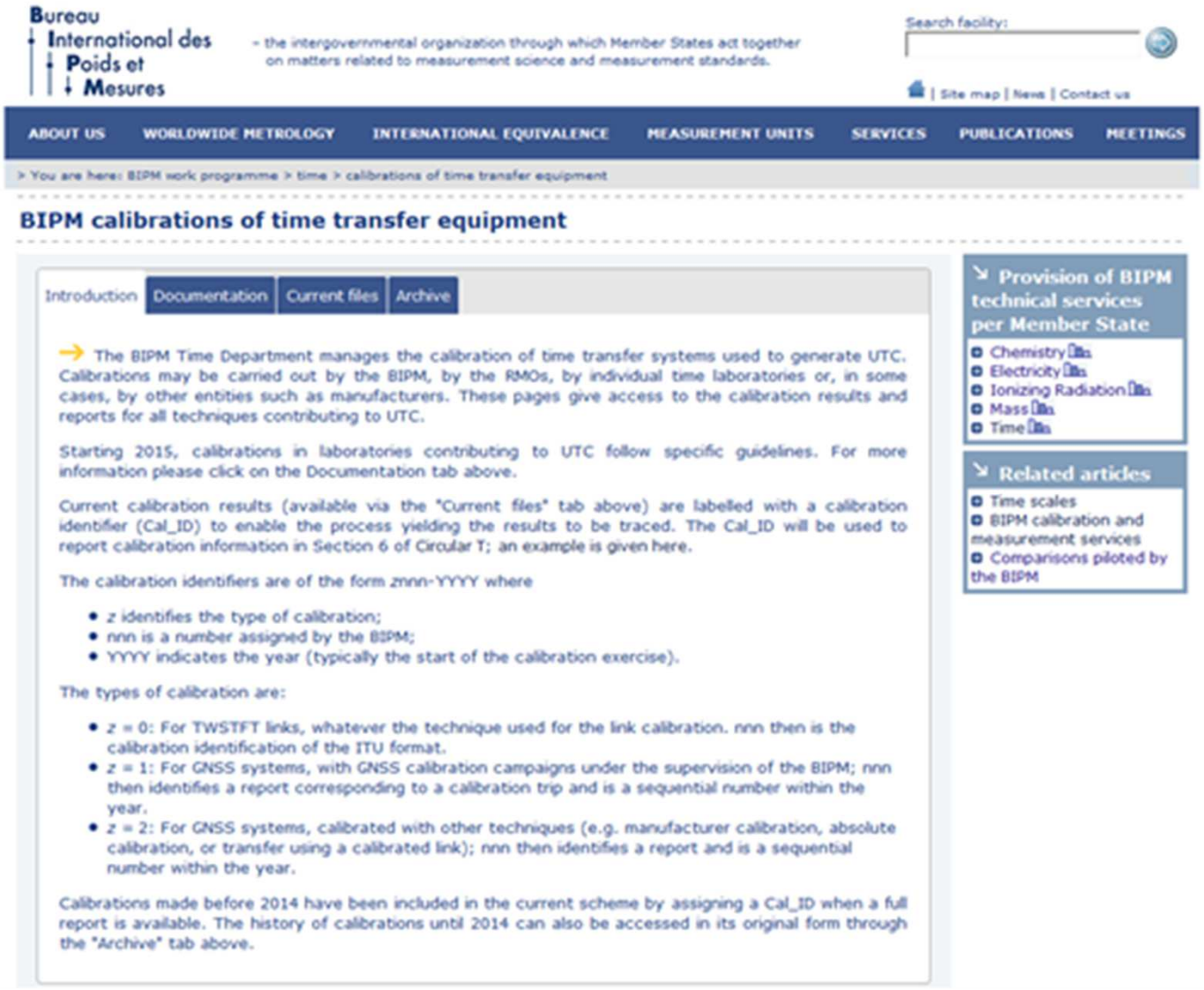
- Present uncertainty: 1.5 ns Group 1, 2.5 ns Group 2 (conventional).
- Goal of 1.5 ns systematic uncertainty for all links within reach.

