BUREAU INTERNATIONAL DES POIDS ET MESURES

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Practical information about the BIPM Time Section

The Time Section of the BIPM issues two periodic publications. These are the monthly *Circular T* and the *Annual Report of the BIPM Time Section*. The complete text of *Circular T* and most tables of the present Annual Report are available through the internet network.
La Section du temps du BIPM produit deux publications périodiques : la Circulaire T, *mensuelle, et le* Rapport annuel de la Section du temps du BIPM. *Les circulaires et la plupart des tableaux de ce rapport annuel sont disponibles par utilisation du réseau internet.*

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Access to the BIPM Time Section data via anonymous FTP

The BIPM Time section is making available several publications and data files via anonymous ftp.
You can access it via the BIPM Web site http://www.bipm.fr or with the following procedure :
ftp 145.238.2.2 user anonymous
system requests that you enter your identity as a password
cd [anonymous.tai] to access the [.tai] subdirectory and get the read.me file listed below.

Listing of the READ.ME file: last update : 19 January 1998

BUREAU INTERNATIONAL DES POIDS ET MESURES - TIME SECTION

The [.tai] subdirectory offers via anonymous ftp (node 145.238.2.2) informations of interest for the time and frequency community. This service presently contains 2 subdirectories:

[.tai.publication] The latest issues of the Time Section publications:

publication	filename
Circular T#XXX	cirt.XXX
GPS schedule #XX	schgps.XX
GLONASS schedule #XX	schglo.XX
Results of the computation of TAI over the two-month interval Z of year 19XY (Z = 1 for Jan-Feb, 2 for Mar-Apr, etc.) until Nov-Dec 1997	tai.XYZ
Weights and	wXY.ZT
rates relative to TAI of clocks in the computation of TAI over the one-month interval ZT of year 19XY (ZT = 01 for Jan, 02 for Feb,..., 12 for Dec) starting Jan 1998	rXY.ZT

[.tai.scale] Time scales data:

content	filename
TT(BIPMXY) computed in year 19XY	ttbipm.XY
• For 1993-19XY:	
Difference between the normalized frequencies of EAL and TAI	ealtaiXY.ar
TAI frequency	ftaiXY.ar (for 1993, 1994)
Measurements of the duration of The TAI scale interval	utaiXY.ar (starting 1995)
Mean duration of TAI scale interval	sitaiXY.ar
Independent local atomic time scales: values of [TAI-TA(lab)]	taiXY.ar
Local representations of UTC: values of [UTC-UTC(lab)]	utcXY.ar
[TAI-GPS time] and [UTC-GPS time]	utcgpsXY.ar
[TAI-GLONASS time] and [UTC-GLONASS time]	utcgloXY.ar
Rates of clocks contributing to TAI	rtaiXY.ar
Weights of clocks contributing to TAI	wtaiXY.ar
• For 19XY-1992:	
Local representations of UTC: Values of [UTC-UTC(lab)]	utc.XY
Local values of [TAI-TA(lab)]	ta.XY

For any comment or query send a message to : tai@bipm.fr

Leap seconds

Secondes intercalaires

Since 1 January 1988, the maintenance of International Atomic Time, TAI, and of Coordinated Universal Time, UTC (with the exception of decisions and announcements concerning leap seconds of UTC) has been the responsibility of the Bureau International des Poids et Mesures (BIPM) under the authority of the Comité International des Poids et Mesures (CIPM). The dates of leap seconds of UTC are decided and announced by the International Earth Rotation Service (IERS), which is responsible for the determination of Earth rotation parameters and for maintenance of the related celestial and terrestrial reference systems. The adjustments of UTC and the relationship between TAI and UTC are given in Tables 1 and 2 of this volume.

Depuis le 1er janvier 1988, l'établissement du Temps atomique international, TAI, et du Temps universel coordonné, UTC, (à l'exception de l'annonce des secondes intercalaires de l'UTC) est placé sous la responsabilité du Bureau international des poids et mesures (BIPM) et du Comité international des poids et mesures (CIPM). Le choix des dates et l'annonce des secondes intercalaires de l'UTC constituent quelques-unes des missions du Service international de la rotation terrestre (IERS), qui est responsable de la détermination des paramètres de la rotation terrestre et de la conservation des systèmes de référence terrestre et céleste associés. Les ajustements de l'UTC et la relation entre le TAI et l'UTC sont donnés dans les tableaux 1 et 2 de ce volume.

Information on IERS can be obtained from:

Des renseignements sur l'IERS peuvent être obtenus à l'adresse suivante:

Central Bureau of IERS
Dr. Daniel GAMBIS
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Telephone: + 33 1 40 51 22 26
Telefax: + 33 1 40 51 22 91
Electronic mail: services@obspm.fr
Anonymous ftp on 145.238.2.21 (subdirectory IERS)

Establishment of the International Atomic Time and of the Coordinated Universal Time

1. Data and computation

The International Atomic Time, TAI, and the Coordinated Universal Time, UTC, are obtained from a combination of data from about 230 atomic clocks kept by 65 laboratories spread worldwide and regularly reported to the BIPM by 49 timing centres maintaining a local UTC, UTC(k) (list in Table 3). This data is in the form of time differences [*UTC*(*k*) - *Clock*] taken at 5 day intervals for Modified Julian Dates (MJD) ending in 4 and 9, at 0h UTC, dates designated here as 'standard dates'. The equipment maintained by these 49 timing centres is detailed in Table 4.

An iterative algorithm produces a free atomic time scale, EAL (Echelle atomique libre) defined as a weighted average of clock readings. The processing is done in deferred-time and treats as a whole two month blocks of data [1]. The weighting procedure and clock frequency prediction are chosen so that EAL is optimized for long-term stability. No attempt is made to ensure the conformity of the EAL scale interval with the second of the International System of Units.

2. Accuracy

The duration of the scale interval of EAL is evaluated by comparison with the data of primary caesium standards, after conversion on the rotating geoid. The TAI is then derived from EAL by adding a linear function of time with a convenient slope to ensure the accuracy of the TAI scale interval. The frequency offset between TAI and EAL is changed when necessary to maintain accuracy, the magnitude of the changes being of the same order as the frequency fluctuations resulting from the instability of EAL. This operation is referred to as the 'steering of TAI'. Table 5 gives the normalized frequency offsets between EAL and TAI. Measurements of the duration of the TAI scale interval and estimates of its mean duration are reported in Tables 6 and 7.

3. Availability

The TAI and UTC are made available in the form of time differences with respect to the local time scales UTC(k), which approximate UTC, and TA(k), which are independent local atomic time scales. These differences, [*UTC* - *UTC*(*k*)] and [*TAI* - *TA*(*k*)], reported in Tables 8 and 9, are computed for the standard dates.

The computation of TAI is carried out every two months. A provisional computation, however, is made every odd-numbered month (January, March, etc.) with the data which is available. In the following month, TAI is recomputed for the whole span of two months. The deviations between the provisional one-month and complete two-month solutions are usually smaller than 1ns. This arrangement allows the monthly publication of results in *Circular T*. When preparing the Annual Report, the results shown in *Circular T* are revised taking into account any improvement in the data made known after its publication. The computation is then strictly made for the six two-month intervals of the year.

4. Time links

In 1997, the network of time links used by the BIPM was non-redundant and mainly relied on the observation of GPS satellites in common views. One international GPS tracking schedule was published by the BIPM, GPS schedule No 29. It is reported in Table 10 and was implemented on 1 October 1997 (MJD 50722).

Laboratories regularly send their GPS observations to the BIPM where they are processed following a unified procedure. Strict common views, synchronized to within 1 s, are used to remove the clock-dither noise brought about by the voluntary degradation, Selective Availability, of GPS signals.

The BIPM organizes the international GPS network which takes the form of local stars within a continent joined by two long-distance links, OP-CRL and OP-NIST, chosen because measured ionospheric delays are routinely available for these three sites. Precise GPS satellites ephemerides, produced by the International Geodynamics Service with a delay of a few days, are also routinely used for these long-distance links. The ultimate precision of one single measurement of $[UTC(k_1) - UTC(k_2)]$, obtained at the BIPM with these procedures, is about 2 ns for short distances and 4 ns for long distances. The BIPM also publishes an evaluation of [*UTC* - *GPS time*] which is reported in Table 11 of this volume.

In 1997, the BIPM published one international GLONASS tracking schedule, GLONASS schedule No 4. It is reported in Table 12 and was implemented on 1 October 1997 (MJD 50722).
The BIPM regularly publishes an evaluation of [*UTC* - *GLONASS time*], given here in Table 13, using current observations of the GLONASS system at the NMi Van Swinden Laboratorium, The Netherlands.

5. Time scales established in retrospect

For the most demanding applications, such as millisecond pulsar timing, the BIPM issues atomic time scales in retrospect. These are designated TT(BIPMxx) where 1900 + xx is the year of computation [2]. The successive versions of TT(BIPMxx) are both updates and revisions: they may differ for common dates. These time scales are available on request from the BIPM or via the internet network.

Notes

Tables 14 and 15 of this report give the rates relative to TAI and the weights of the contributing clocks to TAI in 1997.

The yellow pages, at the end of this volume, give indications about time signal emissions.

The report of the BIPM Time Section, for the year October 1996 - September 1997, to be published in 'Comité International des Poids et Mesures, Report of the 86th Meeting, 1997, Tome 65, BIPM Publications', is reproduced after the yellow pages. All the publications mentioned in this report are available on request from the BIPM.

References

[1] C. Thomas and J. Azoubib, TAI computation : study of an alternative choice for implementing an upper limit of clock weights, *Metrologia*, 1996, **33**, 227-240.

[2] B. Guinot, Atomic time scales for pulsar studies and other demanding applications, *Astron. Astrophys.*, 1988, **192**, 370-373.

Etablissement du Temps atomique international et du Temps universel coordonné

1. Données et mode de calcul

Le Temps atomique international (TAI) et le Temps universel coordonné (UTC) sont obtenus par une combinaison de données provenant d'environ 230 horloges atomiques conservées par 65 laboratoires répartis dans le monde entier, et fournies régulièrement au BIPM par 49 laboratoires de temps qui maintiennent un UTC local, UTC(k) (liste donnée dans le tableau 3). Ces données prennent la forme de differences de temps [UTC(k) - Horloge] *enregistrées de 5 jours en 5 jours pour les dates juliennes modifiées (MJD) se terminant par 4 et 9, à 0hUTC, 'dates normales'. L'équipement maintenu par ces 49 laboratoires de temps est décrit dans le tableau 4.*

Un algorithme itératif qui traite en temps différé des blocs de 2 mois de données [1] produit une échelle atomique libre, EAL, définie comme étant une moyenne pondérée de lectures d'horloges. Le choix de la pondération et du mode de prédiction de fréquence optimise la stabilité de l'EAL à long terme. Il n'est pas tenté d'assurer la conformité de l'intervalle unitaire de l'EAL avec la seconde du Système international d'unités.

2. Exactitude

La durée de l'intervalle unitaire de l'EAL est évaluée par comparaison aux données d'étalons de fréquence à césium primaires, après conversion sur le géoïde en rotation. Ensuite le TAI se déduit de l'EAL par l'addition d'une fonction linéaire du temps dont la pente est convenablement choisie pour assurer l'exactitude de l'intervalle unitaire du TAI. Le décalage de fréquence entre le TAI et l'EAL est changé quand c'est nécessaire pour maintenir l'exactitude, les changements ayant le même ordre de grandeur que les fluctuations de fréquence qui résultent de l'instabilité de l'EAL. Cette opération est désignée par l'expression 'pilotage du TAI'. Le tableau 5 donne les différences de fréquences normalisées entre l'EAL et le TAI. Des mesures de la durée de l'intervalle unitaire du TAI et des estimations de sa durée moyenne sont données dans les tableaux 6 et 7.

3. Disponibilité

Le TAI et l'UTC sont disponibles sous forme de différences de temps avec les échelles locales de temps UTC(k), approximation de l'UTC, et TA(k), temps atomique local indépendant, reportées dans les tableaux 8 et 9.

Le calcul du TAI doit être fait, en principe, tous les deux mois. Mais un calcul provisoire est fait un mois sur deux (pour janvier, mars, etc.) avec les données disponibles. Le mois suivant, le calcul du TAI est repris pour une durée de deux mois.

L'écart entre les résultats des calculs provisoire et complet est ordinairement inférieur à 1 ns. Cette organisation permet la publication mensuelle des résultats dans la Circulaire T *du BIPM. Quand le Rapport annuel est préparé, les résultats de la* Circulaire T *sont révisés, compte-tenu des améliorations de données, connues après la publication de la* Circulaire T. *Les calculs sont alors strictement faits par période de deux mois.*

4. Liaisons horaires

En 1997, le système des liaisons horaires utilisé par le BIPM était non-redondant et reposait principalement sur l'observation des satellites du GPS en vues simultanées.

Le BIPM a produit un programme de poursuite des satellites du GPS, le programme No 29 reproduit dans le tableau 10, mis en oeuvre le 1 octobre 1997 (MJD 50722).

Les laboratoires envoient régulièrement leurs données au BIPM où les calculs sont effectués d'une manière unifiée. On utilise des observations en vues simultanées strictes, c'est-à-dire synchronisées à la seconde près, ceci afin de supprimer la dégradation des signaux des horloges embarquées, due à l'implantation de 'l'accés sélectif'.

Le BIPM organise le réseau international de comparaisons horaires utilisant le GPS selon un schéma en étoile au niveau des continents, et en deux liaisons à longue distance, OP-CRL et OP-NIST, choisies parce que des données de retards ionosphériques mesurés sont disponibles pour ces trois sites. Des éphémérides précises des satellites du GPS, produites par l'IGS et accessibles en quelques jours, sont aussi utilisées de manière courante pour ces deux liaisons. La précision ultime d'une mesure unique [UTC(k_1) - UTC(k_2)] *est alors d'environ 2 ns pour les liaisons à courte distance et d'environ 4 ns pour les liaisons à longue distance. Le BIPM publie aussi une évaluation de* [UTC - temps du GPS], *donnée dans le tableau 11 de ce volume.*

En 1997, le BIPM a produit un programme de poursuite des satellites du GLONASS en vues simultanées, le programme No 4 reproduit dans le tableau 12, mis en oeuvre le 1 octobre 1997 (MJD 50722).
Le BIPM publie régulièrement une évaluation de [UTC - temps du GLONASS], *donnée dans le tableau 13 du présent volume et déduite des observations habituelles du système GLONASS, réalisées au NMi Van Swinden Laboratorium, Pays-Bas.*

5. *Echelles de temps établies rétrospectivement*

Pour les applications les plus exigeantes, comme le chronométrage des pulsars milliseconde, le BIPM produit des échelles de temps rétrospectivement, désignées par TT(BIPMxx), 1900 + xx étant l'année du calcul [2]. Les versions successives de TT(BIPMxx) ne sont pas seulement des mises à jour, mais aussi des révisions, de sorte qu'elles peuvent différer pour les dates communes. Ces échelles de temps sont disponibles sur demande faite au BIPM ou par utilisation du réseau internet.

Notes

Les tableaux 14 et 15 de ce rapport donnent les fréquences relatives au TAI et les poids des horloges qui ont contribué au calcul en 1997.

Les pages jaunes, à la fin de ce volume, concernent les émissions de signaux horaires.

Le rapport à un an (octobre 1996 - septembre 1997) de la section du temps du BIPM à paraître dans 'Comité international des poids et mesures, Procès-verbaux 86e session, 1997, Tome 65, Publications du BIPM', est reproduit après les pages jaunes. Toutes les publications qui y sont mentionnées sont disponibles sur demande au BIPM.

Les références sont données dans le texte anglais, page 11.

List of the Tables included in the Annual Report of the BIPM Time Section for 1997

Tables indicated with * are available through the internet network ftp 145.238.2.2 or http://www.bipm.fr.

Table 1. Frequency offsets and step adjustments of UTC.......... p. 19

Table 2. Relationship between TAI and UTC.......... p. 21

Table 3. Acronyms and locations of the timing centres which maintain a UTC(k) or/and a TA(k).......... p. 22

Table 4. Equipment and source of UTC(k) of the laboratories contributing to TAI in 1997 .... p. 25

Table 5. * Differences between the normalized frequencies of EAL and TAI.......... p. 31
Data file EALTAI97.AR

Table 6. * Measurements of the duration of the TAI scale interval.......... p. 33
Data file UTAI97.AR

Table 7. * Mean duration of the TAI scale interval.......... p. 37
Data file SITAI97.AR

Table 8. * Independent local atomic time scales: values of [*TAI - TA(k)*].......... p. 39
Data file TAI97.AR

Table 9. * Local representations of UTC: values of [*UTC - UTC(k)*].......... p. 47
Data file UTC97.AR

Table 10. International GPS Tracking Schedule No 29.......... p. 67

Table 11. *[*TAI - GPS time*] and [*UTC - GPS time*].......... p. 73
Data file UTCGPS97.AR

Table 12. International GLONASS Tracking Schedule No 4.......... p. 81

Table 13. *[*TAI - GLONASS time*] and [*UTC - GLONASS time*].......... p. 93
Data file UTCGLO97.AR

Table 14. Contributing clocks to TAI in 1997:
14A. * Rates relative to TAI.......... p. 101
Data file RTAI97.AR
14B. Corrections for an homogeneous use of the clock rates published in the current and previous annual reports.......... p. 109

Table 15. Contributing clocks to TAI in 1997:
15A. * Weights.......... p. 111
Data file WTAI97.AR
15B. Statistical data on the weights.......... p. 119

Time Signals.......... p. 121

Report on the scientific work of the BIPM Time Section.......... p. 137

TABLE 1. FREQUENCY OFFSETS AND STEP ADJUSTMENTS OF UTC, UNTIL 31 DECEMBER 1998

Date (at 0h UTC)	Offsets	Steps
1961 Jan. 1	-150×10^{-10}	
1961 Aug. 1	"	+0.050 s
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	-0.100 s
1964 Jan. 1	-150×10^{-10}	
1964 Apr. 1	"	-0.100 s
1964 Sep. 1	"	-0.100 s
1965 Jan. 1	"	-0.100 s
1965 Mar. 1	"	-0.100 s
1965 Jul. 1	"	-0.100 s
1965 Sep. 1	"	-0.100 s
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	+0.100 s
1972 Jan. 1	0	-0.107 7580 s
1972 Jul. 1	"	-1 s
1973 Jan. 1	"	-1 s
1974 Jan. 1	"	-1 s
1975 Jan. 1	"	-1 s
1976 Jan. 1	"	-1 s
1977 Jan. 1	"	-1 s
1978 Jan. 1	"	-1 s
1979 Jan. 1	"	-1 s
1980 Jan. 1	"	-1 s
1981 Jul. 1	"	-1 s
1982 Jul. 1	"	-1 s
1983 Jul. 1	"	-1 s
1985 Jul. 1	"	-1 s
1988 Jan. 1	"	-1 s
1990 Jan. 1	"	-1 s
1991 Jan. 1	"	-1 s
1992 Jul. 1	"	-1 s
1993 Jul. 1	"	-1 s
1994 Jul. 1	"	-1 s
1996 Jan. 1	"	-1 s
1997 Jul. 1	"	-1 s

