Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
AOS	3 Ind. Cs 2 H-masers	1 H-maser (2) + microphase-stepper	* (13)	*	*	*	*	*
APL	3 Ind. Cs 3 H-masers	1 H-maser + frequency synthesizer steered to UTC(APL)			*	*		
AUS	5 Ind. Cs 2 H-masers	1 Cs			*	*	*	*
BEV	2 Ind. Cs 1 H-maser	1 Cs		*	*	*	*	
BIM	3 Ind. Cs	1 Cs			*	*		
BIRM	2 Ind. Cs 3 H-masers	1 Cs + microphase-stepper			*	*		
BY	6 H-masers	3-4 H-masers + microphase-stepper			*		*	
CAO (a)	2 Ind. Cs	1 Cs		*	*	*	*	
CH	4 Ind. Cs (3) 1 H-maser	all the Cs 1 H-maser	*	*		*		*
CNM	2 Ind. Cs 1 H-maser	2 Ind. Cs 1 H-maser + microphase-stepper		*		*	*	
CNMP	3 Ind. Cs	1 Cs + frequency offset generator		*	*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
DLR	3 Ind. Cs 4 H-masers	1 Cs				*		
DMDM	2 Ind. Cs	1 Cs + microphase-stepper		*	*	*		
DTAG	3 Ind. Cs	1 Cs		*		*		
EIM	4 Ind. Cs	1 Cs			*			
ESTC	4 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper				*		
HKO	2 Ind. Cs	1 Cs				*	*	
IFAG (a)	5 Ind. Cs 2 H-masers	1 Cs + microphase-stepper		*	*	*		
IGNA	2 Ind. Cs	1 Cs		*	*			
INPL	2 Ind. Cs	1 Cs				*	*	
INTI	1 Ind. Cs	1 Cs		*	*			
INXE	2 Ind. Cs 1 Ind. Rb	1 Cs			*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
IPQ	3 Ind. Cs	1 Cs + microphase-stepper		*		*	*	*
IT	6 Ind. Cs 3 H-masers 2 Lab. Cs	1 H-maser + microphase-stepper		*	*	*		*
JATC	(4)	1 Cs + microphase-stepper	*					
JV (a)	3 Ind. Cs	1 Cs + microphase-stepper			*			
KEBS (a)	3 Ind. Cs	1 Cs + reference generator				*	*	
KIM	2 Ind. Cs	1 Cs				*	*	
KRIS	5 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper	*	*	*	*	*	*
KZ	5 Ind. Cs (5)	1 Cs + microphase-stepper				*	*	
LT	2 Ind. Cs	1 Cs		*	*			
MIKE	2 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper			*	*		
MKEH	1 Ind. Cs	1 Cs			*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
MSL	2 Ind. Cs	1 Cs + microphase-stepper		*		*		
MTC	5 Ind. Cs	1 Cs (6)			*			
NAO	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*	*			
NICT	29 Ind. Cs 7 H-masers (7) 1 Lab. Cs	18 Cs	*	*	*	*		*
NIM (a)	7 Ind. Cs 6 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NIMB (a)	2 Ind. Cs	1 Cs			*	*		
NIMT	2 Ind. Cs	1 Cs + microphase-stepper		*	*	*		
NIS	3 Ind. Cs	1 Cs		*	*	*	*	
NIST	2 Lab. Cs 7 Ind. Cs 7 H-masers	4 Cs 5 H-masers + microphase-stepper	*	*	*	*		*
NMIJ	4 Ind. Cs 1 Lab. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*	*		*
NMLS	2 Ind. Cs	1 Cs		*		*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
NPL	3 Ind. Cs 4 H-masers	1 H-maser			*	*		*
NPLI	5 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper		*	*	*		*
NRC	6 Ind. Cs 2 Lab. Cs 4 H-masers	1 Cs + microphase-stepper	*	*		*		
NRL	7 Ind. Cs 4 H-masers	1 H-maser + frequency synthesizer steered to UTC(NRL)		*		*		
NTSC	24 Ind. Cs 3 H-masers	1 Cs + microphase-stepper	*	*	*	*		*
ONBA	2 Ind. Cs	1 Cs			*			
ONRJ	7 Ind. Cs 2 H-masers	7 Cs 2 H-masers + frequency offset generator	* (8)	*		*	*	
OP	8 Ind. Cs 3 Lab. Cs 1 Lab. Rb 5 H-masers	1 H-maser (9) + microphase-stepper	* (10)	*	*	*	*	*
ORB	4 Ind. Cs 1 H-masers	1 H-maser or 1 Cs (11) + femtostepper		*		*	*	
PL	12 Ind. Cs 4 H-masers	1 Cs (12) + microphase-stepper	* (13)	*	*	*		
PTB	3 Ind. Cs 4 Lab. Cs (14) 4 H-masers	1 H-maser (15) + microphase-stepper	* (16)	*	*	*	*	*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
ROA	6 Ind. Cs (17) 1 H-maser	1 H-maser (18) + frequency synthesizer steered to UTC(ROA)		*	*	*	*	*
SASO	5 Ind. Cs	1 Cs		*		*	*	
SCL	2 Ind. Cs	1 Cs + microphase-stepper		*	*			
SG	4 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper	*	*	*	*	*	
SIQ	1 Ind. Cs	1 Cs			*			
SMD	3 Ind. Cs 1 H-maser	1 Cs + microphase-stepper			*	*	*	
SMU	1 Ind. Cs	1 Cs + output frequency steering			*	*	*	
SP	18 Ind. Cs (19) 7 H-masers	1 H-maser + microphase-stepper		*		*	*	*
SU	2 Lab. Cs (20) 8-9 H-masers	5-7 H-masers (21)	* (22)	*		*	*	* (23)
TCC (a)	3 Ind. Cs 3 H-masers	1 Cs			*	*		
TL	13 Ind. Cs 2 H-masers	1 H-maser + microphase-stepper	* (24)	*		*		*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2013 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab k	Equipment	Source of UTC(*k*) (1)	TA(*k*)	UTCr	Time Links			
					GPS		GLONASS	Two-Way
					SF	DF		
TP	4 Ind. Cs	1 Cs + output frequency steering				*		
UA (a)	1 Ind. Cs 3 H-masers	3 H-masers + microphase-stepper			*	*	*	
UME	5 Ind. Cs	1 Cs		*		*	*	
USNO	82 Ind. Cs 31 H-masers 5 Lab. Rb	1 H-maser + frequency synthesizer steered to UTC(USNO) (25)	* (25)	*	*	*		*
VMI	3 Ind. Cs	1 Cs + microphase-stepper				*		
VSL	4 Ind. Cs	1 Cs + microphase-stepper		*		*		*
ZA	4 Ind. Cs	1 Cs				*	*	