Calibrations web page

http://www.bipm.org/jsp/en/TimeCalibrations.jsp

On line 09/04/2015

Intended to host all reports of UTC calibrations



Part III: Templates of GNSS times

- Recommendation 11 (2011) on « Finalization and publication of templates on geodetic and timing references »
  - Ongoing, most templates have been published between 2012 and 2016
  - Some templates still need updating due to last leap second insertion

- Templates available at http://www.unoosa.org/oosa/en/ourwork/icg/resources/Regl-ref.html

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Present status of templates

GNSS time	Published/updated	Update needed
GPS time	2012	Leap second
GLONASS time	2014	-
Galileo System time	**Update 2016**	-
EGNOS	2015	-
IGS time	2012	V2 Leap second
BeiDou	**Draft 2016**	
QZSS		
IRNSS		

Provision of templates and updates by 15 January 2017

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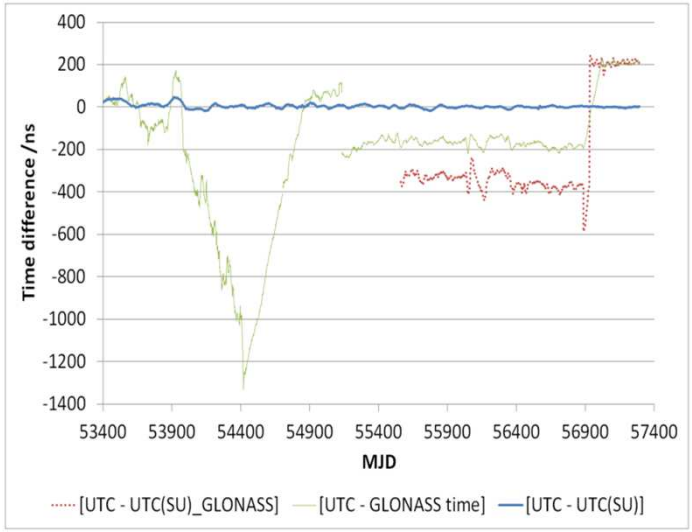
GLONASS time offset from UTC – actions report

- An independent laboratory (AOS, Poland) provides the data to compute the values of [UTC-GLONASS time] and [UTC-UTC(SU)$_{\_GLO}$];



- The hundreds-of-ns offset observed is historical, and originated partly in the calibration of the equipment;

- Coordinated actions between the BIPM, VNIIFTRI and AOS resulted in:
  - The absolute calibration by VNIIFTRI of the BIPM receiver identified by TTS4#136 in GLONASS signals LIC, L2C, L1P, L2P (June 2015);
  - Measurements for the calibration of receivers at AOS relative to BIPM TTS4#136 (Sept/Oct 2016), preliminary results indicate an offset ~204 ns;
  - Final files for October 2016 will be made available to the BIPM for analysis this week, with possible implementation in *Circular T* results computation.

Part IV: CCTF Task group on timescales definition

- ITU has undertaken studies, and requested input on the feasibility of achieving a continuous reference time scale;
- In fact, the discussion has been about « stopping leap second insertions in UTC »;
- There is no formal definition of UTC (nor TAI) issued from metrology, so
  - Rec. ITU-R TF. 460-6 has been (wrongly) interpreted as defining UTC.
- WRC-15
  - Recognized the roles of the BIPM and ITU concerning time scales definition and maintenance, and their dissemination;
  - Invited the various organizations to cooperate for developing studies on the present and potential future reference time scales and submit contributions to WRC-23;
  - Decided than until WRC-23 Rec. 460-6 will continue to apply.

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CCTF Task Group: Mission

- Mission
  - Review the present status of definition of time scales and their applications;
  - Provide the definitions (in a metrological context) of the existing time scales – TAI, UTC;
  - Discuss on the time scale adapted for reference in metrology applications, for adoption after 2023;
  - Develop draft recommendations on the items above to be proposed to the CCTF, which if approved, will submit them to the CIPM (2017) for its adoption, and as the basis of draft resolutions of the CGPM (2018).

- First meeting 28/9/2016