TABLE 2. RELATIONSHIP BETWEEN TAI AND UTC, UNTIL 31 DECEMBER 1998

LIMITS OF VALIDITY (AT 0h UTC)	*TAI - UTC* (IN SECONDS)
1961 Jan. 1 - 1961 Aug. 1	1.422 8180 + (MJD - 37300) x 0.001 296
1961 Aug. 1 - 1962 Jan. 1	1.372 8180 + " "
1962 Jan. 1 - 1963 Nov. 1	1.845 8580 + (MJD - 37665) x 0.001 1232
1963 Nov. 1 - 1964 Jan. 1	1.945 8580 + " "
1964 Jan. 1 - 1964 Apr. 1	3.240 1300 + (MJD - 38761) x 0.001 296
1964 Apr. 1 - 1964 Sep. 1	3.340 1300 + " "
1964 Sep. 1 - 1965 Jan. 1	3.440 1300 + " "
1965 Jan. 1 - 1965 Mar. 1	3.540 1300 + " "
1965 Mar. 1 - 1965 Jul. 1	3.640 1300 + " "
1965 Jul. 1 - 1965 Sep. 1	3.740 1300 + " "
1965 Sep. 1 - 1966 Jan. 1	3.840 1300 + " "
1966 Jan. 1 - 1968 Feb. 1	4.313 1700 + (MJD - 39126) x 0.002 592
1968 Feb. 1 - 1972 Jan. 1	4.213 1700 + " "
1972 Jan. 1 - 1972 Jul. 1	10 (integral number of seconds)
1972 Jul. 1 - 1973 Jan. 1	11
1973 Jan. 1 - 1974 Jan. 1	12
1974 Jan. 1 - 1975 Jan. 1	13
1975 Jan. 1 - 1976 Jan. 1	14
1976 Jan. 1 - 1977 Jan. 1	15
1977 Jan. 1 - 1978 Jan. 1	16
1978 Jan. 1 - 1979 Jan. 1	17
1979 Jan. 1 - 1980 Jan. 1	18
1980 Jan. 1 - 1981 Jul. 1	19
1981 Jul. 1 - 1982 Jul. 1	20
1982 Jul. 1 - 1983 Jul. 1	21
1983 Jul. 1 - 1985 Jul. 1	22
1985 Jul. 1 - 1988 Jan. 1	23
1988 Jan. 1 - 1990 Jan. 1	24
1990 Jan. 1 - 1991 Jan. 1	25
1991 Jan. 1 - 1992 Jul. 1	26
1992 Jul. 1 - 1993 Jul. 1	27
1993 Jul. 1 - 1994 Jul. 1	28
1994 Jul. 1 - 1996 Jan. 1	29
1996 Jan. 1 - 1997 Jul. 1	30
1997 Jul. 1 -	31

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(K), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(K)

AMC	Alternate Master Clock station, Colorado Springs, Colorado, USA
AOS	Astronomiczne Obserwatorium Szerokosciowe, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, MA, USA
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Oesterreich
BIRM	Beijing Institute of Radio Metrology and Measurement, Beijing, P. R. China
CAO	Cagliari Astronomical Observatory , Cagliari, Italia
CH	Consortium of laboratories in Switzerland
CNM	Centro Nacional de Metrologia, Queretaro, Mexico
CRL	Communications Research Laboratory, Tokyo, Japan
CSAO	Shaanxi Astronomical Observatory, Lintong, P.R. China
CSIR	Council for Scientific and Industrial Research, Pretoria, South Africa
F	Commission Nationale de l'Heure, Paris, France
DLR	Deutsche Forschungsanstalt fuer Luft-und Raumfahrt, Oberpfaffenhofen, Germany
DTAG	Deutsche Telecom AG, Darmstadt, Deutschland
GUM	Glówny Urzad Miar, Central Office of Measures, Warszawa, Polska
IEN	Istituto Elettrotecnico Nazionale Galileo Ferraris, Torino, Italia
IFAG(1)	Institut für Angewandte Geodäsie, Frankfurt am Main, Deutschland
IGMA	Instituto Geografico Militar, Buenos-Aires, Argentina
INPL	National Physical Laboratory, Jerusalem, Israel
IPQ	Institute Português da Qualidade (Portuguese Institute for Quality), Monte de Caparica, Portugal.
JATC	Joint Atomic Time Commission, Lintong, P.R. China
KRIS	Korea Research Institute of Standards and Science, Taejon, Rep. of Korea
LDS	The University of Leeds, Leeds, United Kingdom
MSL	Measurement Standards Laboratory, Lower Hutt, New Zealand
NAO(2)	National Astronomical Observatory, Misuzawa, Japan
NIM	National Institute of Metrology, Beijing, P.R. China
NIST	National Institute of Standards and Technology, Boulder, CO, USA
NML	National Measurement Laboratory, Sydney, Australia
NPL	National Physical Laboratory, Teddington, United Kingdom
NPLI	National Physical Laboratory, New-Delhi, India
NRC	National Research Council of Canada, Ottawa, Canada
NRLM	National Research Laboratory of Metrology, Tsukuba, Japan
OMH	Orszagos Mérésügyi Hivatal, Budapest, Hungary
ONBA	Observatorio Naval, Buenos-Aires, Argentina

(1) IFAG : renamed « Bundesamt fuer Kartographie und Geodaesie »
(2) Formerly NAOM

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(K), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(K) (CONT.)

ONRJ	Observatorio Nacional, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique
PSB	National Measurement Center, Singapore Productivity and Standards Board, Singapore
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Deutschland
ROA	Real Instituto y Observatorio de la Armada, San Fernando, Espana
SCL	Standards and Calibration Laboratory, Hong Kong
SO	Shanghai Observatory, Shanghai, P.R. China
SP	Swedish National Testing and Research Institute, Boras, Sweden
SU	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region, Russia
TL	Telecommunication Laboratories, Chung-Li, Taiwan
TP	Institute of Radio Engineering and Electronics, Academy of Sciences of Czech Republic - Czech Republic
TUG	Technische Universität, Graz, Oesterreich
UME	Ulusai Metroloji Enstitüsü, Marmara Research Centre, National Metrology Institute, Gebze-Kocaeli, Turkey
USNO	U.S. Naval Observatory, Washington D.C., USA
VSL	Van Swinden Laboratorium, Delft, Nederland

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K) OF THE LABORATORIES CONTRIBUTING TO TAI IN 1997.

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
AOS	2 Ind. Cs	1 Cs + micro-phase-stepper		*		
APL	2 Ind. Cs 3 H-masers	1 H-maser	* (2)	*		*
AUS	15 Ind. Cs 4 H-masers (3)	1 Cs + micro-phase-stepper	*	*		
BEV (4)	1 Ind. Cs	1 Cs		*		
BIRM (4)	3 Ind. Cs	1 Cs		*		
CAO	3 Ind. Cs	1 Cs		*		
CH	11 Ind. Cs (5)	all the Cs	*	*		
CNM	6 Ind. Cs	1 Cs		*		
CRL	13 Ind. Cs 1 Lab. Cs 4 H-masers	7 Cs	*	*	*	*
CSAO (4)	5 Ind. Cs 2 H-masers	all the Cs	*	*		
CSIR	1 Ind. Cs	1 Cs		*		
DLR (4)	2 Ind. Cs 2 H-masers	1 H-maser		*	*	
DTAG	4 Ind. Cs	1 Cs		*		*
GUM	4 Ind. Cs	1 Cs		*		

TABLE 4. EQUIPMENT AND SOURCE OF UTC(k)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
IEN	5 Ind. Cs	1 Cs + micro-phase-stepper	*	*		
IFAG	5 Ind. Cs 3 H-masers	1 Cs + micro-phase-stepper		*		
IGMA	4 Ind. Cs	1 Cs + micro-phase-stepper		* (6)		
INPL	5 Ind. Cs	4 Cs	*	*		
IPQ	3 Ind. Cs	1 Cs		*		
JATC (4)	7 Ind. Cs 1 Lab. Cs 3 H-masers (7)	1 Cs + micro-phase-stepper	*	*		
KRIS	3 Ind. Cs 1 H-maser	1 Cs + micro-phase-stepper	*	*		
LDS	1 Ind. Cs	1 Cs		*	*	
MSL	3 Ind. Cs	1 Cs		*		
NAO (8)	3 Ind. Cs 1 H-maser	1 Cs + micro-phase-stepper		*		
NIM	3 Ind. Cs	1 Cs + micro-phase-stepper	*	*		
NIST	20 Ind. Cs 1 Lab. Cs 5 H-masers	11 Cs 3 H-maser	*	*	*	*
NML (9)	3 Ind. Cs 2 H-maser	1 Cs + micro-phase-stepper		*		*

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
NPL	6 Ind. Cs 2 H-maser	1 H-maser		*		*
NPLI (4)	3 Ind. Cs	1 Cs		*		
NRC	1 Ind. Cs 3 Lab. Cs 2 H-masers	1 Lab. Cs + micro-phase-stepper (10)	*	*		*
NRLM	5 Ind. Cs	1 Cs		*		
OMH	1 Ind. Cs	1 Cs		*		
ONBA (11)	2 Ind. Cs	1 Cs + micro-phase-stepper				
ONRJ	7 Ind. Cs 2 H-masers	1 Cs		*		
OP	5 Ind. Cs 2 Lab. Cs 1 H-maser	1 Cs + micro-phase-stepper	* (12)	*		
ORB	3 Ind. Cs 1 H-maser	1 Cs + micro-phase-stepper		*		
PSB (13) (14)	2 Ind. Cs	1 Cs		*		
PTB	4 Ind. Cs 3 Lab. Cs (15) 3 H-masers	1 Lab. Cs	* (16)	*		*

TABLE 4. EQUIPMENT AND SOURCE OF UTC(K)... (CONT.)

Ind. Cs : Industrial Cs standard

Lab. Cs : Laboratory Cs standard

H-maser : Hydrogen maser

* means 'yes'

Lab k	Equipment	Source of UTC(k) (1)	TA(k)	Time Links		
				GPS	GLONASS	Two-Way
ROA	7 Ind. Cs	all the Cs		*		
SCL	3 Ind. Cs	1 Cs + micro-phase-stepper		*		
SO	1 Ind. Cs 3 H-masers	1 H-maser + micro-phase-stepper	*	* (6)		
SP	3 Ind. Cs	1 Cs + micro-phase-stepper		*		
SU	1 Lab. Cs 10 H-masers	6 H-masers	* (17)	*	*	
TL	5 Ind. Cs	1 Cs + micro-phase-stepper		*		
TP	4 Ind. Cs	1 Cs + output frequency steering		*		
TUG	3 Ind. Cs	1 Cs		*		*
UME (4)	2 Ind. Cs	1 Cs		*		
USNO	78 Ind. Cs 12 H-masers 1 prototype Mercury Ion Frequency Standard 1 Linear Ion Trap Standard	UTC(USNO,MC) is an H-maser + frequency synthesizer steered to UTC(USNO) (18)	* (18)	*	*	*
VSL	4 Ind. Cs	1 Cs + micro-phase-stepper		*	*	*

NOTES

(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) APL . *TA(APL)-UTC(APL)* = 29.999 998 537 s from 50448 to 50630.
TA(APL)-UTC(APL) = 30.999 998 537 s from 50630 to 50813.

(3) AUS . Some of the standards are located as follows (at the end of 1997) :

* Orroral Observatory (ORR, Belconnen)	3 Cs,
* Canberra Deep Space Communication Complex (CDSCC, Canberra)	2 Cs, 2 H-Masers,
* Philips Calibration Service (PHILIPS, Sydney)	1 Cs,
* Telstra Corporation Ltd (TELSTRA, Perth)	1 Cs,
* Telstra Corporation Ltd (TELSTRA, Melbourne)	7 Cs,
* Hewlett-Packard (HP, Melbourne)	1 Cs.

Australian laboratories are intercompared by GPS.

(4) Information based on the Annual Report for 1996, not confirmed by the laboratory.

(5) CH . The standards are located as follows (at the end of 1997) :

* Office Fédéral de Métrologie (OFMET, Bern)	7 Cs,
* Observatoire de Neuchâtel (ON, Neuchâtel)	3 Cs,
* Swisscom (PTT, Bern)	1 Cs.

They are intercompared by GPS (OFMET-ON) and the TV method (OFMET-PTT) and linked to the foreign laboratories through the Swiss Federal Office of Metrology.

(6) GPS link via local restitution of GPS time.

(7) JATC . The standards are located as follows :
* Shaanxi Astronomical Observatory (CSAO),
* Shanghai Astronomical Observatory (SO),
* Wuhan Time Observatory.

The link between UTC(JATC) and UTC(CSAO) is obtained by internal connection.

(8) NAO . Formerly NAOM.

(9) NML . National Measurement Laboratory, CSIRO, Sydney, Australia.

(10) NRC . In 1997, UTC(NRC) was derived from NRC Cs VI C.

(11) ONBA. Linked by TV to IGMA.

NOTES (CONT.)

(12) OP . The French atomic time scale TA(F) is computed by the BNM-LPTF with data from 12 industrial caesium clocks located as follows (at the end of 1997) :

* Centre Electronique de l'Armement (CELAR, Rennes)	1 Cs,
* Centre National d'Etudes Spatiales (CNES, Toulouse)	2 Cs,
* Centre National d'Etudes des Télécommunications (CNET, Bagneux)	1 Cs,
* Observatoire de la Côte d'Azur (OCA, Grasse)	1 Cs,
* Hewlett-Packard (HP, Orsay)	1 Cs,
* Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (BNM-LPTF, Paris)	4 Cs,
* Observatoire de Besançon (OB, Besançon)	2 Cs.

Links by GPS : OP-OB, OP-OCA, OP-CNES, OP-CELAR, OP-HP.
Other national links by the TV method and GPS.

(13) PSB . National Measurement Center, Productivity and Standards Board, Singapore.

(14) Information not confirmed by the laboratory.

(15) PTB . The laboratory Cs, PTB CS2 and PTB CS3 are operated continuously as clocks. The laboratory Cs, PTB CS1, has been operated continuously as a clock since MJD = 50569 (1 May 1997).
TA(PTB) and UTC(PTB) were directly derived from PTB CS2 in 1997.

(16) PTB . *TA(PTB) - UTC(PTB)* = 30.000 363 400 s from 50448 to 50630.
TA(PTB) - UTC(PTB) = 31.000 363 400 s from 50630 to 50813.

(17) SU . *TA(SU) - UTC(SU)* = 27.172 759 000 s from MJD = 50449 to MJD = 50630.
TA(SU) - UTC(SU) = 28.172 759 000 s from MJD = 50630 to MJD = 50814.

(18) USNO. The time scales A.1(MEAN) and UTC(USNO) are computed by USNO. They rely on a number of Cs clocks and H-masers. A.1(MEAN) is a free atomic time scale while UTC(USNO) is closely steered on UTC.
In addition, a number of clocks are in operation at the Alternate Master clock Station, Colorado Springs, Colorado; their data are used to compute TA(AMC).

TABLE 5. DIFFERENCES BETWEEN THE NORMALIZED FREQUENCIES OF EAL AND TAI, UNTIL JANUARY 1998

(File available on http://www.bipm.fr under the name EALTAI97.AR)

Date	MJD	f(EAL) - f(TAI) in 10^{-13}
until 1977 Jan 1	until 43144	0
1977 Jan 1 - 1977 Apr 26	43144 - 43259	10.0
1977 Apr 26 - 1977 Jun 25	43259 - 43319	9.8
1977 Jun 25 - 1977 Aug 24	43319 - 43379	9.6
1977 Aug 24 - 1977 Oct 23	43379 - 43439	9.4
1977 Oct 23 - 1978 Oct 28	43439 - 43809	9.2
1978 Oct 28 - 1979 Jun 25	43809 - 44049	9.0
1979 Jun 25 - 1979 Aug 24	44049 - 44109	8.8
1979 Aug 24 - 1979 Oct 23	44109 - 44169	8.6
1979 Oct 23 - 1982 Apr 30	44169 - 45089	8.4
1982 Apr 30 - 1982 Jun 29	45089 - 45149	8.2
1982 Jun 29 - 1982 Aug 28	45149 - 45209	8.0
1982 Aug 28 - 1984 Feb 29	45209 - 45759	7.8
1984 Feb 29 - 1987 Apr 24	45759 - 46909	8.0
1987 Apr 24 - 1987 Dec 30	46909 - 47159	8.0125
1987 Dec 30 - 1989 Jun 22	47159 - 47699	8.0
1989 Jun 22 - 1989 Dec 29	47699 - 47889	7.95
1989 Dec 29 - 1990 Feb 27	47889 - 47949	7.90
1990 Feb 27 - 1990 Apr 28	47949 - 48009	7.85
1990 Apr 28 - 1990 Jun 27	48009 - 48069	7.80
1990 Jun 27 - 1990 Aug 26	48069 - 48129	7.75
1990 Aug 26 - 1991 Feb 22	48129 - 48309	7.70
1991 Feb 22 - 1991 Apr 23	48309 - 48369	7.625
1991 Apr 23 - 1991 Aug 31	48369 - 48499	7.55
1991 Aug 31 - 1991 Oct 30	48499 - 48559	7.50
1991 Oct 30 - 1992 Apr 27	48559 - 48739	7.45
1992 Apr 27 - 1992 Jun 26	48739 - 48799	7.40
1992 Jun 26 - 1993 Apr 22	48799 - 49099	7.35
1993 Apr 22 - 1995 Feb 21	49099 - 49769	7.40
1995 Feb 21 - 1995 Apr 22	49769 - 49829	7.39
1995 Apr 22 - 1995 Jun 21	49829 - 49889	7.38
1995 Jun 21 - 1995 Aug 30	49889 - 49959	7.37
1995 Aug 30 - 1995 Oct 29	49959 - 50019	7.36
1995 Oct 29 - 1995 Dec 28	50019 - 50079	7.35
1995 Dec 28 - 1996 Feb 26	50079 - 50139	7.34
1996 Feb 26 - 1996 Apr 26	50139 - 50199	7.33
1996 Apr 26 - 1996 Jun 30	50199 - 50264	7.32
1996 Jun 30 - 1996 Aug 29	50264 - 50324	7.31
1996 Aug 29 - 1996 Oct 28	50324 - 50384	7.295
1996 Oct 28 - 1996 Dec 27	50384 - 50444	7.280
1996 Dec 27 - 1997 Feb 25	50444 - 50504	7.265
1997 Feb 25 - 1997 Apr 26	50504 - 50564	7.250
1997 Apr 26 - 1997 Jun 30	50564 - 50629	7.230
1997 Jun 30 - 1997 Aug 29	50629 - 50689	7.210
1997 Aug 29 - 1997 Oct 28	50689 - 50749	7.190
1997 Oct 28 - 1997 Dec 27	50749 - 50809	7.170
1997 Dec 27 - 1998 Jan 31	50809 - 50844	7.160

As the time scales UTC and TAI differ by an integral number of seconds (see Tables 1 and 2), UTC is necessarily subjected to the same intentional frequency adjustments as TAI.

TABLE 6. MEASUREMENTS OF THE DURATION OF THE TAI SCALE INTERVAL

(File available on http://www.bipm.fr under the name UTAI97.AR)

The following table gives the difference *d* between the duration of the TAI scale interval and the SI second as produced by the primary standards CRL Cs1, LPTF-JPO, LPTF-F01, NIST-7, NRC CsV, NRC CsVI A and C, PTB CS1, PTB CS2, PTB CS3 and SU MCsR 102 for the period 1992-1997. Previous calibrations are available in the successive annual reports of the BIPM Time Section volumes 1 to 9.

The frequencies of the primary frequency standards are corrected for the gravitational shift (of about $1x10^{-13}$ for an altitude of 1000 m), and for the black-body radiation shift (of about $2x10^{-14}$ for a temperature of 40 °C) when available (standards tagged with a *).

The characteristics of the calibrations of the TAI frequency provided by the different primary standards are as follows:

Standard	Unc. (1 σ)	Operation	Comparison with	Transfer to TAI
CRL Cs1	$1.1x10^{-13}$	discontinuous	UTC(CRL)	60 d
LPTF-JPO*	$1.1x10^{-13}$	discontinuous	UTC(OP)	10 d
LPTF-F01*	$2.2x10^{-15}$	discontinuous	H maser	5 d, 10 d or 30d
NIST-7*	0.7 or $1.0x10^{-14}$	discontinuous	H maser	5 d or 10 d
NRC CsV	$\approx 1x10^{-13}$	continuous	TAI	60 d
NRC CsVI A	$\approx 1x10^{-13}$	continuous	TAI	60 d
NRC CsVI C	$\approx 1x10^{-13}$	continuous	TAI	60 d
PTB CS1*	$3x10^{-14}$	continuous	TAI	60 d
PTB CS2*	$1.5x10^{-14}$	continuous	TAI	60 d
PTB CS3*	$1.4x10^{-14}$	continuous	TAI	60 d
SU MCsR 102*	$5x10^{-14}$	discontinuous	UTC(SU)	60 d

Note :

The uncertainty quoted in this table is the type B standard uncertainty of the primary frequency standard, as declared to the BIPM by the laboratory. It does not include any additional uncertainty due to frequency transfer from the primary frequency standard to TAI.