Notes

(a) Information based on the Annual Report for 2012, not confirmed by the laboratory.

(b) Information not confirmed by the laboratory.

(1) When several clocks are indicated as source of UTC(*k*), laboratory k computes a software clock, steered to UTC. Often a physical realization of UTC(*k*) is obtained using a Cs clock and a micro-phase-stepper.

(2) AOS The UTC(AOS) is formed technically using 1 hydrogen maser and microstepper, it is steered using TA(PL) data as a reference.
TA(PL) laboratories are linked via MC GPS-CV, except for two clocks of TPSA, two clocks of NIT and four clocks of AOS linked via a two-directional optical fibre connection to GUM

(3) CH All the standards are located in Bern at METAS (Swiss Federal Institute of Metrology).
Since November 2007, UTC(CH) is defined in real time by a hydrogen maser steered to the paper time scale UTC(CH.P) which is defined as a weighted average of all the clocks, steered to UTC.
TA(CH) is also a weighted average of all the clocks, but free running.

(4) JATC The standards are located at National Time Service Centre (NTSC).
The link between UTC(JATC) and UTC(NTSC) is obtained by internal connection.

(5) KZ The standards are located as follows:

*Kazakhstan Institute for Metrology (Astana)	4 Cs
*South-Kazakhstan branch of Kazakhstan Institute for Metrology (Almaty)	1 Cs

(6) MTC UTC(MT) is generated by Symmetricom/Microsemi TSC 2043B Direct Digital Synthesizer, DC to 6.48 MHz

(7) NICT The standards are located as follows:

* Koganei Headquarters	19 Cs, 7 H-masers
* Ohtakadoya-yama LF station	4 Cs
* Hagane-yama LF station	5 Cs
* Advanced ICT Research Institute in Kobe	2 Cs

(8) ONRJ The Brazilian atomic time scale TA(ONRJ) is computed by the National Observatory Time Service Division in Rio de Janeiro with data from 7 industrial caesium clocks and 2 hydrogen masers.

(9) OP Since MJD 56218 UTC(OP) is based on the output signal of a H-maser frequency steered towards UTC using the LNE-SYRTE fountains calibrations.

Notes (Cont.)

(10) OP The French atomic time scale TA(F) is computed by the LNE-SYRTE with data from 25 industrial caesium clocks located as follows (at the end of 2013) :

* Centre Electronique de l'Armement (CELAR, Rennes)	2 Cs
* Centre National d'Etudes Spatiales (CNES, Toulouse)	3 Cs
* France Telecom Recherche et Developpement (Lannion)	2 Cs
* Agilent Technologies France (Les Ulis)	1 Cs
* Observatoire de la Côte d'Azur (OCA, Grasse)	2 Cs
* Observatoire de Paris (LNE-SYRTE, Paris)	8 Cs
* Observatoire de Besançon (OB, Besançon)	2 Cs
* Direction des Constructions Navales (DCN, Brest)	4 Cs
* Spectracom, Orolia (Les Ulis)	1 Cs

All laboratories are linked via GPS receivers. The TA(F) frequency is steered using the LNE-SYRTE PFS data. The difference TA(F) – UTC(OP) is published in the OP Time Service Bulletin.