TABLE 6. (CONT.)

d in 10^{-14} s

Interval for transfer to TAI	Central date of the calibration	CRL Cs1*	LPTF JPO*	NIST NIST-7*	SU MCsR 102*	LPTF F01*
48859-48919	1992 Sep 30				+0.1	
48919-48979	1992 Nov 30				-0.9	
48949-49009	1992 Dec 23	-2.6				
48979-49039	1993 Jan 30				+4.0	
49039-49099	1993 Mar 31				-2.0	
49119-49129	1993 May 17		+11.6			
49099-49159	1993 May 30				-1.9	
49159-49229	1993 Jul 30				-1.3	
49229-49289	1993 Sep 30				+0.6	
49289-49349	1993 Nov 30				+5.2	
49469-49529	1994 May 30				+0.6	
49529-49589	1994 Jul 31				-0.5	
49589-49649	1994 Sep 30				-3.5	
49649-49709	1994 Nov 30				+0.3	
49789-49799	1995 Mar 16			+2.0		
49809-49819	1995 Apr 5			+3.0		
49819-49829	1995 Apr 15			+2.9		
49829-49839	1995 Apr 25			+2.0		
49839-49849	1995 May 8			+2.2		
49899-49909	1995 Jul 7			+2.2		
49959-49969	1995 Sep 3			+3.3		
49959-50019	1995 Sep 30				+3.5	
49969-49979	1995 Sep 14					+1.4
49979-49989	1995 Sep 24					+1.6
49989-49999	1995 Oct 4					+1.8
49999-50009	1995 Oct 14					+2.2
50009-50019	1995 Oct 24					+1.4
50029-50039	1995 Nov 13					+1.3
50039-50049	1995 Nov 23					+1.1
50049-50059	1995 Dec 3					+0.6
50059-50069	1995 Dec 13					+1.1
50069-50079	1995 Dec 23					+1.6
50019-50029	1995 Nov 7			+2.2		
50019-50079	1995 Nov 30				+4.3	
50079-50084	1995 Dec 30			+2.5		
50094-50124	1996 Jan 27				+8.4	
50124-50154	1996 Feb 26				+2.4	
50144-50149	1996 Mar 4			+2.1		
50154-50184	1996 Mar 27				+1.9	
50199-50209	1996 May 1			+2.5		
50209-50214	1996 May 8					+1.8
50214-50219	1996 May 13					+2.3
50219-50224	1996 May 18					+2.2
50439-50449	1996 Dec 27			+2.7		
50619-50629	1997 Jun 25			+1.7		
50739-50749	1997 Oct 23			-0.3		
50754-50784	1997 Nov 17					+0.99

TABLE 6. (CONT.)

d in 10^{-14} s

Interval for transfer to TAI	Central date of the calibration	NRC CsV	NRC CsVIA	NRC CsVIC	PTB CS1*	PTB CS2*	PTB CS3*
48619-48679	1992 Jan 28	+9.5	-15.6	+0.4	-0.4	+2.1	-
48679-48739	1992 Mar 28	+13.3	-20.3	0.0	+0.7	+2.6	-
48739-48799	1992 May 27	+12.2	-22.2	-6.0	+1.3	+4.3	-
48799-48859	1992 Jul 26	+7.6	-20.6	-14.6	+0.1	+4.1	-
48859-48919	1992 Sep 24	-5.5	-14.5	-20.2	+0.7	+3.4	-
48919-48979	1992 Nov 23	-	-	-20.3	+2.6	+1.8	-
48979-49039	1993 Jan 22	-	-	-19.0	+2.0	+1.4	-
49039-49099	1993 Mar 23	-	-	-11.8	+2.8	+0.6	-
49099-49159	1993 May 22	-	-	-13.1	+0.8	+2.4	-
49159-49229	1993 Jul 26	-	-	-9.0	+1.3	+2.1	-
49229-49289	1993 Sep 29	-	-	-9.4	+2.3	+2.9	-
49289-49349	1993 Nov 28	-	-	-12.6	-0.7	+2.3	-
49349-49409	1994 Jan 27	-	-	-10.2	+0.6	+1.4	-
49409-49469	1994 Mar 28	-	-	-11.6	+1.4	+1.3	-
49469-49529	1994 May 27	-	-	-11.4	+1.2	+2.9	-
49529-49589	1994 Jul 26	-	-	-10.8	+2.1	+3.3	-
49589-49649	1994 Sep 24	-	-	-10.8	+1.0	+2.4	-
49649-49709	1994 Nov 23	-	-	-10.4	+0.6	+1.9	-
49709-49769	1995 Jan 22	-	-	-	+2.5	+2.7	-
49769-49829	1995 Mar 23	-	-7.5	-1.7	-0.1	+3.0	-
49829-49889	1995 May 22	-	-10.7	-6.1	+3.5	+2.0	-
49889-49959	1995 Jul 26	-	-11.6	-5.0	-	+3.5	-
49959-50019	1995 Sep 29	-	-11.1	-5.8	-	+2.7	+4.9
50019-50079	1995 Nov 28	-	-9.2	-6.3	-	+2.5	+4.3
50079-50139	1996 Jan 27	-	-15.7	-8.2	-	+3.1	-
50139-50199	1996 Mar 27	-	-17.6	-7.2	-	+2.8	-
50199-50264	1996 May 28	-	-15.5	-5.9	-	+2.6	-
50264-50324	1996 Jul 30	-	-15.6	-7.7	-	+2.9	+5.6
50324-50384	1996 Sep 28	-	-13.7	-2.5	-	+2.2	+2.6
50384-50444	1996 Nov 27	-	-12.5	-5.3	-	+2.9	+5.0
50444-50504	1997 Jan 26	-	-10.9	+1.7	-	+2.8	+5.6
50504-50564	1997 Mar 27	-	-11.0	+2.4	-	+2.8	+4.5
50564-50629	1997 May 28	-	-11.0	-0.5	-	+2.6	+4.9
50629-50689	1997 Jul 30	-	-11.2	+0.7	-	+0.4	+3.4
50689-50749	1997 Sep 28	-	-12.1	+0.7	-	+1.4	+3.8
50749-50809	1997 Nov 27	-	-12.3	+0.5	-	+0.5	+2.5

TABLE 7. MEAN DURATION OF THE TAI SCALE INTERVAL IN SI SECOND ON THE ROTATING GEOID

(File available on http://www.bipm.fr under the name SITAI97.AR)

The estimate of the mean duration of the TAI scale interval in SI second on the rotating geoid, and its relative uncertainty are computed by the BIPM according to the method described in 'Azoubib J., Granveaud M., Guinot B., *Metrologia* 13, 1977, pp. 87-93', using all available measurements from the six most accurate primary frequency standards LPTF-F01, NIST-7, PTB CS1, PTB CS2, PTB CS3 and SU MCsR 102, consistently corrected for the black-body radiation shift.

For the months	Mean duration in s	Relative uncertainty
1992 Jan - Feb	$1 + 2.1\times10^{-14}$	1.2×10^{-14}
1992 Mar - Apr	+ 2.5	1.2
1992 May - Jun	+ 3.8	1.2
1992 Jul - Aug	+ 3.0	1.2
1992 Sep - Oct	+ 2.5	1.1
1992 Nov - Dec	+ 1.9	1.1
1993 Jan - Feb	$1 + 1.7\times10^{-14}$	0.9×10^{-14}
1993 Mar - Apr	+ 1.3	0.9
1993 May - Jun	+ 1.8	0.9
1993 Jul - Aug	+ 1.9	0.9
1993 Sep - Oct	+ 2.1	0.9
1993 Nov - Dec	+ 1.9	0.9
1994 Jan - Feb	$1 + 1.7\times10^{-14}$	0.9×10^{-14}
1994 Mar - Apr	+ 1.8	0.9
1994 May - Jun	+ 2.1	0.9
1994 Jul - Aug	+ 2.3	0.9
1994 Sep - Oct	+ 2.0	0.8
1994 Nov - Dec	+ 2.0	0.8
1995 Jan - Feb	$1 + 2.3\times10^{-14}$	0.7×10^{-14}
1995 Mar - Apr	+ 2.4	0.5
1995 May - Jun	+ 2.4	0.5
1995 Jul - Aug	+ 2.4	0.6
1995 Sep - Oct	+ 2.1	0.4
1995 Nov - Dec	+ 1.7	0.4
1996 Jan - Feb	$1 + 2.2\times10^{-14}$	0.6×10^{-14}
1996 Mar - Apr	+ 2.3	0.6
1996 May - Jun	+ 2.4	0.5
1996 Jul - Aug	+ 2.6	0.7
1996 Sep - Oct	+ 2.5	0.8
1996 Nov - Dec	+ 2.6	0.7
1997 Jan - Feb	$1 + 2.6\times10^{-14}$	0.7×10^{-14}
1997 Mar - Apr	+ 2.4	0.8
1997 May - Jun	+ 2.1	0.7
1997 Jul - Aug	+ 1.7	0.8
1997 Sep - Oct	+ 1.2	0.7
1997 Nov - Dec	+ 1.0	0.5

TABLE 8 - INDEPENDENT LOCAL ATOMIC TIME SCALES

(File available on http://www.bipm.fr under the name TAI97.AR)

The following table gives the values of [*TAI - TA(k)*], where TA(k) denotes the independent time scale established by laboratory k.

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*TAI - TA(k)* AMC (*)	APL	AUS	CH	CRL
Jan 1	50449	-	2006	-75316	-52528	78969
Jan 6	50454	-	2038	-75418	-52351	79184
Jan 11	50459	-	2076	-75505	-52182	79384
Jan 16	50464	-	2109	-75663	-52010	79595
Jan 21	50469	-	2145	-75732	-51825	79804
Jan 26	50474	-	2178	-75847	-51637	80008
Jan 31	50479	-	2203	-75924	-51456	80210
Feb 5	50484	-	-	-76050	-51266	80416
Feb 10	50489	-	-	-76197	-51074	80623
Feb 15	50494	-	-	-76303	-50901	80830
Feb 20	50499	-	-	-76389	-50724	81033
Feb 25	50504	-	-	-76498	-50548	81232
Mar 2	50509	-	-	-76602	-50372	81441
Mar 7	50514	-	-	-76685	-50198	81641
Mar 12	50519	-	2494	-76805	-50030	81851
Mar 17	50524	-	2521	-76904	-49872	82055
Mar 22	50529	-	2547	-77008	-49703	82258
Mar 27	50534	-	2563	-77110	-49532	82462
Apr 1	50539	-	2613	-77236	-49365	82670
Apr 6	50544	-	2654	-77374	-49189	82884
Apr 11	50549	-	2722	-77481	-49015	83095
Apr 16	50554	-	2775	-77557	-48841	83317
Apr 21	50559	-	2825	-77684	-48651	83532
Apr 26	50564	-	2880	-77803	-48466	83746
May 1	50569	-	2947	-77916	-48281	83961
May 6	50574	-	3003	-77979	-48106	84171
May 11	50579	-	3051	-78102	-47939	84386
May 16	50584	-	3096	-78171	-47778	84597
May 21	50589	-	3150	-78303	-47615	84811
May 26	50594	-	3209	-78411	-47460	85027
May 31	50599	-364969	3257	-78532	-47294	85238
Jun 5	50604	-364968	3310	-78602	-47136	85449
Jun 10	50609	-364971	3367	-78688	-46979	85657
Jun 15	50614	-364973	3415	-78814	-46808	85874
Jun 20	50619	-364978	3470	-78904	-46651	86086
Jun 25	50624	-364983	3516	-79022	-46486	86301
Jun 30	50629	-364987	3581	-79107	-46316	86512

(*) AMC . TA(AMC) designates the atomic time scale computed by USNO with data from the Alternate Master Clock station, Colorado Springs, Colorado, USA.

TABLE 8. (CONT)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*TAI - TA(k)* AMC	APL	AUS	CH	CRL
Jul 5	50634	-364987	3638	-79225	-46141	86727
Jul 10	50639	-364990	3692	-79346	-45972	86937
Jul 15	50644	-364991	3753	-79441	-45801	87154
Jul 20	50649	-364991	3795	-79537	-45632	87368
Jul 25	50654	-364994	3859	-79654	-45460	87580
Jul 30	50659	-364999	3918	-79736	-45290	87793
Aug 4	50664	-365005	3972	-79831	-45123	88006
Aug 9	50669	-365009	4036	-79989	-44943	88218
Aug 14	50674	-365014	4088	-80118	-44770	88425
Aug 19	50679	-365019	4139	-80211	-44612	88638
Aug 24	50684	-365022	4195	-80239	-44448	88853
Aug 29	50689	-365026	4259	-80429	-44267	89064
Sep 3	50694	-365019	4312	-80507	-44089	89271
Sep 8	50699	-365022	4370	-80598	-43916	89484
Sep 13	50704	-365023	4434	-80711	-43748	89699
Sep 18	50709	-365027	4491	-80815	-43576	89911
Sep 23	50714	-365027	4538	-80932	-43403	90124
Sep 28	50719	-365030	4595	-81032	-43213	90336
Oct 3	50724	-365040	4653	-81103	-43050	90546
Oct 8	50729	-365042	4703	-81162	-42880	90753
Oct 13	50734	-365045	4746	-81276	-42714	90962
Oct 18	50739	-365048	4792	-81404	-42554	91172
Oct 23	50744	-365052	4833	-81558	-42382	91380
Oct 28	50749	-365058	4873	-81654	-42203	91594
Nov 2	50754	-365064	4911	-81781	-42012	91804
Nov 7	50759	-365067	4948	-81868	-41810	92012
Nov 12	50764	-365072	5001	-81971	-41612	92223
Nov 17	50769	-365078	5028	-82085	-41419	92434
Nov 22	50774	-365083	5073	-82190	-41209	92645
Nov 27	50779	-365086	5113	-82276	-41031	92853
Dec 2	50784	-365101	5158	-82446	-40827	93061
Dec 7	50789	-365103	5200	-82528	-40645	93272
Dec 12	50794	-365110	5241	-82662	-40447	93479
Dec 17	50799	-365118	5275	-82765	-40264	93692
Dec 22	50804	-365123	5310	-82823	-40072	93899
Dec 27	50809	-365128	5359	-82920	-39886	94100

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) CSAO	F	IEN	INPL	JATC
Jan 1	50449	2251	163414	1981	-367592	13560
Jan 6	50454	2169	163402	2020	-368335	13531
Jan 11	50459	2078	163388	2059	-369089	13505
Jan 16	50464	2027	163380	2103	-369841	13508
Jan 21	50469	1981	163372	2142	-370604	13510
Jan 26	50474	1910	163364	2185	-371394	13484
Jan 31	50479	1891	163353	2227	-372187	13507
Feb 5	50484	1755	163341	2268	-372994	13437
Feb 10	50489	1753	163333	2318	-373774	13498
Feb 15	50494	1664	163316	2361	-374540	13478
Feb 20	50499	1593	163305	2414	-375315	13471
Feb 25	50504	1518	163291	2462	-376100	13455
Mar 2	50509	1454	163281	2513	-376875	13442
Mar 7	50514	1381	163270	2560	-377633	13438
Mar 12	50519	1320	163262	2609	-378404	13444
Mar 17	50524	1257	163247	2640	-379187	13461
Mar 22	50529	1200	163235	2680	-379950	13488
Mar 27	50534	1124	163225	2718	-380705	13498
Apr 1	50539	1063	163214	2753	-381480	13504
Apr 6	50544	987	163203	2790	-382253	13512
Apr 11	50549	928	163192	2818	-383038	13517
Apr 16	50554	849	163179	2852	-383835	13521
Apr 21	50559	778	163169	2888	-384646	13533
Apr 26	50564	742	163159	2929	-385461	13556
May 1	50569	652	163147	2961	-386228	13505
May 6	50574	604	163139	2996	-386998	13500
May 11	50579	523	163126	3045	-387767	13464
May 16	50584	492	163113	3093	-388534	13485
May 21	50589	393	163104	3147	-389286	13444
May 26	50594	306	163092	3194	-390067	13400
May 31	50599	265	163082	3245	-390844	13410
Jun 5	50604	234	163071	3290	-391626	13429
Jun 10	50609	136	163064	3340	-392360	13388
Jun 15	50614	96	163056	3395	-393103	13388
Jun 20	50619	-1	163049	3436	-393823	13339
Jun 25	50624	-33	163043	3484	-394503	13356
Jun 30	50629	-107	163032	3534	-395227	13323

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) CSAO	F	IEN	INPL	JATC
Jul 5	50634	-180	163024	3584	-395945	13269
Jul 10	50639	-246	163013	3634	-396685	13212
Jul 15	50644	-309	162998	3681	-397419	13179
Jul 20	50649	-383	162989	3727	-398159	13125
Jul 25	50654	-427	162979	3770	-398901	13102
Jul 30	50659	-518	162970	3823	-	13051
Aug 4	50664	-590	162961	3868	-	13032
Aug 9	50669	-634	162951	3916	-400471	13044
Aug 14	50674	-695	162947	3968	-400250	13031
Aug 19	50679	-783	162942	4011	-400002	12988
Aug 24	50684	-826	162935	4055	-399764	12965
Aug 29	50689	-922	162929	4106	-399519	12923
Sep 3	50694	-1001	162922	4153	-399274	12886
Sep 8	50699	-1049	162915	4210	-399030	12891
Sep 13	50704	-1108	162907	4258	-398775	12873
Sep 18	50709	-1178	162899	4304	-398530	12826
Sep 23	50714	-1260	162893	4356	-398279	12770
Sep 28	50719	-1338	162888	4398	-398034	12714
Oct 3	50724	-1327	162874	4453	-397785	12774
Oct 8	50729	-1390	162864	4481	-397545	12770
Oct 13	50734	-1446	162855	4513	-397305	12786
Oct 18	50739	-1493	162848	4560	-397053	12813
Oct 23	50744	-1565	162839	4604	-396791	12898
Oct 28	50749	-1625	162837	4658	-396535	12800
Nov 2	50754	-1749	162830	4694	-396281	12623
Nov 7	50759	-1765	162822	4744	-396022	12528
Nov 12	50764	-1790	162817	4800	-395757	12434
Nov 17	50769	-1861	162812	4844	-395504	12314
Nov 22	50774	-1898	162808	4895	-395249	12230
Nov 27	50779	-2003	162805	4929	-394990	12068
Dec 2	50784	-2037	162798	4973	-394739	11969
Dec 7	50789	-2126	162796	5015	-394493	11803
Dec 12	50794	-2183	162790	5050	-394245	11667
Dec 17	50799	-2223	162780	5085	-393992	11565
Dec 22	50804	-2292	162773	5129	-393740	11435
Dec 27	50809	-2309	162767	5181	-393489	11363

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) KRIS	NIST	NML (*)	NRC
Jan 1	50449	5402	-45154661	-	27264
Jan 6	50454	5413	-45154875	-	27258
Jan 11	50459	5413	-45155089	-	27251
Jan 16	50464	5415	-45155305	-	27242
Jan 21	50469	5423	-45155519	-	27235
Jan 26	50474	5448	-45155734	-	27229
Jan 31	50479	5442	-45155951	-	27220
Feb 5	50484	5447	-45156163	-	27214
Feb 10	50489	5461	-45156378	-	27206
Feb 15	50494	5487	-45156596	-	27197
Feb 20	50499	5514	-45156809	-	27184
Feb 25	50504	5547	-45157021	-	27178
Mar 2	50509	5584	-45157235	-	27170
Mar 7	50514	5597	-45157456	-	27155
Mar 12	50519	5594	-45157670	-	27147
Mar 17	50524	5581	-45157883	-	27141
Mar 22	50529	5579	-45158100	-	27129
Mar 27	50534	5568	-45158315	-	27118
Apr 1	50539	5557	-45158531	-	27108
Apr 6	50544	5543	-45158745	-	27095
Apr 11	50549	5528	-45158955	-	27085
Apr 16	50554	5517	-45159172	-	27071
Apr 21	50559	5497	-45159389	-	27065
Apr 26	50564	5490	-45159601	-	27065
May 1	50569	5463	-45159816	-	27065
May 6	50574	5459	-45160035	427	27057
May 11	50579	5452	-45160248	427	27056
May 16	50584	5431	-45160466	425	27053
May 21	50589	5414	-45160675	443	27056
May 26	50594	5395	-45160887	461	27059
May 31	50599	5387	-45161107	486	27060
Jun 5	50604	5380	-45161321	488	27074
Jun 10	50609	5382	-45161536	499	27081
Jun 15	50614	5374	-45161749	500	27085
Jun 20	50619	5369	-45161964	522	27087
Jun 25	50624	5359	-45162178	542	27085
Jun 30	50629	5355	-45162391	549	27081

(*) NML . National Measurement Laboratory, Sydney, Australia.

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) KRIS	NIST	NML	NRC
Jul 5	50634	5352	-45162602	567	27074
Jul 10	50639	5355	-45162813	580	27071
Jul 15	50644	5357	-45163024	599	27075
Jul 20	50649	5337	-45163235	614	27072
Jul 25	50654	5322	-45163447	613	27067
Jul 30	50659	5313	-45163663	620	27052
Aug 4	50664	5325	-45163878	625	27050
Aug 9	50669	5311	-45164090	649	27049
Aug 14	50674	5298	-45164301	641	27053
Aug 19	50679	5293	-45164515	648	27053
Aug 24	50684	5280	-45164728	669	27049
Aug 29	50689	5287	-45164942	670	27049
Sep 3	50694	5305	-45165154	676	27053
Sep 8	50699	5302	-45165368	689	27046
Sep 13	50704	5302	-45165578	688	27046
Sep 18	50709	5313	-45165791	727	27044
Sep 23	50714	5291	-45166004	735	27039
Sep 28	50719	5298	-45166217	789	27034
Oct 3	50724	5293	-45166428	788	27034
Oct 8	50729	5283	-45166640	814	27031
Oct 13	50734	5278	-45166855	812	27030
Oct 18	50739	5282	-45167066	830	27027
Oct 23	50744	5272	-45167278	818	27022
Oct 28	50749	5277	-45167493	837	27016
Nov 2	50754	5289	-45167705	850	27007
Nov 7	50759	5286	-45167921	874	26995
Nov 12	50764	5272	-45168133	874	27002
Nov 17	50769	5262	-45168346	913	27003
Nov 22	50774	5260	-45168556	924	27004
Nov 27	50779	5257	-45168768	927	26998
Dec 2	50784	5267	-45168982	926	26988
Dec 7	50789	5288	-45169190	929	26984
Dec 12	50794	5293	-45169404	913	26983
Dec 17	50799	5327	-45169618	917	26985
Dec 22	50804	5341	-45169828	919	26991
Dec 27	50809	5364	-45170039	922	26997

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) PTB	SO	SU (*)	USNO
Jan 1	50449	-361532	-46349	27241959	-34762894
Jan 6	50454	-361538	-46377	27241954	-34763213
Jan 11	50459	-361539	-46391	27241950	-34763535
Jan 16	50464	-361545	-46382	27241939	-34763859
Jan 21	50469	-361550	-46399	27241930	-34764185
Jan 26	50474	-361553	-46409	27241921	-34764509
Jan 31	50479	-361558	-46410	27241915	-34764834
Feb 5	50484	-361563	-46401	27241907	-34765156
Feb 10	50489	-361568	-46402	27241901	-34765478
Feb 15	50494	-361572	-46413	27241892	-34765805
Feb 20	50499	-361576	-46392	27241884	-34766128
Feb 25	50504	-361581	-46398	27241871	-34766451
Mar 2	50509	-361584	-46408	27241859	-34766771
Mar 7	50514	-361589	-46434	27241852	-34767099
Mar 12	50519	-361595	-46436	27241850	-34767423
Mar 17	50524	-361604	-46424	27241836	-34767742
Mar 22	50529	-361603	-46452	27241829	-34768069
Mar 27	50534	-361607	-46466	27241820	-34768392
Apr 1	50539	-361612	-46502	27241812	-34768715
Apr 6	50544	-361614	-46486	27241804	-34769036
Apr 11	50549	-361623	-46523	27241796	-34769357
Apr 16	50554	-361630	-46544	27241790	-34769680
Apr 21	50559	-361638	-46508	27241783	-34770002
Apr 26	50564	-361640	-46491	27241771	-34770321
May 1	50569	-361649	-46493	27241766	-34770641
May 6	50574	-361654	-46484	27241761	-34770966
May 11	50579	-361659	-46464	27241753	-34771285
May 16	50584	-361667	-46456	27241745	-34771608
May 21	50589	-361671	-46494	27241735	-34771925
May 26	50594	-361673	-46513	27241728	-34772246
May 31	50599	-361675	-46520	27241726	-34772570
Jun 5	50604	-361680	-46518	27241711	-34772892
Jun 10	50609	-361684	-46520	27241704	-34773214
Jun 15	50614	-361685	-46555	27241698	-34773535
Jun 20	50619	-361690	-46587	27241690	-34773858
Jun 25	50624	-361694	-46589	27241683	-34774180
Jun 30	50629	-361697	-46584	27241668	-34774501

(*) SU . Listed values are TAI-TA(SU) - 2.80 seconds.

TABLE 8. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	TAI - TA(k) PTB	SO	SU	USNO
Jul 5	50634	-361694	-46575	27241663	-34774819
Jul 10	50639	-361693	-46618	27241649	-34775139
Jul 15	50644	-361695	-46608	27241644	-34775457
Jul 20	50649	-361690	-46582	27241636	-34775775
Jul 25	50654	-361684	-46569	27241632	-34776097
Jul 30	50659	-361677	-46573	27241624	-34776418
Aug 4	50664	-361673	-46616	27241614	-34776739
Aug 9	50669	-361669	-46600	27241604	-34777057
Aug 14	50674	-361659	-46603	27241595	-34777377
Aug 19	50679	-361648	-46616	27241587	-34777697
Aug 24	50684	-361644	-46588	27241582	-34778018
Aug 29	50689	-361629	-46567	27241572	-34778337
Sep 3	50694	-361628	-46563	27241561	-34778651
Sep 8	50699	-361633	-46567	27241554	-34778970
Sep 13	50704	-361632	-46601	27241546	-34779287
Sep 18	50709	-361635	-46603	27241539	-34779607
Sep 23	50714	-361633	-46585	27241531	-34779925
Sep 28	50719	-361624	-46592	27241517	-34780246
Oct 3	50724	-361628	-46577	27241506	-34780559
Oct 8	50729	-361627	-46597	27241499	-34780878
Oct 13	50734	-361624	-46576	27241489	-34781196
Oct 18	50739	-361622	-46590	27241477	-34781514
Oct 23	50744	-361618	-46583	27241470	-34781832
Oct 28	50749	-361609	-46604	27241461	-34782155
Nov 2	50754	-361598	-46606	27241454	-34782475
Nov 7	50759	-361588	-46617	27241454	-34782794
Nov 12	50764	-361578	-46640	27241444	-34783113
Nov 17	50769	-361573	-46644	27241438	-34783431
Nov 22	50774	-361564	-46648	27241424	-34783749
Nov 27	50779	-361560	-46650	27241417	-34784067
Dec 2	50784	-361551	-46681	27241409	-34784386
Dec 7	50789	-361553	-46696	27241407	-34784702
Dec 12	50794	-361553	-46695	27241386	-34785021
Dec 17	50799	-361551	-46722	27241384	-34785341
Dec 22	50804	-361549	-46735	27241375	-34785658
Dec 27	50809	-361539	-46761	27241371	-34785975

TABLE 9. LOCAL REPRESENTATIONS OF UTC : VALUES OF [*UTC* - *UTC(k)*]

(File available on http://www.bipm.fr under the name UTC97.AR)

The following table gives the values of [*UTC*-*UTC(k)*], where UTC(k) denotes the approximation to UTC kept by laboratory k.

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*UTC - UTC(k)* AOS	APL	AUS	BEV	BIRM	CAO (1)
Jan 1	50449	688	543	-47	-	-4198	-3140
Jan 6	50454	818	575	-18	-	-4272	108
Jan 11	50459	939	613	1	-	-4357	46
Jan 16	50464	1034	646	-7	-	-4417	18
Jan 21	50469	1048	682	-20	-	-4462	-11
Jan 26	50474	1092	715	0	-	-4532	-30
Jan 31	50479	1073	740	9	-	-4571	-71
Feb 5	50484	1012	-	26	-	-4637	-102
Feb 10	50489	919	-	30	-	-4695	-131
Feb 15	50494	798	-	58	-	-4734	-154
Feb 20	50499	715	-	82	-	-4796	-187
Feb 25	50504	592	-	89	-	-4864	-215
Mar 2	50509	457	-	117	-	-4920	-251
Mar 7	50514	392	-	116	-	-4967	-271
Mar 12	50519	354	1031	151	-	-5033	-310
Mar 17	50524	283	1058	171	-	-5098	-338
Mar 22	50529	219	1084	190	-	-5167	-356
Mar 27	50534	133	1100	188	-	-5206	-386
Apr 1	50539	-31	1150	226	-	-5246	-422
Apr 6	50544	-212	1191	252	-	-5270	-440
Apr 11	50549	-257	1259	270	-	-5305	-497
Apr 16	50554	-315	1312	287	-	-5351	-513
Apr 21	50559	-364	1362	293	-	-5403	-533
Apr 26	50564	-441	1417	287	-	-5438	-546
May 1	50569	-499	1484	326	-	-5507	-584
May 6	50574	-394	1540	340	-	-5572	-596
May 11	50579	-250	1588	336	-	-5638	-627
May 16	50584	-52	1633	351	-	-5688	-641
May 21	50589	6	1687	328	-	-5746	-660
May 26	50594	84	1746	302	-	-5809	-696
May 31	50599	237	1794	281	-	-5862	-746
Jun 5	50604	258	1847	292	-	-5927	-786
Jun 10	50609	273	1904	278	-	-5994	-839
Jun 15	50614	234	1952	267	-	-6030	-860
Jun 20	50619	194	2007	258	-	-6099	-902
Jun 25	50624	196	2053	265	-	-6162	-919
Jun 30	50629	207	2118	266	-	-6221	-951

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	AOS	APL	AUS	BEV	BIRM	CAO (1)
		UTC - UTC(k)					
Jul 5	50634	156	2175	278	-	-6272	-985
Jul 10	50639	78	2229	251	-	-6324	-1018
Jul 15	50644	-33	2290	269	-	-6379	-1059
Jul 20	50649	-96	2332	262	-	-6451	-1088
Jul 25	50654	-176	2396	252	-	-6501	-1113
Jul 30	50659	-346	2455	271	-	-6555	-1145
Aug 4	50664	-478	2509	256	-	-6609	-1186
Aug 9	50669	-608	2573	261	-	-6606	-1223
Aug 14	50674	-768	2625	225	-	-6724	-1250
Aug 19	50679	-872	2676	230	-	-6775	-1284
Aug 24	50684	-1003	2732	238	-	-6827	-1332
Aug 29	50689	-987	2796	251	-	-6885	-1370
Sep 3	50694	-937	2849	229	-	-6944	-1401
Sep 8	50699	-853	2907	218	-	-7007	-1430
Sep 13	50704	-875	2971	207	-	-7072	-1462
Sep 18	50709	-801	3028	218	-	-7121	-1488
Sep 23	50714	-699	3075	223	-	-7188	-1508
Sep 28	50719	-547	3132	210	-	-7242	-1525
Oct 3	50724	-590	3190	219	-	-7297	-1570
Oct 8	50729	-719	3240	196	-	-7349	-1591
Oct 13	50734	-868	3283	202	-	-7414	-1621
Oct 18	50739	-1024	3329	186	-	-7477	-1649
Oct 23	50744	-1156	3370	155	-	-7528	-1682
Oct 28	50749	-1290	3410	154	-	-7570	-1729
Nov 2	50754	-1395	3448	155	-	-7608	-1757
Nov 7	50759	-1357	3485	163	-	-7644	-1800
Nov 12	50764	-1291	3538	170	-	-7692	-1817
Nov 17	50769	-1233	3565	169	-	-7730	-1848
Nov 22	50774	-1108	3610	162	-	-7823	-1882
Nov 27	50779	-966	3650	165	-	-7869	-1912
Dec 2	50784	-773	3695	183	-	-7919	-1931
Dec 7	50789	-668	3737	181	-	-7962	-1963
Dec 12	50794	-572	3778	197	-	-8024	-1997
Dec 17	50799	-430	3812	207	-	-8080	-2007
Dec 22	50804	-220	3847	208	-	-8133	-2034
Dec 27	50809	-204	3896	218	-	-8181	-2059

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) CH (2)	CNM	CRL (3)	CSAO	CSIR (4)	DLR
Jan 1	50449	191	-4618	-27	21	7215	508
Jan 6	50454	205	-4565	-18	4	7264	534
Jan 11	50459	206	-4528	-19	-22	7322	549
Jan 16	50464	209	-4466	-19	-9	7593	572
Jan 21	50469	225	-4430	-14	10	7818	589
Jan 26	50474	244	-4370	-16	4	8058	606
Jan 31	50479	256	-4321	-17	50	8254	623
Feb 5	50484	274	-4297	-16	-21	8335	632
Feb 10	50489	279	-4242	-20	42	8412	636
Feb 15	50494	266	-4179	-16	17	8486	634
Feb 20	50499	257	-4141	-21	11	8531	625
Feb 25	50504	246	-4067	-26	1	8609	613
Mar 2	50509	236	-4036	-27	1	8628	601
Mar 7	50514	223	-4006	-22	-7	8574	590
Mar 12	50519	198	-3949	-28	-4	8484	571
Mar 17	50524	163	-3896	-29	-2	8352	549
Mar 22	50529	139	-3846	-30	6	8259	532
Mar 27	50534	118	-3793	-24	-5	8168	512
Apr 1	50539	92	-3740	-27	-1	8156	486
Apr 6	50544	76	-3689	-31	-12	8148	462
Apr 11	50549	61	-3632	-35	-6	8216	436
Apr 16	50554	46	-3582	-29	-20	8265	408
Apr 21	50559	48	-3532	-22	-26	8311	381
Apr 26	50564	44	-3473	-14	3	8330	353
May 1	50569	40	-3420	-9	-22	8382	321
May 6	50574	28	-3361	0	-5	8459	292
May 11	50579	11	-3307	8	-21	8545	260
May 16	50584	-12	-3256	10	12	8647	226
May 21	50589	-32	-3198	18	-22	8782	191
May 26	50594	-61	-3144	23	-44	8894	154
May 31	50599	-79	-3096	19	-20	8999	123
Jun 5	50604	-104	-3048	20	14	9064	88
Jun 10	50609	-127	-2996	15	-19	9166	50
Jun 15	50614	-136	-2938	17	5	9272	14
Jun 20	50619	-159	-2889	10	-27	9408	-27
Jun 25	50624	-174	-2841	17	6	9537	-69
Jun 30	50629	-184	-2784	14	-3	9675	-111

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) CH (2)	CNM	CRL (3)	CSAO	CSIR (4)	DLR
Jul 5	50634	-184	-2739	15	-11	826	-151
Jul 10	50639	-170	-2680	7	-12	711	-191
Jul 15	50644	-155	-2619	10	-11	606	-236
Jul 20	50649	-141	-2570	16	-20	502	-277
Jul 25	50654	-125	-2511	14	1	411	-320
Jul 30	50659	-110	-2450	11	-25	344	-357
Aug 4	50664	-95	-2391	7	-32	252	-396
Aug 9	50669	-50	-2341	12	-11	133	-448
Aug 14	50674	-13	-2284	5	-8	40	-490
Aug 19	50679	9	-2224	7	-31	-24	-536
Aug 24	50684	37	-2160	16	-9	-69	-578
Aug 29	50689	82	-2109	3	-40	-142	-625
Sep 3	50694	121	-2054	-6	-54	-191	-673
Sep 8	50699	141	-1997	-8	-37	-289	-722
Sep 13	50704	157	-1944	-7	-31	-373	-767
Sep 18	50709	176	-1884	-11	-37	-467	-812
Sep 23	50714	196	-1826	-16	-54	-533	-855
Sep 28	50719	233	-1762	-14	-67	-618	-902
Oct 3	50724	237	-1700	-22	6	-704	-952
Oct 8	50729	219	-1633	-29	0	-795	-1000
Oct 13	50734	198	-1576	-33	1	-875	-1047
Oct 18	50739	171	-1512	-35	11	-952	-1097
Oct 23	50744	155	-1449	-42	-4	-1052	-1143
Oct 28	50749	147	-1392	-46	-7	-1132	-1183
Nov 2	50754	151	-1331	-49	-74	-1217	-1226
Nov 7	50759	165	-1276	-58	-33	-1288	-1281
Nov 12	50764	172	-1225	-64	-1	-1363	-1327
Nov 17	50769	157	-1144	-63	-15	-1441	-1377
Nov 22	50774	159	-1086	-68	5	-1515	-1426
Nov 27	50779	129	-1030	-64	-43	-1599	-1472
Dec 2	50784	125	-966	-68	-19	-1674	-1516
Dec 7	50789	99	-913	-64	-51	-1748	-1562
Dec 12	50794	93	-848	-78	-51	-1835	-1609
Dec 17	50799	89	-790	-74	-34	-1928	-1664
Dec 22	50804	93	-727	-75	-46	-2009	-1710
Dec 27	50809	92	-667	-75	-6	-2091	-1757

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) DTAG	GUM (5)	IEN (6)	IFAG (7)	IGMA (8)	INPL (9)
Jan 1	50449	-607	-9	462	-3827	170	-664
Jan 6	50454	-607	-14	459	-3745	161	-715
Jan 11	50459	-618	-13	457	-3650	178	-771
Jan 16	50464	-628	-9	462	-3588	166	-819
Jan 21	50469	-634	-4	463	-3523	163	-870
Jan 26	50474	-637	10	469	-3486	168	-942
Jan 31	50479	-642	16	475	-3415	168	-1011
Feb 5	50484	-649	27	485	-3344	166	-1086
Feb 10	50489	-658	38	493	-3263	171	-1128
Feb 15	50494	-657	50	494	-3181	168	-1154
Feb 20	50499	-685	60	512	-3106	175	-1193
Feb 25	50504	-705	67	517	-3042	170	-1251
Mar 2	50509	-709	84	524	-2986	168	-1307
Mar 7	50514	-696	102	523	-2931	159	-1356
Mar 12	50519	-692	118	533	-2869	170	-1427
Mar 17	50524	-705	128	534	-2800	173	-1519
Mar 22	50529	-705	148	543	-2745	174	-1601
Mar 27	50534	-712	163	544	-2641	184	-1686
Apr 1	50539	-709	176	545	-2575	174	-1802
Apr 6	50544	-714	192	544	-2509	191	-1927
Apr 11	50549	-718	200	536	-2428	188	-2075
Apr 16	50554	-731	218	525	-2327	184	-2250
Apr 21	50559	-747	241	527	-2249	206	-2461
Apr 26	50564	-743	268	528	-2181	222	-2671
May 1	50569	-746	279	529	-2115	228	-2812
May 6	50574	-733	300	527	-2021	223	-2934
May 11	50579	-728	309	532	-1940	241	-3034
May 16	50584	-731	337	537	-1903	233	-3110
May 21	50589	-718	362	542	-1864	268	-3149
May 26	50594	-722	382	541	-1816	275	-3196
May 31	50599	-716	413	548	-1748	286	-3217
Jun 5	50604	-708	429	551	-1676	277	-3215
Jun 10	50609	-714	448	557	-1630	305	-3165
Jun 15	50614	-711	474	567	-1585	294	-3096
Jun 20	50619	-694	491	562	-1553	322	-2988
Jun 25	50624	-681	516	569	-1530	341	-2851
Jun 30	50629	-675	520	580	-1473	343	-2770

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*UTC - UTC(k)* DTAG	GUM (5)	IEN (6)	IFAG (7)	IGMA (8)	INPL (9)
Jul 5	50634	-669	538	593	-1406	41	-2691
Jul 10	50639	-651	583	600	-1364	29	-2632
Jul 15	50644	-647	601	600	-1324	40	-2564
Jul 20	50649	-634	626	598	-1271	55	-2507
Jul 25	50654	-637	647	593	-1216	40	-2452
Jul 30	50659	-629	669	600	-1115	48	-
Aug 4	50664	-621	686	605	-1040	60	-
Aug 9	50669	-625	702	611	-955	66	-1698
Aug 14	50674	-622	718	617	-905	57	-908
Aug 19	50679	-608	741	616	-816	59	-833
Aug 24	50684	-603	753	613	-731	49	-767
Aug 29	50689	-601	766	611	-698	55	-695
Sep 3	50694	-596	774	611	-619	58	-623
Sep 8	50699	-587	786	617	-556	49	-552
Sep 13	50704	-580	803	621	-570	48	-470
Sep 18	50709	-565	827	623	-618	36	-403
Sep 23	50714	-571	845	626	-661	46	-337
Sep 28	50719	-572	872	628	-729	53	-291
Oct 3	50724	-560	897	4	-804	74	-255
Oct 8	50729	-558	914	-12	-851	76	-231
Oct 13	50734	-562	931	-23	-878	80	-207
Oct 18	50739	-556	953	-20	-931	91	-171
Oct 23	50744	-541	979	-15	-997	94	-125
Oct 28	50749	-522	1006	-4	-1065	99	-85
Nov 2	50754	-509	1013	-3	-1072	110	-64
Nov 7	50759	-501	1010	8	-1105	96	-42
Nov 12	50764	-480	1010	26	-1158	93	-15
Nov 17	50769	-452	1005	31	-1195	97	0
Nov 22	50774	-461	1005	48	-1259	94	19
Nov 27	50779	-446	1024	47	-1316	91	33
Dec 2	50784	-417	1018	55	-1369	88	29
Dec 7	50789	-392	1013	60	-1427	81	20
Dec 12	50794	-366	1001	62	-1462	97	13
Dec 17	50799	-350	991	62	-1513	100	11
Dec 22	50804	-351	989	68	-1553	86	8
Dec 27	50809	-348	988	81	-1605	83	4