(11) ORB The source of UTC(ORB) is generated by a Cs clock since July 2013.

(12) PL The Polish official timescale UTC(PL) is maintained by the GUM.

(13) PL The Polish atomic timescale TA(PL) is computed by the AOS and GUM with data from 14 caesium clocks and 3 hydrogen masers located as follows:

* Central Office of Measures (GUM, Warsaw)	3 Cs, 1 H-maser
* Astrogeodynamical Observatory, Space Research Center P.A.S. (AOS, Borowiec)	2 Cs, 2 H-masers
* National Institute of Telecommunications (IŁ, Warsaw)	2 Cs
* Polish Telecom (TPSA, Warsaw)	3 Cs
* Military Primary Standards Laboratory (CWOM, Warsaw and Poznan)	2 Cs

and additionally

* Time and Frequency Standard Laboratory of the Semiconductor Physics Institute, a guest laboratory from Lithuania (LT, Vilnius, Lithuania)	2 Cs

All laboratories are linked via MC GPS-CV, except for two clocks of TPSA and two clocks of NIT linked via a two-directional optical fibre connection.

(14) PTB The laboratory Cs, PTB CS1 and PTB CS2 are operated continuously as clocks.
PTB CSF1 and CSF2 are fountain frequency standards using laser cooled caesium atoms. Both are intermittently operated as frequency standards. Contributions to TAI are made through comparisons with one of PTB's hydrogen masers.

(15) PTB UTC(PTB) is based on the output of an active hydrogen maser steered in frequency since MJD 55224 (February 2010).

(16) PTB Starting MJD 56079 0:00 UTC TA(PTB) is generated from an active hydrogen maser, steered in frequency so as to follow PTB caesium fountains as close as possible. The deviation *d* between the fountains and the TAI second is not taken into account.
TAI-TA(PTB) has an initial arbitrary offset from TAI without continuity to the data reported in previous months.
TA(PTB)-UTC(PTB) is published in PTB Time Service Bulletin.

Notes (Cont.)

(17) ROA The standards are located as follows:

* Real Observatorio de la Armada en San Fernando	5 Cs, 1 H-maser
* Centro Español de Metrología	1 Cs

(18) ROA Since March 2009, UTC(ROA) is defined in real time by a hydrogen maser, steered to the paper time scale UTC(ROA) which is defined as a weighted average of all the clocks, steered to UTC.

(19) SP The standards are located as follows (at the end of 2013):

* SP Technical Research Institute of Sweden (SP, Borås)	4 Cs, 2 H-masers
* SP Technical Research Institute of Sweden (SP, Stockholm)	5 Cs
* STUPI AB (Stockholm)	8 Cs, 3 H-masers
* Onsala Space Observatory (Onsala)	1 Cs, 2 H-masers

(20) SU CsFO1 and CsFO2 are fountain frequency standards using laser cooled caesium atoms. Both are intermittently operated as frequency standards. During 2013 both CsFO1 and CsFO2 were under experimental operation and there was no contribution to TAI.

(21) SU Laboratory computes UTC(SU) as a software clock, steered to UTC.

(22) SU Starting UTC 0:00 MJD 56289 TA(SU) is generated from an ensemble of active hydrogen masers, software steered in frequency so as to follow SU caesium fountains as closely as possible. The deviation *d* between the fountains and the TAI second is not taken into account.
TAI-TA(SU) has an initial arbitrary offset from TAI without continuity to the data reported in previous months.
TA(SU)-UTC(SU) is published in the SU Time Service Bulletin.

(23) SU Starting MJD 56564 0:00 UTC time link to contribute to TAI have been shifted from GLO/GPS to Two-way. Two-way measurements are referred to MC(SU). Difference UTC(SU) – MC(SU) for the referred period have been regularly evaluated by the SU Time Service.

(24) TL TA(TL) is generated from a 13-caesium-clock ensemble.

(25) USNO The time scales A.1(MEAN) and UTC(USNO) are computed by USNO. They are determined by a weighted average of Cs clocks, hydrogen masers, and rubidium fountains located at the USNO. A.1(MEAN) is a free atomic time scale, while UTC(USNO) is steered to UTC. Included in the total number of USNO atomic standards are the clocks located at the USNO Alternate Master Clock in Colorado Springs, CO.