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) IPQ	JATC	KRIS (10)	LDS	MSL (11)	NAO (12)
Jan 1	50449	227	3571	-176	24	-5575	-3161
Jan 6	50454	233	3559	-183	5	-5569	-3196
Jan 11	50459	237	3542	-200	-13	-5573	-3240
Jan 16	50464	247	3546	-216	12	-5603	-3270
Jan 21	50469	254	3556	-222	-10	-5638	-3327
Jan 26	50474	266	3543	-214	-2	-5677	-3375
Jan 31	50479	268	3577	-239	-2	-5647	-3426
Feb 5	50484	275	3500	-257	-11	-5627	-3474
Feb 10	50489	292	3578	-262	-10	-5620	-3519
Feb 15	50494	298	3562	-258	0	-5670	-3557
Feb 20	50499	299	3560	-243	2	-5651	-3607
Feb 25	50504	297	3552	-225	-9	-5590	-3670
Mar 2	50509	302	3547	-195	-28	-5644	-3715
Mar 7	50514	317	3552	-178	-32	-5579	-3667
Mar 12	50519	328	3572	-183	-21	-5546	-3618
Mar 17	50524	335	3578	-195	-22	-5593	-3571
Mar 22	50529	343	3593	-196	-19	-5544	-3530
Mar 27	50534	348	3595	-211	-36	-5562	-3476
Apr 1	50539	359	3608	-215	-27	-5518	-3426
Apr 6	50544	370	3600	-220	-35	-5502	-3375
Apr 11	50549	376	3612	-224	-59	-5505	-3329
Apr 16	50554	387	3605	-221	-63	-5564	-3263
Apr 21	50559	391	3610	-227	-66	-5630	-3210
Apr 26	50564	401	3652	-219	-65	-5615	-3170
May 1	50569	405	3613	-229	-78	-5651	-3120
May 6	50574	418	3618	-216	-80	-5710	-3053
May 11	50579	433	3589	-206	-78	-5754	-2989
May 16	50584	448	3615	-209	-56	-5758	-2912
May 21	50589	454	3565	-212	-91	-5759	-2842
May 26	50594	463	3529	-203	-92	-5766	-2776
May 31	50599	474	3546	-189	-87	-5712	-2713
Jun 5	50604	482	3569	-181	-55	-5720	-2653
Jun 10	50609	490	3526	-175	-66	-5669	-2598
Jun 15	50614	509	3537	-171	-78	-5711	-2530
Jun 20	50619	513	3496	-166	-78	-5721	-2470
Jun 25	50624	526	3522	-168	-72	-5695	-2402
Jun 30	50629	533	3501	-167	-74	-5673	-2335

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) IPQ	JATC	KRIS (10)	LDS	MSL (11)	NAO (12)
Jul 5	50634	540	3479	-159	-67	-5718	-2269
Jul 10	50639	548	3468	-140	-73	-5762	-2195
Jul 15	50644	565	3467	-131	-57	-5726	-2146
Jul 20	50649	582	3457	-142	-37	-5730	-2079
Jul 25	50654	598	3470	-134	-52	-5816	-2017
Jul 30	50659	610	3434	-130	-40	-5828	-1954
Aug 4	50664	616	3439	-112	-27	-5838	-1900
Aug 9	50669	634	3474	-120	-13	-5838	-1834
Aug 14	50674	652	3477	-127	-20	-5809	-1764
Aug 19	50679	662	3460	-123	-6	-5815	-1714
Aug 24	50684	688	3478	-130	0	-5816	-1644
Aug 29	50689	704	3458	-115	16	-5743	-1588
Sep 3	50694	729	3446	-86	13	-5812	-1539
Sep 8	50699	756	3480	-75	13	-5813	-1463
Sep 13	50704	769	3493	-59	15	-5863	-1395
Sep 18	50709	754	3474	-35	18	-5943	-1319
Sep 23	50714	768	3452	-34	28	-5935	-1264
Sep 28	50719	796	3424	-15	2	-6011	-1189
Oct 3	50724	794	3489	-16	15	-6030	-1114
Oct 8	50729	809	3477	-22	21	-6077	-1064
Oct 13	50734	823	3479	-31	23	-6122	-996
Oct 18	50739	836	3497	-25	38	-6103	-931
Oct 23	50744	844	3570	-29	46	-6095	-869
Oct 28	50749	861	3459	-20	35	-6078	-807
Nov 2	50754	889	3385	-2	39	-6097	-736
Nov 7	50759	910	3419	5	49	-6093	-671
Nov 12	50764	925	3446	-5	41	-6121	-617
Nov 17	50769	938	3434	-8	39	-6149	-533
Nov 22	50774	953	3441	-5	50	-6152	-458
Nov 27	50779	967	3389	-6	42	-6199	-403
Dec 2	50784	971	3409	3	54	-6235	-329
Dec 7	50789	979	3371	10	54	-6287	-251
Dec 12	50794	989	3358	2	62	-6267	-163
Dec 17	50799	1004	3373	23	55	-6247	-97
Dec 22	50804	1015	3347	27	54	-6113	-53
Dec 27	50809	1032	3389	42	52	-6075	-1

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) NIM (13)	NIST	NML (14)	NPL (15)	NRC (16)	NRLM
Jan 1	50449	-1263	44	-	83	187	-11
Jan 6	50454	-1287	43	-	86	180	-3
Jan 11	50459	-1292	41	-	84	173	-5
Jan 16	50464	-1285	38	-	84	163	2
Jan 21	50469	-1311	36	-	81	155	3
Jan 26	50474	-1345	34	-	81	147	9
Jan 31	50479	-1353	29	-	79	137	6
Feb 5	50484	-1360	30	-	80	130	14
Feb 10	50489	-1386	27	-	80	121	19
Feb 15	50494	-1400	22	-	78	111	17
Feb 20	50499	-1402	21	-	75	97	21
Feb 25	50504	-1404	22	-	71	90	12
Mar 2	50509	-1449	20	-	68	80	17
Mar 7	50514	-1467	13	-	69	64	23
Mar 12	50519	-1474	12	-	68	55	25
Mar 17	50524	-1485	13	-	64	48	34
Mar 22	50529	-1483	9	-	67	36	42
Mar 27	50534	-1504	8	-	68	24	46
Apr 1	50539	-1526	5	-	67	12	47
Apr 6	50544	-1529	4	-	69	-2	49
Apr 11	50549	-1536	6	-	70	-4	46
Apr 16	50554	-1557	2	-	71	-10	50
Apr 21	50559	-1562	-3	-	72	-9	59
Apr 26	50564	-1573	-2	-	72	-1	63
May 1	50569	-1604	-5	377	71	6	71
May 6	50574	-1622	-9	391	72	6	77
May 11	50579	-1634	-7	391	74	9	86
May 16	50584	-1638	-10	389	72	10	86
May 21	50589	-1676	-4	408	69	17	91
May 26	50594	-1701	-1	424	70	25	92
May 31	50599	-1703	-6	449	70	31	97
Jun 5	50604	-1714	-5	451	70	48	97
Jun 10	50609	-1739	-5	462	67	60	99
Jun 15	50614	-1783	-3	463	67	68	108
Jun 20	50619	-1810	-3	485	66	74	105
Jun 25	50624	-1823	-2	505	63	76	108
Jun 30	50629	-1844	0	512	63	64	110

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) NIM (13)	NIST	NML (14)	NPL (15)	NRC (16)	NRLM
Jul 5	50634	-1851	4	530	64	48	117
Jul 10	50639	-1898	8	543	65	36	121
Jul 15	50644	-1917	12	562	59	32	126
Jul 20	50649	-1935	16	577	60	20	134
Jul 25	50654	-1950	19	576	60	7	139
Jul 30	50659	-1957	18	584	61	-18	138
Aug 4	50664	-1965	18	589	62	-14	148
Aug 9	50669	-1979	21	613	62	-11	152
Aug 14	50674	-2034	25	605	63	-3	155
Aug 19	50679	-2053	26	612	66	1	162
Aug 24	50684	-2069	28	633	67	2	170
Aug 29	50689	-2093	29	634	71	6	177
Sep 3	50694	-2125	31	641	71	10	182
Sep 8	50699	-2148	30	653	77	3	189
Sep 13	50704	-2195	32	652	81	-1	197
Sep 18	50709	-2236	32	691	83	-3	209
Sep 23	50714	-2267	31	698	82	-8	210
Sep 28	50719	-2308	31	752	82	-13	210
Oct 3	50724	-2329	31	751	80	-14	213
Oct 8	50729	-2355	29	777	83	-17	225
Oct 13	50734	-2365	24	776	85	-17	231
Oct 18	50739	-2371	23	795	85	-20	236
Oct 23	50744	-2397	21	782	87	-25	236
Oct 28	50749	-2411	16	802	87	-25	252
Nov 2	50754	-2429	14	814	88	-27	265
Nov 7	50759	-2431	8	838	89	-33	275
Nov 12	50764	-2458	6	838	94	-19	285
Nov 17	50769	-2491	3	876	89	-12	287
Nov 22	50774	-2481	3	888	89	-5	292
Nov 27	50779	-2488	1	891	87	-9	296
Dec 2	50784	-2497	-2	889	91	-17	296
Dec 7	50789	-2521	2	891	91	-19	303
Dec 12	50794	-2524	1	875	88	-18	303
Dec 17	50799	-2521	-1	879	87	-13	308
Dec 22	50804	-2523	2	881	81	-5	308
Dec 27	50809	-2553	3	884	83	3	308

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) OMH	ONBA (17)	ONRJ (18)	OP (19)	ORB (20)	PSB (21)
Jan 1	50449	-	-15221	31787	66	115	-
Jan 6	50454	-	-15464	32057	64	108	-
Jan 11	50459	-	-15846	32362	52	128	-
Jan 16	50464	-	-15811	32774	54	117	-
Jan 21	50469	-	-15766	33150	52	156	-
Jan 26	50474	-	-15782	33576	54	188	-
Jan 31	50479	-	-15882	34030	49	172	-
Feb 5	50484	-	-16057	34496	47	174	-
Feb 10	50489	-	-16155	34924	40	157	-
Feb 15	50494	-	-16293	35306	30	171	-
Feb 20	50499	-	-16368	35768	23	175	-
Feb 25	50504	-	-16552	36142	6	183	-
Mar 2	50509	-	-16636	36448	2	179	-
Mar 7	50514	-	-16811	36846	4	193	-
Mar 12	50519	-	-16961	37333	7	190	-
Mar 17	50524	-	-17208	37830	3	192	-
Mar 22	50529	-	-17467	38288	0	212	-
Mar 27	50534	-	-17681	38713	-6	228	-
Apr 1	50539	-	-17757	39087	-8	233	-
Apr 6	50544	-	-18059	39485	-14	224	-
Apr 11	50549	-	-18357	39892	-6	225	-
Apr 16	50554	634	-18638	40299	-12	245	-
Apr 21	50559	640	-18874	40717	-8	241	-
Apr 26	50564	663	-19130	41195	-4	250	-
May 1	50569	658	139	41655	-3	265	-
May 6	50574	668	-240	42084	2	242	-
May 11	50579	679	-431	42566	16	261	-
May 16	50584	681	-716	42952	20	245	-
May 21	50589	700	-1000	43335	25	258	-
May 26	50594	698	-1513	43734	22	258	-
May 31	50599	715	-2041	44121	27	267	-
Jun 5	50604	729	-2560	44504	32	270	-
Jun 10	50609	758	-3175	44925	40	262	-
Jun 15	50614	769	-3782	45402	45	238	-
Jun 20	50619	787	-4292	45883	53	263	-
Jun 25	50624	818	-4758	46366	70	261	-
Jun 30	50629	826	-5240	46802	75	285	-

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*UTC - UTC(k)* OMH	ONBA (17)	ONRJ (18)	OP (19)	ORB (20)	PSB (21)
Jul 5	50634	865	-6136	-330	84	290	-
Jul 10	50639	881	-6833	-308	84	273	-
Jul 15	50644	904	-7454	-300	86	281	-
Jul 20	50649	935	-8141	-281	88	294	-
Jul 25	50654	946	-8671	-253	83	282	-
Jul 30	50659	958	-9130	-222	82	291	-
Aug 4	50664	970	-9511	-205	81	297	-
Aug 9	50669	999	-10186	-187	67	344	-
Aug 14	50674	1033	-10815	-165	67	322	295
Aug 19	50679	1042	-11445	-151	56	338	309
Aug 24	50684	1053	-	-123	53	308	333
Aug 29	50689	1066	-	-117	44	316	356
Sep 3	50694	1092	-	-103	37	296	368
Sep 8	50699	1121	-	-85	33	294	392
Sep 13	50704	1146	-	-67	29	291	412
Sep 18	50709	1158	-	-54	28	295	430
Sep 23	50714	1170	-	-33	28	284	451
Sep 28	50719	1169	-	-19	23	280	474
Oct 3	50724	1171	-	-11	19	305	489
Oct 8	50729	1179	-	12	16	287	518
Oct 13	50734	1195	-	31	12	282	533
Oct 18	50739	1207	-	41	17	309	564
Oct 23	50744	1203	-	60	9	293	584
Oct 28	50749	1212	-	78	-1	312	607
Nov 2	50754	1246	-	107	-3	321	635
Nov 7	50759	1280	-	116	1	310	659
Nov 12	50764	1280	-	133	6	293	677
Nov 17	50769	1301	-	157	6	279	704
Nov 22	50774	1317	-	178	4	288	733
Nov 27	50779	1344	-	178	11	269	764
Dec 2	50784	1346	-	196	8	249	794
Dec 7	50789	1367	-	207	9	237	829
Dec 12	50794	1383	-1351	220	14	204	856
Dec 17	50799	1393	-1138	222	13	188	878
Dec 22	50804	1393	-1093	246	15	187	903
Dec 27	50809	1406	-782	264	21	193	943

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	*UTC - UTC(k)* PTB	ROA (22)	SCL (23)	SO	SP	SU
Jan 1	50449	1868	19	-231	1152	-6	959
Jan 6	50454	1862	3	-196	1132	-4	954
Jan 11	50459	1861	-59	-171	1131	-	950
Jan 16	50464	1855	-6	-113	1142	204	939
Jan 21	50469	1850	-4	-117	1127	217	930
Jan 26	50474	1847	-9	-134	1118	233	921
Jan 31	50479	1842	-16	-136	1119	233	915
Feb 5	50484	1837	-18	-109	1125	244	907
Feb 10	50489	1832	-21	-103	1119	241	901
Feb 15	50494	1828	-24	-105	1107	248	892
Feb 20	50499	1824	-29	-105	1127	248	884
Feb 25	50504	1819	-41	-105	1120	243	871
Mar 2	50509	1816	-50	-104	1110	255	859
Mar 7	50514	1811	-49	-81	1086	254	852
Mar 12	50519	1805	-38	-88	1087	263	850
Mar 17	50524	1796	-39	-85	1103	268	836
Mar 22	50529	1797	-40	-72	1083	273	829
Mar 27	50534	1793	-38	-62	1081	271	820
Apr 1	50539	1788	-34	-43	1060	277	812
Apr 6	50544	1786	-33	-19	1084	277	804
Apr 11	50549	1777	-33	-17	1057	276	796
Apr 16	50554	1770	-36	-3	1022	278	790
Apr 21	50559	1762	-47	-1	1038	293	783
Apr 26	50564	1760	-57	20	1039	296	771
May 1	50569	1751	-63	31	1019	298	766
May 6	50574	1746	-72	48	1012	301	761
May 11	50579	1741	-75	70	1028	309	753
May 16	50584	1733	-77	69	1041	310	745
May 21	50589	1729	-82	63	1014	308	735
May 26	50594	1727	-92	82	1002	311	728
May 31	50599	1725	-99	65	995	321	726
Jun 5	50604	1720	-97	-	1001	324	711
Jun 10	50609	1716	-91	-	1003	327	704
Jun 15	50614	1715	-75	-	980	335	698
Jun 20	50619	1710	-65	-	963	342	690
Jun 25	50624	1706	-59	-	965	345	683
Jun 30	50629	1703	-54	-	967	347	668

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) PTB	ROA (22)	SCL (23)	SO	SP	SU
Jul 5	50634	1706	-46	-	976	358	663
Jul 10	50639	1707	-43	-	930	364	649
Jul 15	50644	1705	-50	-	931	360	644
Jul 20	50649	1710	-42	-	948	373	636
Jul 25	50654	1716	-27	-	955	376	632
Jul 30	50659	1723	-23	-	950	399	624
Aug 4	50664	1727	-24	-	937	-	614
Aug 9	50669	1731	-21	-	948	413	604
Aug 14	50674	1741	-25	-	944	425	595
Aug 19	50679	1752	-28	-	927	422	587
Aug 24	50684	1756	-19	-	941	427	582
Aug 29	50689	1771	-12	-	946	437	572
Sep 3	50694	1772	-15	-	937	460	561
Sep 8	50699	1767	-7	-	932	464	554
Sep 13	50704	1768	0	-	895	487	546
Sep 18	50709	1765	8	-	890	495	539
Sep 23	50714	1767	12	-	906	502	531
Sep 28	50719	1776	15	-	897	517	517
Oct 3	50724	1772	14	-	911	528	506
Oct 8	50729	1773	18	-	885	531	499
Oct 13	50734	1776	13	-	901	527	489
Oct 18	50739	1778	15	-	888	548	477
Oct 23	50744	1782	17	-	894	565	470
Oct 28	50749	1791	20	-	874	575	461
Nov 2	50754	1802	32	-	870	588	454
Nov 7	50759	1812	37	-	864	597	454
Nov 12	50764	1822	44	-	847	614	444
Nov 17	50769	1827	45	-	848	618	438
Nov 22	50774	1836	46	-	852	628	424
Nov 27	50779	1840	46	-	858	628	417
Dec 2	50784	1849	45	-	838	632	409
Dec 7	50789	1847	54	-3	829	627	407
Dec 12	50794	1847	55	-23	838	634	386
Dec 17	50799	1849	64	-69	817	635	384
Dec 22	50804	1851	67	-92	814	639	375
Dec 27	50809	1861	61	-118	794	-	371

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) TL (24)	TP (25)	TUG	UME	USNO	VSL (26)
Jan 1	50449	-	99	1201	247	13	-384
Jan 6	50454	-	111	1233	256	14	-388
Jan 11	50459	-	128	1265	264	16	-395
Jan 16	50464	479	126	1294	277	17	-392
Jan 21	50469	492	132	1331	279	15	-397
Jan 26	50474	495	138	1357	291	16	-399
Jan 31	50479	511	128	1404	305	15	-412
Feb 5	50484	524	124	1430	315	17	-417
Feb 10	50489	545	132	1461	323	18	-415
Feb 15	50494	563	127	1490	335	16	-422
Feb 20	50499	570	136	1511	344	16	-433
Feb 25	50504	574	144	1548	358	15	-440
Mar 2	50509	568	120	1577	377	18	-443
Mar 7	50514	580	120	1609	388	12	-440
Mar 12	50519	592	125	1651	400	11	-450
Mar 17	50524	594	118	1688	408	15	-456
Mar 22	50529	609	114	1730	419	10	-458
Mar 27	50534	620	124	1768	431	9	-460
Apr 1	50539	631	107	1805	445	8	-463
Apr 6	50544	637	108	1848	445	9	-453
Apr 11	50549	640	91	1892	452	10	-441
Apr 16	50554	652	104	1923	463	9	-438
Apr 21	50559	656	118	1960	467	10	-429
Apr 26	50564	668	120	1994	475	13	-418
May 1	50569	680	117	2032	487	15	-405
May 6	50574	686	115	2064	501	11	-391
May 11	50579	687	106	2108	513	14	-378
May 16	50584	700	111	2142	515	13	-374
May 21	50589	711	110	2187	523	18	-364
May 26	50594	725	114	2223	522	18	-344
May 31	50599	744	120	2262	530	14	-326
Jun 5	50604	753	121	2302	533	16	-318
Jun 10	50609	776	122	2340	540	15	-309
Jun 15	50614	798	126	2374	551	14	-300
Jun 20	50619	789	137	2409	560	12	-286
Jun 25	50624	779	122	2442	563	10	-277
Jun 30	50629	771	120	2467	572	8	-264

TABLE 9. (CONT.)

Unit is one nanosecond.

Date 1997 0h UTC	MJD	UTC - UTC(k) TL (24)	TP (25)	TUG	UME	USNO	VSL (26)
Jul 5	50634	762	128	2503	582	10	-258
Jul 10	50639	749	131	2543	593	9	-258
Jul 15	50644	738	126	2573	602	10	-255
Jul 20	50649	726	141	2609	610	11	-247
Jul 25	50654	718	149	2643	616	9	-243
Jul 30	50659	707	144	2686	623	8	-236
Aug 4	50664	695	149	2727	638	8	-229
Aug 9	50669	689	162	2778	644	11	-221
Aug 14	50674	675	173	2824	659	12	-215
Aug 19	50679	654	180	2869	681	11	-198
Aug 24	50684	655	192	2897	690	10	-193
Aug 29	50689	636	184	2936	702	9	-192
Sep 3	50694	615	189	2987	711	12	-181
Sep 8	50699	608	194	3027	722	9	-172
Sep 13	50704	596	193	3075	732	10	-161
Sep 18	50709	590	205	3106	747	10	-159
Sep 23	50714	578	206	3148	772	11	-150
Sep 28	50719	568	211	3188	786	9	-139
Oct 3	50724	560	214	3233	792	14	-133
Oct 8	50729	554	208	3278	808	15	-128
Oct 13	50734	552	203	3324	810	16	-110
Oct 18	50739	549	206	3370	819	17	-99
Oct 23	50744	542	215	3404	827	16	-90
Oct 28	50749	539	217	3455	839	10	-76
Nov 2	50754	529	217	3500	846	9	-76
Nov 7	50759	520	227	3555	862	6	-77
Nov 12	50764	523	227	3611	880	5	-66
Nov 17	50769	520	223	3660	883	2	-79
Nov 22	50774	518	225	3707	889	2	-63
Nov 27	50779	509	227	3747	902	1	-56
Dec 2	50784	503	211	3787	917	0	-58
Dec 7	50789	506	220	3819	922	1	-45
Dec 12	50794	494	213	3862	937	-1	-34
Dec 17	50799	495	214	3906	939	-4	-31
Dec 22	50804	493	209	3947	940	-3	-31
Dec 27	50809	486	200	3990	954	-2	-14

TABLE 9. (CONT.)

Notes

(1) CAO . Change of master clock on 50451.35

(2) CH . Frequency steps of UTC(CH) in ns/d :

MJD	Freq. step
50453	+1.68
50483	+3.48
50513	+1.28
50543	-0.80
50573	-1.01
50603	-0.73
50633	-4.91
50663	-3.94
50693	+3.41
50723	+6.90
50763	+4.13
50793	-4.06

(3) CRL . Frequency steps of UTC(CRL) in ns/d :

MJD	Freq. step
50589.0	+1.43
50770.0	-0.86

(4) CSIR. Frequency step of UTC(CSIR) of + 8.64 ns/d on MJD = 50507.42
Change of master clock and GPS receiver on MJD = 50630

(5) GUM . Frequency step of UTC(GUM) of + 5.53 ns/d on MJD = 50749

(6) IEN . Time step of UTC(IEN) of + 635 ns on MJD = 50721.37

(7) IFAG. Change of master clock between MJD = 50699 and MJD = 50704

(8) IGMA. Time step of UTC(IGMA) of + 300 ns and frequency step of UTC(IGMA) of + 1.50 ns/d on MJD = 50630.0

(9) INPL. Frequency steps of UTC(INPL) in ns/d :

MJD	Freq. step
50673	+186.31
50707	+2.59
50714	+2.59
50720	+3.46
50750	+4.32
50776	+3.46

TABLE 9. (CONT.)

(10) KRIS. Frequency step of UTC(KRIS) of - 1.73 ns/d on MJD = 50494

(11) MSL . Apparent time step of *UTC-UTC(MSL)* of + 31 ns between MJD = 50604 and MJD = 50609 due to GPS equipment calibration.

(12) NAO . Formerly NAOM. Change of master clock on MJD = 50511.01

(13) NIM . Apparent time step of *UTC-UTC(NIM)* between MJD = 50444 and MJD = 50449

(14) NML . National Measurement Laboratory, Sydney, Australia.

(15) NPL . Change of master clock on MJD = 50759.48
Frequency steps of UTC(NPL) in ns/d :

MJD	Freq. step
50444.59	+1.0
50549.44	+0.2
50583.40	+0.2
50703.45	+0.4
50737.36	+0.4
50757.00	-1.0
50759.48	+1.1

(16) NRC . Frequency steps of UTC(NRC) in ns/d :

MJD	Freq. step
50544.00	-1.73
50574.00	+0.65
50624.00	+2.59
50659.00	-2.59
50689.00	+0.86
50744.00	-1.30
50774.00	+0.86

(17) ONBA. Time step of UTC(ONBA) of - 19500 ns on MJD = 50568.

(18) ONRJ. Change of master clock on MJD = 50630.0

(19) OP . Change of master clock on MJD = 50752.42
Frequency steps of UTC(OP) in ns/d :

MJD	Freq. step
50456.56	+0.86
50507.56	-0.86
50539.56	-0.43
50630.56	+1.30
50660.56	+0.43
50783.56	+0.86

TABLE 9. (CONT.)

(20) ORB . Frequency step of UTC(ORB) of +0.864 ns/d on MJD = 50706

(21) PSB . National Measurement Center, Singapore Productivity and Standards Board, Singapore.

(22) ROA . Time step of UTC(ROA) of -110 ns on MJD = 50463.48
Frequency steps of UTC(ROA) in ns/d :

MJD	Freq. step
50511.5	-1.6
50599.4	-2.2

(23) SCL . Frequency steps of UTC(SCL) in ns/d :

MJD	Freq. step
50384.071	-4.66 *
50464.122	+2.59
50504.250	-1.73
50525.250	-0.86
50589.250	+2.59

* Frequency step to be added in Note (24), p. 61, of the Annual Report for 1996.

(24) TL . Frequency step of UTC(TL) of +4.32 ns/d on MJD = 50615

(25) TP . Frequency step of UTC(TP) of +1.12 ns/d on MJD = 50448.5

(26) VSL . Frequency steps of UTC(VSL) in ns/d :

MJD	Freq. step
50507.6	-0.86
50542.6	-1.73

TABLE 10. INTERNATIONAL GPS TRACKING SCHEDULE NO 29 FOR MJD = 50722 (1997 OCTOBER 1) AT 0H UTC

This is a suggested tracking schedule for international time comparisons using GPS satellites in common-view between ten areas of the globe.

Area		Participating laboratories
Europe	E	AOS, BEV, CAO, CH, DLR, DTAG, GUM, IEN, IFAG, IPQ, LDS, Mad*, NPL, OMH, OP, ORB, PTB, ROA, SP, SU, TP, TUG, UME, VSL
East North America	ENA	AO*, APL, NRC, USNO
West North America	WNA	3S Navigation*, CNM, Gold*, NIST, WWV*
Hawaii	H	WWVH*
East Asia	EA	BIRM, CRL, CSAO, KRIS, NAO, NIM, NRLM, SCL, SO, TL
Australia and New Zealand	A	Can*, ATC*, ORR*, MSL, NML
India	I	NPLI
Middle East	ME	INPL
South Africa	SAF	CSIR
South America	SAM	IGMA, ONBA, ONRJ, Kou*

* Mad, Gold, Can : JPL Deep Space Network, Madrid, Goldstone, Canberra.
WWV, WWVH : NIST stations in Colorado and Hawaii.
AO : Arecibo Observatory.
Kou: CNES Kourou Center.
ATC, ORR : Australian laboratories.
3S Navigation: Irvine, California.

Other laboratories are designated by their usual acronyms.

The start times of the tracks are referenced to UTC. The start time of a track is the date of the first observation. It may be necessary to advance this time by 2 minutes if you operate an NBS-type receiver, in order to allow the lock-on procedure onto the satellite signal. The track length is 780 s. All the track times should be decremented 4 minutes each day, to account for the GPS sidereal orbits. The track times were chosen to maximize elevation angles between pairs of stations. The class bytes are such that in association with the satellite number they form a unique identifyer for each common view.

The European area, having numerous possible connections, has a heavy schedule. The establishment of sub-schedules permits the sharing of the work. European laboratories have been contacted to ensure the coordination of sub-schedules.

TABLE 10. GPS SCHEDULE NO 29, 1997 OCTOBER 1 (CONT.)

*** Europe ***

Class	PRN	Start h	Start m	Connects	Subschedules E1	E2	E3	E4
18	25	0	2	ENA,WNA,ME,SAM	*	*	*	*
54	25	0	50	SAM,ME	*	*	*	*
4C	17	1	22	SAF,ME,I				*
55	25	1	54	SAM,ME,SAF	*	*	*	*
18	3	2	26	ENA,WNA,SAM		*		
10	6	2	42	EA,ME,I			*	
54	3	2	58	SAM,ENA,WNA	*	*	*	*
4C	23	3	14	SAF,ME,I				*
10	17	4	2	EA,ME,I	*	*	*	*
4C	21	4	34	SAF,ME,I				*
4C	22	5	6	SAF,SAM,ME	*	*	*	*
10	23	5	54	EA,ME,I	*	*	*	*
54	15	6	10	SAM,ENA,WNA		*		
08	15	6	26	WNA,ENA,SAM		*		
10	21	6	58	EA,ME,I	*	*	*	*
10	1	7	46	EA,ME,I			*	
4C	31	8	2	SAF,ME	*	*	*	*
00	14	8	18	ENA,SAM,ME		*		
4C	29	8	34	SAF,ME,I				*
00	16	9	6	ENA,SAM	*	*	*	*
00	7	9	54	ENA,WNA,SAM	*	*	*	*
4C	15	10	10	SAF,ME,I				*
10	25	10	26	EA,ME,I			*	
54	18	10	42	SAM,SAF,ME				*
00	4	10	58	ENA,WNA	*	*	*	*
48	14	11	30	ME,I			*	
60	18	12	2	ENA,ME	*	*	*	*
08	24	12	34	WNA,ENA		*		
4C	19	13	6	SAF,ME,I	*	*	*	*
54	24	13	22	SAM,ENA,WNA,ME		*		
07	10	14	10	ENA,WNA	*	*	*	*
10	18	14	26	EA,ME,I			*	
10	19	15	14	EA,ME,I	*	*	*	*
08	26	16	18	WNA,ENA,SAM	*	*	*	*
10	27	17	22	EA,ME,I	*	*	*	*
18	9	18	26	ENA,WNA,SAM	*	*	*	*
10	2	18	58	EA,ME,I			*	
00	23	19	14	ENA,WNA,SAM		*		
54	23	19	30	SAM,ENA,WNA	*	*	*	*
00	5	19	46	ENA,ME,SAM		*		
10	7	20	2	EA,ME,I			*	
11	7	20	34	EA,ME,I	*	*	*	*
00	30	21	6	ENA,SAM		*		
10	4	21	38	EA,ME,I	*	*	*	*
08	1	21	54	WNA,ENA		*		
BC	9	22	26	ME,SAF,I				*
10	24	22	42	EA,ME,I	*	*	*	*
10	5	23	14	EA,ME,I			*	

TABLE 10. GPS SCHEDULE NO 29, 1997 OCTOBER 1 (CONT.)

*** E. North America ***

Class	PRN	Start h	Start m	Connects
18	25	0	2	WNA,E,ME,SAM
18	16	0	18	WNA,H
18	18	0	50	WNA,EA,H
18	3	2	26	WNA,E,SAM
68	31	2	42	SAM,WNA
54	3	2	58	E,SAM,WNA
19	18	3	14	WNA,H
18	19	3	30	WNA,H
18	27	3	46	WNA,H,EA
68	18	4	18	SAM,WNA
19	27	4	50	WNA,H
18	2	5	54	WNA,H
54	15	6	10	E,SAM,WNA
08	15	6	26	E,WNA,SAM
00	14	8	18	E,SAM,ME
20	9	8	34	EA,WNA,H
00	16	9	6	E,SAM
18	4	9	22	WNA,H,SAM
20	5	9	38	EA,WNA,H
00	7	9	54	E,WNA,SAM
18	24	10	26	WNA,H
00	4	10	58	E,WNA
18	5	11	14	WNA
20	30	11	30	EA,WNA,H
28	30	11	46	WNA,EA,H
60	18	12	2	ME,E
08	24	12	34	E,WNA
20	6	12	50	EA,WNA,H
54	24	13	22	E,SAM,WNA,ME
07	10	14	10	E,WNA
18	6	15	30	WNA,H,SAM
18	23	16	2	WNA,H
08	26	16	18	E,WNA,SAM
68	9	16	34	SAM
69	9	17	54	SAM,WNA
18	17	18	10	WNA,SAM
18	9	18	26	WNA,E,SAM
18	21	18	42	WNA,H
18	1	18	58	WNA,H
00	23	19	14	E,WNA,SAM
54	23	19	30	E,SAM,WNA
00	5	19	46	E,ME,SAM
19	25	20	34	WNA,H,SAM
20	15	20	50	EA,WNA,H
00	30	21	6	E,SAM
08	1	21	54	WNA,E
28	14	22	10	EA,WNA,H
28	16	23	30	WNA,EA

*** W. North America ***

Class	PRN	Start h	Start m	Connects
18	25	0	2	ENA,E,ME,SAM
18	16	0	18	ENA,H
28	18	0	34	EA,H
18	18	0	50	ENA,EA,H
18	3	2	26	ENA,E,SAM
68	31	2	42	ENA,SAM
54	3	2	58	E,SAM,ENA
19	18	3	14	ENA,H
18	19	3	30	ENA,H
18	27	3	46	ENA,H,EA
68	18	4	18	ENA,SAM
19	27	4	50	ENA,H
18	2	5	54	ENA,H
54	15	6	10	E,SAM,ENA
08	15	6	26	E,ENA,SAM
28	26	6	42	EA,H
20	9	8	34	ENA,EA,H
18	4	9	22	ENA,H,SAM
20	5	9	38	ENA,EA,H
00	7	9	54	E,ENA,SAM
18	24	10	26	ENA,H
00	4	10	58	E,ENA
18	5	11	14	ENA
20	30	11	30	ENA,EA,H
28	30	11	46	EA,H,ENA
28	6	12	18	EA,H
08	24	12	34	E,ENA
20	6	12	50	ENA,EA,H
54	24	13	22	E,SAM,ENA,ME
07	10	14	10	E,ENA
18	6	15	30	ENA,H,SAM
18	23	16	2	ENA,H
08	26	16	18	E,ENA,SAM
28	3	17	6	EA,H
69	9	17	54	ENA,SAM
18	17	18	10	ENA,SAM
18	9	18	26	ENA,E,SAM
18	21	18	42	ENA,H
18	1	18	58	ENA,H
00	23	19	14	E,ENA,SAM
54	23	19	30	E,SAM,ENA
3C	31	20	2	A,H
19	25	20	34	ENA,H,SAM
20	15	20	50	EA,ENA,H
08	1	21	54	E,ENA
28	14	22	10	EA,ENA,H
28	16	23	30	EA,ENA

*** East Asia ***

Class	PRN	Start h	Start m	Connects
28	18	0	34	WNA,H
18	18	0	50	ENA,WNA,H
98	26	1	54	A,I
3C	4	2	10	A,H
10	6	2	42	E,ME,I
3C	24	2	58	A,H
18	27	3	46	ENA,WNA,H
10	17	4	2	E,ME,I
98	10	4	50	A
98	9	5	6	A,I
10	23	5	54	E,ME,I
28	26	6	42	WNA,H
10	21	6	58	E,ME,I
10	1	7	46	E,ME,I
20	9	8	34	ENA,WNA,H
20	5	9	38	ENA,WNA,H
10	25	10	26	E,ME,I
98	22	10	42	A,I
3C	1	11	14	A,H
20	30	11	30	ENA,WNA,H
28	30	11	46	WNA,H,ENA
98	1	12	2	A
28	6	12	18	WNA,H
20	6	12	50	ENA,WNA,H
98	29	13	22	A,I
98	3	13	38	A,I
98	25	14	10	A,H
10	18	14	26	E,ME,I
37	3	14	58	H,I
10	19	15	14	E,ME,I
99	22	16	34	A,H
28	3	17	6	WNA,H
10	27	17	22	E,ME,I
10	2	18	58	E,ME,I
98	14	19	14	A,H
3C	14	19	30	A,H
10	7	20	2	E,ME,I
11	7	20	34	E,ME,I
20	15	20	50	ENA,WNA,H
36	14	21	6	H
98	2	21	22	A,I
10	4	21	38	E,ME,I
28	14	22	10	WNA,ENA,H
3C	18	22	26	A,H
10	24	22	42	E,ME,I
3C	7	22	58	A,H
10	5	23	14	E,ME,I
28	16	23	30	WNA,ENA

TABLE 10. GPS SCHEDULE NO 29, 1997 OCTOBER 1 (CONT.)

*** Hawaii ***

Class	PRN	Start h	Start m	Connects
18	16	0	18	ENA,WNA
28	18	0	34	EA,WNA
18	18	0	50	ENA,WNA,EA
3C	27	1	06	A
3C	4	2	10	A,EA
3C	2	2	42	A
3C	24	2	58	A,EA
19	18	3	14	ENA,WNA
18	19	3	30	ENA,WNA
18	27	3	46	ENA,WNA,EA
19	27	4	50	ENA,WNA
18	2	5	54	ENA,WNA
28	26	6	42	WNA,EA
3C	5	7	14	A
20	9	8	34	ENA,EA,WNA
3C	30	8	50	A
3C	26	9	6	A
18	4	9	22	ENA,WNA,SAM
20	5	9	38	ENA,EA,WNA
3C	6	9	54	A
18	24	10	26	ENA,WNA
3C	1	11	14	A,EA
20	30	11	30	ENA,EA,WNA
28	30	11	46	WNA,EA,ENA
28	6	12	18	EA,WNA
20	6	12	50	ENA,EA,WNA
98	25	14	10	EA,A
3C	21	14	42	A
37	3	14	58	EA,I
18	6	15	30	ENA,WNA,SAM
18	23	16	2	ENA,WNA
99	22	16	34	EA,A
28	3	17	6	WNA,EA
3C	29	18	26	A
18	21	18	42	ENA,WNA
18	1	18	58	ENA,WNA
98	14	19	14	EA,A
3C	14	19	30	A,EA
3C	31	20	2	A,WNA
3D	31	20	18	A
19	25	20	34	ENA,WNA,SAM
20	15	20	50	EA,ENA,WNA
36	14	21	6	EA
28	14	22	10	EA,WNA,ENA
3C	18	22	26	A,EA
3C	7	22	58	A,EA

*** Australia ***

Class	PRN	Start h	Start m	Connects
CC	26	0	2	SAF
3C	27	1	06	H
CC	9	1	38	SAF
98	26	1	54	EA,I
3C	4	2	10	H,EA
3C	2	2	42	H
3C	24	2	58	H,EA
F9	4	3	30	A
CC	30	4	18	SAF
F9	24	4	34	A
98	10	4	50	EA
98	9	5	6	EA,I
CC	6	5	22	SAF,I
CD	6	5	54	SAF
3C	5	7	14	H
3C	30	8	50	H
3C	26	9	6	H
3C	6	9	54	H
F9	23	10	10	A
CC	3	10	26	SAF
98	22	10	42	EA,I
3C	1	11	14	H,EA
98	1	12	2	EA
CC	31	12	18	SAF
CD	31	12	34	SAF
98	29	13	22	EA,I
98	3	13	38	EA,I
CC	15	13	54	SAF
98	25	14	10	EA,H
3C	21	14	42	H
CC	14	15	14	SAF
99	22	16	34	EA,H
CC	16	16	50	SAF
CC	18	17	38	SAF
CD	18	17	54	SAF
3C	29	18	26	H
98	14	19	14	EA,H
3C	14	19	30	H,EA
3C	31	20	2	H,WNA
3D	31	20	18	H
F9	19	21	6	A
98	2	21	22	EA,I
3C	18	22	26	H,EA
3C	7	22	58	H,EA
F9	27	23	14	A

*** India ***

Class	PRN	Start h	Start m	Connects
4C	17	1	22	E,SAF,ME
98	26	1	54	EA,A
10	6	2	42	E,EA,ME
4C	23	3	14	E,SAF,ME
10	17	4	2	E,EA,ME
4C	21	4	34	E,SAF,ME
98	9	5	6	EA,A
CC	6	5	22	A,SAF
10	23	5	54	E,EA,ME
BC	1	6	10	ME,SAF
10	21	6	58	E,EA,ME
10	1	7	46	E,EA,ME
4C	29	8	34	E,SAF,ME
4C	15	10	10	E,SAF,ME
10	25	10	26	E,EA,ME
98	22	10	42	EA,A
48	14	11	30	E,ME
BC	14	12	50	ME,SAF
4C	19	13	6	E,SAF,ME
98	29	13	22	EA,A
98	3	13	38	EA,A
10	18	14	26	E,EA,ME
37	3	14	58	H,EA
10	19	15	14	E,EA,ME
10	27	17	22	E,EA,ME
10	2	18	58	E,EA,ME
10	7	20	2	E,EA,ME
11	7	20	34	E,EA,ME
98	2	21	22	EA,A
10	4	21	38	E,EA,ME
BC	9	22	26	ME,SAF,E
10	24	22	42	E,EA,ME
10	5	23	14	E,EA,ME

TABLE 10. GPS SCHEDULE NO 29, 1997 OCTOBER 1 (CONT.)

*** Middle East ***

Class	PRN	Start h	Start m	Connects
18	25	0	2	ENA,WNA,E,SAM
54	25	0	50	E,SAM
4C	17	1	22	E,SAF,I
55	25	1	54	E,SAM,SAF
10	6	2	42	E,EA,I
4C	23	3	14	E,SAF,I
10	17	4	2	E,EA,I
4C	21	4	34	E,SAF,I
4C	22	5	6	E,SAF,SAM
10	23	5	54	E,EA,I
BC	1	6	10	SAF,I
10	21	6	58	E,EA,I
10	1	7	46	E,EA,I
4C	31	8	2	E,SAF
00	14	8	18	E,ENA,SAM
4C	29	8	34	E,SAF,I
4C	15	10	10	E,SAF,I
10	25	10	26	E,EA,I
54	18	10	42	E,SAM,SAF
48	14	11	30	E,I
60	18	12	2	ENA,E
BC	14	12	50	SAF,I
4C	19	13	6	E,SAF,I
54	24	13	22	E,SAM,ENA,WNA
BC	4	14	10	SAF,SAM
10	18	14	26	E,EA,I
10	19	15	14	E,EA,I
10	27	17	22	E,EA,I
10	2	18	58	E,EA,I
00	5	19	46	E,ENA,SAM
10	7	20	2	E,EA,I
11	7	20	34	E,EA,I
10	4	21	38	E,EA,I
CA	6	21	54	SAF,SAM
BC	9	22	26	SAF,I,E
10	24	22	42	E,EA,I
10	5	23	14	E,EA,I

*** South Africa ***

Class	PRN	Start h	Start m	Connects
CC	26	0	2	A
4C	17	1	22	E,ME,I
CC	9	1	38	A
55	25	1	54	E,SAM,ME
4C	23	3	14	E,ME,I
CC	30	4	18	A
4C	21	4	34	E,ME,I
4C	22	5	6	E,SAM,ME
CC	6	5	22	A,I
CD	6	5	54	A
BC	1	6	10	ME,I
4C	31	8	2	E,ME
4C	29	8	34	E,ME,I
CA	19	9	38	SAM
4C	15	10	10	E,ME,I
CC	3	10	26	A
54	18	10	42	E,SAM,ME
CC	31	12	18	A
CD	31	12	34	A
BC	14	12	50	ME,I
4C	19	13	6	E,ME,I
CC	15	13	54	A
BC	4	14	10	ME,SAM
CC	14	15	14	A
CC	16	16	50	A
CC	18	17	38	A
CD	18	17	54	A
CA	6	21	54	SAM,ME
BC	9	22	26	ME,I,E

*** South America ***

Class	PRN	Start h	Start m	Connects
18	25	0	2	ENA,WNA,E,ME
54	25	0	50	E,ME
55	25	1	54	E,ME,SAF
18	3	2	26	ENA,WNA,E
68	31	2	42	ENA,WNA
54	3	2	58	E,ENA,WNA
68	18	4	18	ENA,WNA
4C	22	5	6	E,SAF,ME
54	15	6	10	E,ENA,WNA
08	15	6	26	E,WNA,ENA
00	14	8	18	E,ENA,ME
00	16	9	6	E,ENA
18	4	9	22	ENA,WNA,H
CA	19	9	38	SAF
00	7	9	54	E,ENA,WNA
54	18	10	42	E,SAF,ME
54	24	13	22	E,ENA,WNA,ME
BC	4	14	10	ME,SAF
18	6	15	30	ENA,WNA,H
08	26	16	18	E,WNA,ENA
68	9	16	34	ENA
69	9	17	54	ENA,WNA
18	17	18	10	ENA,WNA
18	9	18	26	ENA,WNA,E
00	23	19	14	E,ENA,WNA
54	23	19	30	E,ENA,WNA
00	5	19	46	E,ENA,ME
19	25	20	34	ENA,WNA,H
00	30	21	6	E,ENA
CA	6	21	54	SAF,ME

TABLE 11. [TAI - GPS TIME] AND [UTC - GPS TIME]

(File available on http://www.bipm.fr under the name UTCGPS97.AR)

The GPS satellites disseminate a common time scale designated as 'GPS time'. The relation between GPS time and TAI is :

$$[TAI - GPS\ time] = 19\ \mathrm{s} + C_0,$$

where the time difference of 19 seconds is kept constant and C_0 is a quantity of order tens of nanoseconds, varying with time.

The relation between GPS time and UTC involves a variable number of seconds as a consequence of the leap seconds of the UTC system and is as follows :

from 1996 January 1, 0h UTC, until 1997 July 1, 0h UTC :

$$[UTC - GPS\ time] = -11\ \mathrm{s} + C_0.$$

from 1997 July 1, 0h UTC, until further notice :

$$[UTC - GPS\ time] = -12\ \mathrm{s} + C_0.$$

Here C_0 is given at 0h UTC every day.

C_0 is computed as follows: the GPS data taken at the Paris Observatory, from satellites with highest elevation, are first corrected for precise satellite ephemerides and for measured ionospheric delays, and then smoothed to obtain daily values of $[UTC(OP) - GPS\ time]$ at 0h UTC. Daily values of C_0 are derived from them using linear interpolation of $[UTC - UTC(OP)]$ from Table 9. The global uncertainty of daily C_0 values is of order 10 ns.

In the following tables, the standard deviation σ characterizes the dispersion of individual measurements, and N is the number of measurements used on a given day for estimation of the corresponding daily C_0 value.

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jan 1	50449	55	51	11
Jan 2	50450	51	37	9
Jan 3	50451	45	-	-
Jan 4	50452	40	56	11
Jan 5	50453	38	43	9
Jan 6	50454	41	49	10
Jan 7	50455	39	44	9
Jan 8	50456	37	46	9
Jan 9	50457	33	39	8
Jan 10	50458	27	44	9
Jan 11	50459	30	49	10
Jan 12	50460	39	38	8
Jan 13	50461	43	55	11
Jan 14	50462	42	56	11
Jan 15	50463	41	47	9
Jan 16	50464	39	55	11
Jan 17	50465	37	48	10
Jan 18	50466	39	32	6
Jan 19	50467	45	42	8
Jan 20	50468	41	43	9
Jan 21	50469	31	47	9
Jan 22	50470	30	40	8
Jan 23	50471	41	56	11
Jan 24	50472	46	35	7
Jan 25	50473	44	40	8
Jan 26	50474	42	49	10
Jan 27	50475	43	47	9
Jan 28	50476	41	56	11
Jan 29	50477	39	35	7
Jan 30	50478	39	49	10
Jan 31	50479	41	53	11

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Feb 1	50480	47	52	10
Feb 2	50481	46	43	9
Feb 3	50482	40	45	9
Feb 4	50483	33	52	10
Feb 5	50484	38	45	9
Feb 6	50485	44	45	9
Feb 7	50486	45	49	10
Feb 8	50487	46	49	10
Feb 9	50488	42	42	9
Feb 10	50489	39	35	7
Feb 11	50490	41	51	10
Feb 12	50491	45	47	9
Feb 13	50492	45	32	7
Feb 14	50493	43	48	10
Feb 15	50494	43	29	6
Feb 16	50495	42	45	9
Feb 17	50496	35	64	13
Feb 18	50497	35	48	10
Feb 19	50498	40	35	7
Feb 20	50499	43	54	11
Feb 21	50500	39	49	10
Feb 22	50501	30	43	9
Feb 23	50502	25	46	9
Feb 24	50503	30	56	17
Feb 25	50504	40	50	10
Feb 26	50505	41	32	6
Feb 27	50506	38	50	10
Feb 28	50507	42	41	8

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Mar 1	50508	46	53	11
Mar 2	50509	43	45	9
Mar 3	50510	38	45	9
Mar 4	50511	32	47	9
Mar 5	50512	25	42	8
Mar 6	50513	24	39	8
Mar 7	50514	25	43	9
Mar 8	50515	30	45	9
Mar 9	50516	29	45	10
Mar 10	50517	26	45	9
Mar 11	50518	26	36	7
Mar 12	50519	34	44	9
Mar 13	50520	40	47	9
Mar 14	50521	38	32	6
Mar 15	50522	36	43	9
Mar 16	50523	41	44	9
Mar 17	50524	43	43	10
Mar 18	50525	39	47	9
Mar 19	50526	40	38	8
Mar 20	50527	45	51	11
Mar 21	50528	45	44	9
Mar 22	50529	37	53	11
Mar 23	50530	32	40	8
Mar 24	50531	31	46	9
Mar 25	50532	31	53	11
Mar 26	50533	26	59	12
Mar 27	50534	16	47	10
Mar 28	50535	15	52	10
Mar 29	50536	20	52	10
Mar 30	50537	28	41	8
Mar 31	50538	30	40	8

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Apr 1	50539	30	57	11
Apr 2	50540	26	55	11
Apr 3	50541	28	38	8
Apr 4	50542	37	35	7
Apr 5	50543	42	53	11
Apr 6	50544	42	33	7
Apr 7	50545	43	41	8
Apr 8	50546	36	45	9
Apr 9	50547	28	37	7
Apr 10	50548	24	42	8
Apr 11	50549	27	43	9
Apr 12	50550	27	47	9
Apr 13	50551	24	40	8
Apr 14	50552	24	41	8
Apr 15	50553	27	43	9
Apr 16	50554	26	47	10
Apr 17	50555	30	37	7
Apr 18	50556	36	49	10
Apr 19	50557	36	39	8
Apr 20	50558	30	37	7
Apr 21	50559	25	51	10
Apr 22	50560	28	44	9
Apr 23	50561	38	50	10
Apr 24	50562	42	45	9
Apr 25	50563	42	43	9
Apr 26	50564	37	48	10
Apr 27	50565	31	32	6
Apr 28	50566	30	38	8
Apr 29	50567	35	45	9
Apr 30	50568	35	47	10

Table 11. (Cont.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
May 1	50569	30	46	10
May 2	50570	24	55	11
May 3	50571	21	43	9
May 4	50572	21	50	10
May 5	50573	22	44	9
May 6	50574	21	44	9
May 7	50575	26	46	9
May 8	50576	31	42	8
May 9	50577	34	43	9
May 10	50578	32	51	10
May 11	50579	27	50	10
May 12	50580	30	46	9
May 13	50581	44	43	9
May 14	50582	49	43	9
May 15	50583	49	35	7
May 16	50584	52	40	8
May 17	50585	50	37	7
May 18	50586	44	45	9
May 19	50587	42	41	8
May 20	50588	42	63	13
May 21	50589	41	47	10
May 22	50590	40	34	7
May 23	50591	42	43	9
May 24	50592	34	50	10
May 25	50593	23	51	10
May 26	50594	16	33	7
May 27	50595	19	48	10
May 28	50596	27	51	10
May 29	50597	36	49	10
May 30	50598	37	51	10
May 31	50599	31	47	9

Table 11. (Cont.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jun 1	50600	21	56	11
Jun 2	50601	17	50	10
Jun 3	50602	26	41	8
Jun 4	50603	33	37	7
Jun 5	50604	32	35	7
Jun 6	50605	32	46	9
Jun 7	50606	36	35	7
Jun 8	50607	42	50	10
Jun 9	50608	38	50	10
Jun 10	50609	32	50	12
Jun 11	50610	33	30	7
Jun 12	50611	32	37	9
Jun 13	50612	31	42	8
Jun 14	50613	32	36	7
Jun 15	50614	25	39	8
Jun 16	50615	17	36	7
Jun 17	50616	15	41	8
Jun 18	50617	15	49	10
Jun 19	50618	11	34	7
Jun 20	50619	10	43	9
Jun 21	50620	17	50	10
Jun 22	50621	25	56	11
Jun 23	50622	26	49	10
Jun 24	50623	24	30	6
Jun 25	50624	21	42	8
Jun 26	50625	23	38	8
Jun 27	50626	26	45	9
Jun 28	50627	28	43	9
Jun 29	50628	35	52	10
Jun 30	50629	40	49	10

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jul 1	50630	35	36	9
Jul 2	50631	32	44	9
Jul 3	50632	36	41	8
Jul 4	50633	32	45	9
Jul 5	50634	24	45	9
Jul 6	50635	24	50	10
Jul 7	50636	25	51	11
Jul 8	50637	22	49	10
Jul 9	50638	22	37	8
Jul 10	50639	24	49	11
Jul 11	50640	21	44	9
Jul 12	50641	16	44	9
Jul 13	50642	9	32	6
Jul 14	50643	11	41	8
Jul 15	50644	18	39	8
Jul 16	50645	22	41	8
Jul 17	50646	25	36	7
Jul 18	50647	27	48	10
Jul 19	50648	28	42	8
Jul 20	50649	27	37	7
Jul 21	50650	28	47	9
Jul 22	50651	30	43	9
Jul 23	50652	21	43	9
Jul 24	50653	7	50	10
Jul 25	50654	2	49	10
Jul 26	50655	4	47	9
Jul 27	50656	12	38	8
Jul 28	50657	15	65	13
Jul 29	50658	19	51	11
Jul 30	50659	20	40	9
Jul 31	50660	19	45	12

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Aug 1	50661	18	51	11
Aug 2	50662	17	57	12
Aug 3	50663	19	50	11
Aug 4	50664	21	30	7
Aug 5	50665	20	55	13
Aug 6	50666	20	41	9
Aug 7	50667	19	52	11
Aug 8	50668	20	51	11
Aug 9	50669	24	48	10
Aug 10	50670	30	-	-
Aug 11	50671	31	35	10
Aug 12	50672	24	51	12
Aug 13	50673	20	52	16
Aug 14	50674	23	43	10
Aug 15	50675	25	43	10
Aug 16	50676	26	44	10
Aug 17	50677	29	42	10
Aug 18	50678	27	53	12
Aug 19	50679	17	48	11
Aug 20	50680	10	32	8
Aug 21	50681	9	38	9
Aug 22	50682	13	49	13
Aug 23	50683	15	40	10
Aug 24	50684	15	45	11
Aug 25	50685	20	50	12
Aug 26	50686	24	42	10
Aug 27	50687	23	37	8
Aug 28	50688	22	49	11
Aug 29	50689	25	53	12
Aug 30	50690	20	37	8
Aug 31	50691	16	55	13

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Sep 1	50692	21	47	14
Sep 2	50693	20	47	11
Sep 3	50694	21	42	9
Sep 4	50695	25	45	10
Sep 5	50696	22	53	12
Sep 6	50697	18	45	10
Sep 7	50698	17	35	8
Sep 8	50699	15	61	13
Sep 9	50700	7	45	9
Sep 10	50701	-3	57	12
Sep 11	50702	1	31	7
Sep 12	50703	13	46	10
Sep 13	50704	14	46	10
Sep 14	50705	4	38	8
Sep 15	50706	0	48	10
Sep 16	50707	2	39	8
Sep 17	50708	4	39	9
Sep 18	50709	6	42	10
Sep 19	50710	14	41	10
Sep 20	50711	25	34	9
Sep 21	50712	31	48	12
Sep 22	50713	31	59	15
Sep 23	50714	25	27	7
Sep 24	50715	15	24	7
Sep 25	50716	13	61	17
Sep 26	50717	23	53	15
Sep 27	50718	30	60	18
Sep 28	50719	20	41	11
Sep 29	50720	6	39	13
Sep 30	50721	12	-	-

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Oct 1	50722	17	41	7
Oct 2	50723	6	39	8
Oct 3	50724	4	43	8
Oct 4	50725	9	41	8
Oct 5	50726	15	44	8
Oct 6	50727	14	38	7
Oct 7	50728	10	39	7
Oct 8	50729	10	39	7
Oct 9	50730	14	33	6
Oct 10	50731	12	43	8
Oct 11	50732	8	32	6
Oct 12	50733	11	36	7
Oct 13	50734	19	45	8
Oct 14	50735	21	40	7
Oct 15	50736	17	45	8
Oct 16	50737	12	46	9
Oct 17	50738	13	44	8
Oct 18	50739	20	38	7
Oct 19	50740	23	33	6
Oct 20	50741	22	48	9
Oct 21	50742	14	32	6
Oct 22	50743	14	30	6
Oct 23	50744	19	27	5
Oct 24	50745	25	30	6
Oct 25	50746	24	37	7
Oct 26	50747	18	35	7
Oct 27	50748	10	40	7
Oct 28	50749	1	38	7
Oct 29	50750	-1	40	8
Oct 30	50751	4	41	8
Oct 31	50752	14	49	9

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Nov 1	50753	14	49	9
Nov 2	50754	7	35	6
Nov 3	50755	4	42	8
Nov 4	50756	8	42	8
Nov 5	50757	13	41	8
Nov 6	50758	10	35	6
Nov 7	50759	3	39	9
Nov 8	50760	-1	47	9
Nov 9	50761	-8	49	9
Nov 10	50762	-10	37	7
Nov 11	50763	-1	47	9
Nov 12	50764	8	50	9
Nov 13	50765	5	58	11
Nov 14	50766	-1	50	11
Nov 15	50767	-5	38	7
Nov 16	50768	-4	42	8
Nov 17	50769	-2	49	9
Nov 18	50770	0	42	8
Nov 19	50771	1	47	9
Nov 20	50772	1	43	8
Nov 21	50773	0	39	7
Nov 22	50774	0	39	7
Nov 23	50775	0	45	8
Nov 24	50776	2	42	8
Nov 25	50777	5	40	7
Nov 26	50778	5	39	7
Nov 27	50779	0	45	8
Nov 28	50780	-9	30	8
Nov 29	50781	-13	45	8
Nov 30	50782	-12	46	8

TABLE 11. (CONT.)

Date 1997 0h UTC	MJD	C_0 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Dec 1	50783	-5	48	9
Dec 2	50784	-1	50	9
Dec 3	50785	-3	45	8
Dec 4	50786	-6	50	9
Dec 5	50787	-4	38	8
Dec 6	50788	-4	46	8
Dec 7	50789	-8	43	8
Dec 8	50790	-11	51	9
Dec 9	50791	-10	39	9
Dec 10	50792	-4	41	7
Dec 11	50793	-1	46	8
Dec 12	50794	-2	45	8
Dec 13	50795	-3	36	7
Dec 14	50796	-4	42	8
Dec 15	50797	-11	51	9
Dec 16	50798	-17	48	9
Dec 17	50799	-16	38	7
Dec 18	50800	-6	38	7
Dec 19	50801	8	49	9
Dec 20	50802	12	49	9
Dec 21	50803	7	51	9
Dec 22	50804	-2	49	9
Dec 23	50805	-6	52	14
Dec 24	50806	-	-	-
Dec 25	50807	0	35	11
Dec 26	50808	5	66	12
Dec 27	50809	0	43	8
Dec 28	50810	-11	52	23
Dec 29	50811	-15	47	11
Dec 30	50812	-9	47	9
Dec 31	50813	-4	41	8

TABLE 12. INTERNATIONAL GLONASS TRACKING SCHEDULE NO 4 FOR MJD = 50722 (1997 OCTOBER 1) AT 0H UTC

This is a suggested tracking schedule for international time comparisons using GLONASS satellites in common-view between ten areas of the globe.

Area		Participating laboratories
Europe	E	BIPM, DLR, LDS, SU, VSL, RIRT*
East North America	ENA	USNO
West North America	WNA	NIST, 3S Navigation*
East Asia	EA	BIRM, CRL
Australia and New Zealand	A	
India	I	
Middle East	ME	
South Africa	SAF	
South America	SAM	

* RIRT : Russian Institute of Radionavigation and Time, St Petersbourg, Russia.
3S Navigation, Irvine, California.

Other laboratories are designated by their usual acronyms.

The start times of the tracks are referenced to UTC. The start time of a track is the date of the first observation. The receiver is required to lock-on to the signal in advance of this time so the first observation is made at the indicated time. The track length is 780 s. All the track times should be decremented by 4 minutes each day. Slot number should be increased by 1 each day, within each of 3 orbital planes. This is due to the motion of GLONASS satellites within the orbital planes. Each of these planes contains 8 almanac slots (plane 1: slots 1 to 8, plane 2: slots 9 to 16, plane 3: slots 17 to 24).

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** Europe ***

Start h m	Channel 1 Class	Slot	Connects	Channel 2 Class	Slot	Connects
00 02	09	11	WNA,ENA	10	19	EA,I,ME
00 18	08	11	WNA,ENA	49	19	EA,I,ME
00 34	08	21	WNA,ENA,SAM	10	4	EA,I,ME
00 50	54	10	ENA,ME,SAF,SAM	48	20	I,ME
01 06	01	21	WNA,ENA,ME,SAM	40	4	EA,I,ME
01 22	30	12	WNA,ENA,H	41	6	I,ME
01 38	01	12	WNA,ENA	40	20	EA,I,ME
01 54	00	12	WNA,ENA	10	20	EA,I,ME
02 10	08	12	WNA,ENA	40	5	EA,I,ME
02 26	48	5	EA,I,ME	02	21	ENA
02 42	01	22	WNA,ENA	10	5	EA,I,ME
02 58	08	22	WNA,ENA	11	20	EA,I,ME,SAF
03 14	00	13	WNA,ENA,H	00	22	WNA,ENA,ME
03 30	08	13	WNA,ENA,H	48	7	ME
03 46	30	13	WNA,ENA,H	40	6	EA,I,ME
04 02	48	22	ENA,I,ME	48	21	ME,SAF
04 18	09	23	WNA,ENA	48	6	EA,I,ME
04 34	08	23	WNA,ENA	10	6	EA,I,ME
04 50	01	23	WNA,ENA,ME	11	6	EA,I,ME
05 06	00	23	WNA,ENA,ME	4C	8	ME,SAF,SAM
05 22	40	7	I,ME	40	22	I,ME,SAF
05 38	E4	7	E	48	23	ME
05 54	4C	1	ENA,SAF,SAM	48	23	ME
06 10	00	8	ENA,ME	10	16	EA,H,I
06 26	08	24	WNA,ENA	10	7	EA,I,ME
06 42	48	24	WNA,ENA,ME	11	7	EA,I,ME
06 58	00	24	WNA,ENA,ME	48	8	ENA,I,ME
07 14	00	1	ENA,ME,SAM	4C	23	ME,SAF,SAM
07 30	30	17	WNA,ENA,H	10	9	EA,I,ME
07 46	01	17	WNA,ENA	40	8	EA,I,ME
08 02	54	23	ME,SAF,SAM	10	8	EA,I,ME
08 18	08	17	WNA,ENA	44	9	I
08 34	10	10	EA,I,ME	48	1	ENA,I,ME
08 50	08	2	WNA,ENA,SAM	00	17	WNA,ENA,ME,SAM
09 06	54	24	ENA,ME,SAM	41	11	I,ME
09 22	00	2	WNA,ENA,ME	30	18	WNA,ENA,H
09 38	48	12	I,ME,SAF	40	10	I,ME
09 54	00	18	WNA,ENA	54	3	WNA,ENA,SAM
10 10	10	1	EA,I,ME	40	11	EA,I,ME
10 26	08	18	WNA,ENA,SAM	48	11	EA,I,ME
10 42	08	3	WNA,ENA	10	11	EA,I,ME
10 58	08	19	WNA,ENA,H	40	1	I,ME,SAF
11 14	00	19	WNA,ENA,H	00	3	WNA,ENA,ME
11 30	01	3	WNA,ENA,ME	11	11	EA,I,ME
11 46	30	19	WNA,ENA,H	48	2	ME,SAF

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** Europe ***

Start h m	Channel 1 Class	Slot	Connects	Channel 2 Class	Slot	Connects
12 02	30	4	WNA,ENA,H	40	12	EA,I,ME
12 18	4C	14	ME,SAF,SAM	48	3	ENA,I,ME
12 34	08	4	WNA,ENA	10	12	EA,I,ME
12 50	48	13	ENA,I,ME	40	2	I,ME,SAF
13 06	00	4	WNA,ENA,ME	48	14	ENA,ME,SAF,SAM
13 22	40	3	I,ME	41	13	EA,I,ME
13 38	30	5	WNA,ENA,H	40	13	EA,I,ME
13 54	00	14	ENA,ME	4C	3	I,ME,SAF
14 10	09	5	WNA,ENA	10	13	EA,I,ME
14 26	08	5	WNA,ENA	11	13	EA,I,ME
14 42	01	5	WNA,ENA,ME	49	13	EA,I,ME
14 58	00	5	WNA,ENA,ME	41	14	I
15 14	00	15	ENA,ME,SAM	10	23	EA,I,ME
15 30	48	4	ME,SAF,SAM	30	6	WNA,ENA,H
15 46	09	6	WNA,ENA,H	40	14	EA,I,ME
16 02	10	14	EA,I,ME	54	5	ENA,ME,SAM
16 18	08	6	WNA,ENA	30	23	EA,H,I
16 34	54	16	WNA,ENA,SAM	10	24	EA,I,ME
16 50	08	16	WNA,ENA,SAM	00	6	WNA,ENA,ME,SAM
17 06	4C	5	ENA,ME,SAF,SAM	48	17	I,ME,SAF
17 22	00	16	WNA,ENA,ME	30	7	WNA,ENA,H
17 38	10	15	EA,I,ME	01	6	WNA,ENA
17 54	00	7	WNA,ENA	54	9	WNA,ENA,SAM
18 10	48	16	ENA,I,ME	48	18	I,ME,SAF
18 26	08	7	WNA,ENA,SAM	40	17	EA,I,ME
18 42	08	9	WNA,ENA	10	17	EA,I,ME
18 58	08	8	WNA,ENA,H	40	15	EA,I,ME,SAF
19 14	00	9	WNA,ENA,ME	4C	19	ME,SAF,SAM
19 30	30	8	WNA,ENA,H	11	17	EA,I
19 46	01	8	WNA,ENA,H	40	16	I,ME
20 02	30	10	WNA,ENA,H	40	18	EA,I,ME
20 18	48	9	ENA,I,ME	4C	20	ME,SAF,SAM
20 34	08	10	WNA,ENA	10	18	EA,I,ME
20 50	48	19	ENA,I,ME	41	16	I,ME
21 06	00	10	WNA,ENA,ME	54	20	ENA,ME,SAF,SAM
21 22	40	9	I,ME,SAF	41	19	EA,I,ME
21 38	30	11	WNA,ENA,H	40	19	EA,I,ME
21 54	48	10	ENA,ME	01	20	ENA,ME
22 10	02	11	WNA,ENA	11	19	EA,I,ME
22 26	30	3	EA,H,I	54	21	ENA,SAM
22 42	01	11	WNA,ENA,ME	12	19	EA,I,ME
22 58	00	11	WNA,ENA,ME	41	20	I
23 14	00	21	ENA,ME,SAM	11	5	EA,I,ME,SAF
23 30	4C	10	ME,SAF,SAM	09	12	WNA,ENA,H

Table 12. GLONASS Schedule no 4, 1997 October 1 (Cont.)

*** E. North America ***

Start h m	Channel 1 Class	Channel 1 Slot	Channel 1 Connects	Channel 2 Class	Channel 2 Slot	Channel 2 Connects
00 02	09	11	WNA,E	33	1	H
00 18	08	11	WNA,E	68	10	SAM
00 34	08	21	WNA,E,SAM	18	12	WNA,EA,H
00 50	54	10	E,ME,SAF,SAM	1A	2	WNA
01 06	01	21	WNA,E,ME,SAM	E7	11	ENA
01 22	30	12	WNA,E,H	68	23	SAM
01 38	01	12	WNA,E	20	13	WNA,EA,H
01 54	00	12	WNA,E	18	22	WNA,SAM
02 10	08	12	WNA,E	58	21	I,ME
02 26	32	23	WNA,H,SAM	02	21	E
02 42	01	22	WNA,E	32	13	H
02 58	08	22	WNA,E	18	23	WNA,H,SAM
03 14	00	13	WNA,E,H	00	22	WNA,E,ME
03 30	08	13	WNA,E,H	E7	12	ENA
03 46	30	13	WNA,E,H	5C	24	ENA
04 02	48	22	E,I,ME	20	14	WNA,EA,H
04 18	09	23	WNA,E	18	13	WNA,SAM
04 34	08	23	WNA,E	32	14	WNA,H
04 50	01	23	WNA,E,ME	E7	7	ENA
05 06	00	23	WNA,E,ME	18	24	WNA,H
05 22	20	15	WNA,EA,H	18	14	WNA,H
05 38	18	15	WNA	19	14	WNA
05 54	4C	1	E,SAF,SAM	19	15	WNA,EA,H
06 10	00	8	E,ME	68	13	WNA,SAM
06 26	08	24	WNA,E	18	15	WNA,H
06 42	48	24	WNA,E,ME	69	23	SAF,SAM
06 58	00	24	WNA,E,ME	48	8	E,I,ME
07 14	00	1	E,ME,SAM	20	16	WNA,EA,H
07 30	30	17	WNA,E,H	32	15	WNA,H
07 46	01	17	WNA,E	68	24	SAM
08 02	68	2	WNA,SAM	32	16	H
08 18	08	17	WNA,E	18	18	WNA,EA,H
08 34	18	16	WNA,H	48	1	E,I,ME
08 50	08	2	WNA,E,SAM	00	17	WNA,E,ME,SAM
09 06	54	24	E,ME,SAM	18	3	WNA
09 22	00	2	WNA,E,ME	30	18	WNA,E,H
09 38	20	19	WNA,EA,H	68	17	SAM
09 54	00	18	WNA,E	54	3	WNA,E,SAM
10 10	68	4	WNA,H,SAM	E7	2	ENA
10 26	08	18	WNA,E,SAM	58	2	I,ME
10 42	08	3	WNA,E	32	4	H,SAM
10 58	08	19	WNA,E,H	68	18	SAM
11 14	00	19	WNA,E,H	00	3	WNA,E,ME
11 30	01	3	WNA,E,ME	20	20	WNA,EA,H
11 46	30	19	WNA,E,H	18	4	WNA,H

Table 12. GLONASS Schedule no 4, 1997 October 1 (Cont.)

*** E. North America ***

Start h m	Channel 1 Class	Channel 1 Slot	Channel 1 Connects	Channel 2 Class	Channel 2 Slot	Channel 2 Connects
12 02	30	4	WNA,E,H	E7	5	ENA
12 18	32	5	WNA,H	48	3	E,I,ME
12 34	08	4	WNA,E	19	20	WNA
12 50	48	13	E,I,ME	18	19	WNA,SAM
13 06	00	4	WNA,E,ME	48	14	E,ME,SAF,SAM
13 22	18	5	WNA,H	18	20	WNA
13 38	30	5	WNA,E,H	68	19	SAM
13 54	00	14	E,ME	20	21	WNA,EA,H
14 10	09	5	WNA,E	32	20	H,SAM
14 26	08	5	WNA,E	E7	15	ENA
14 42	01	5	WNA,E,ME	E7	14	ENA
14 58	00	5	WNA,E,ME	18	21	WNA,H
15 14	00	15	E,ME,SAM	68	20	WNA,H,SAM
15 30	20	22	WNA,EA	30	6	WNA,E,H
15 46	09	6	WNA,E,H	60	5	ME,SAM
16 02	18	7	WNA,EA,H	54	5	E,ME,SAM
16 18	08	6	WNA,E	58	15	I,ME
16 34	54	16	WNA,E,SAM	32	22	WNA,H
16 50	08	16	WNA,E,SAM	00	6	WNA,E,ME,SAM
17 06	4C	5	E,ME,SAF,SAM	68	9	SAM
17 22	00	16	WNA,E,ME	30	7	WNA,E,H
17 38	19	10	WNA	01	6	WNA,E
17 54	00	7	WNA,E	54	9	WNA,E,SAM
18 10	48	16	E,I,ME	20	8	WNA,EA,H
18 26	08	7	WNA,E,SAM	32	10	H
18 42	08	9	WNA,E	E7	6	ENA
18 58	08	8	WNA,E,H	68	6	SAM
19 14	00	9	WNA,E,ME	18	10	WNA,H,SAM
19 30	30	8	WNA,E,H	68	7	SAM
19 46	01	8	WNA,E,H	20	1	WNA,EA
20 02	30	10	WNA,E,H	E7	9	ENA
20 18	48	9	E,I,ME	32	11	WNA,H
20 34	08	10	WNA,E	32	1	WNA,H
20 50	48	19	E,I,ME	18	8	WNA,SAM
21 06	00	10	WNA,E,ME	54	20	E,ME,SAF,SAM
21 22	18	1	WNA,H	18	11	WNA,H
21 38	30	11	WNA,E,H	68	21	SAF,SAM
21 54	48	10	E,ME	01	20	E,ME
22 10	02	11	WNA,E	5C	1	SAM
22 26	68	1	WNA,H,SAM	54	21	E,SAM
22 42	01	11	WNA,E,ME	69	10	SAF,SAM
22 58	00	11	WNA,E,ME	18	2	WNA
23 14	00	21	E,ME,SAM	19	1	WNA,H,SAM
23 30	20	3	WNA,EA,H	09	12	WNA,E,H

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** W. North America ***

Start	Channel 1			Channel 2		
	Class	Slot	Connects	Class	Slot	Connects
h m						
00 02	09	11	ENA,E	28	12	EA,H
00 18	08	11	ENA,E	6C	3	H,I
00 34	08	21	ENA,E,SAM	18	12	ENA,EA,H
00 50	28	13	EA,H	1A	2	ENA
01 06	01	21	ENA,E,ME,SAM	29	3	EA,H
01 22	30	12	ENA,E,H	28	3	EA
01 38	01	12	ENA,E	20	13	ENA,EA,H
01 54	00	12	ENA,E	18	22	ENA,SAM
02 10	08	12	ENA,E	34	3	EA,H
02 26	32	23	ENA,H,SAM	EA	13	WNA
02 42	01	22	ENA,E	28	4	EA,H
02 58	08	22	ENA,E	18	23	ENA,H,SAM
03 14	00	13	ENA,E,H	00	22	ENA,E,ME
03 30	08	13	ENA,E,H	29	4	EA
03 46	30	13	ENA,E,H	28	14	EA,H
04 02	34	24	H	20	14	ENA,EA,H
04 18	09	23	ENA,E	18	13	ENA,SAM
04 34	08	23	ENA,E	32	14	ENA,H
04 50	01	23	ENA,E,ME	28	15	EA,H,I
05 06	00	23	ENA,E,ME	18	24	ENA,H
05 22	20	15	ENA,EA,H	18	14	ENA,H
05 38	18	15	ENA	19	14	ENA
05 54	34	18	H,A	19	15	ENA,EA,H
06 10	80	18	A	68	13	ENA,SAM
06 26	08	24	ENA,E	18	15	ENA,H
06 42	48	24	ENA,E,ME	34	16	EA,H,I
06 58	00	24	ENA,E,ME	EA	18	WNA
07 14	34	14	H	20	16	ENA,EA,H
07 30	30	17	ENA,E,H	32	15	ENA,H
07 46	01	17	ENA,E	28	16	EA,H
08 02	68	2	ENA,SAM	34	19	EA,H,A
08 18	08	17	ENA,E	18	18	ENA,EA,H
08 34	18	16	ENA,H	29	9	EA,H
08 50	08	2	ENA,E,SAM	00	17	ENA,E,ME,SAM
09 06	28	19	EA,H	18	3	ENA
09 22	00	2	ENA,E,ME	30	18	ENA,E,H
09 38	20	19	ENA,EA,H	28	9	EA,H
09 54	00	18	ENA,E	54	3	ENA,E,SAM
10 10	68	4	ENA,H,SAM	80	16	H,A
10 26	08	18	ENA,E,SAM	34	9	EA,H
10 42	08	3	ENA,E	28	10	EA,H
10 58	08	19	ENA,E,H	28	20	EA,H
11 14	00	19	ENA,E,H	00	3	ENA,E,ME
11 30	01	3	ENA,E,ME	20	20	ENA,EA,H
11 46	30	19	ENA,E,H	18	4	ENA,H

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** W. North America ***

Start	Channel 1			Channel 2		
	Class	Slot	Connects	Class	Slot	Connects
h m						
12 02	30	4	ENA,E,H	34	20	EA,H
12 18	32	5	ENA,H	EA	19	WNA
12 34	08	4	ENA,E	19	20	ENA
12 50	29	21	EA,H	18	19	ENA,SAM
13 06	00	4	ENA,E,ME	34	6	H
13 22	18	5	ENA,H	18	20	ENA
13 38	30	5	ENA,E,H	28	21	EA,H
13 54	EA	6	WNA	20	21	ENA,EA,H
14 10	09	5	ENA,E	34	21	EA,H
14 26	08	5	ENA,E	80	7	H,A
14 42	01	5	ENA,E,ME	6C	22	EA,H,I
14 58	00	5	ENA,E,ME	18	21	ENA,H
15 14	34	7	H	68	20	ENA,H,SAM
15 30	20	22	ENA,EA	30	6	ENA,E,H
15 46	09	6	ENA,E,H	28	22	EA,H
16 02	18	7	ENA,EA,H	80	8	H,A
16 18	08	6	ENA,E	34	8	EA,H,A
16 34	54	16	ENA,E,SAM	32	22	ENA,H
16 50	08	16	ENA,E,SAM	00	6	ENA,E,ME,SAM
17 06	28	8	EA,H	28	23	EA,H
17 22	00	16	ENA,E,ME	30	7	ENA,E,H
17 38	19	10	ENA	01	6	ENA,E
17 54	00	7	ENA,E	54	9	ENA,E,SAM
18 10	34	22	H,A	20	8	ENA,EA,H
18 26	08	7	ENA,E,SAM	34	23	EA,H
18 42	08	9	ENA,E	28	24	EA
18 58	08	8	ENA,E,H	80	23	H,A
19 14	00	9	ENA,E,ME	18	10	ENA,H,SAM
19 30	30	8	ENA,E,H	28	1	EA,H
19 46	01	8	ENA,E,H	20	1	ENA,EA
20 02	30	10	ENA,E,H	34	1	EA,H
20 18	7C	8	SAM	32	11	ENA,H
20 34	08	10	ENA,E	32	1	ENA,H
20 50	35	12	H	18	8	ENA,SAM
21 06	00	10	ENA,E,ME	34	2	EA,H
21 22	18	1	ENA,H	18	11	ENA,H
21 38	30	11	ENA,E,H	28	2	EA,H
21 54	80	13	H,A	34	12	H
22 10	02	11	ENA,E	34	13	H,A
22 26	68	1	ENA,H,SAM	EA	12	WNA
22 42	01	11	ENA,E,ME	35	3	EA,H,I
22 58	00	11	ENA,E,ME	18	2	ENA
23 14	35	12	H	19	1	ENA,H,SAM
23 30	20	3	ENA,EA,H	09	12	ENA,E,H

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** East Asia ***

Start		Channel 1			Channel 2	
h m	Class	Slot	Connects	Class	Slot	Connects
00 02	28	12	WNA,H	10	19	E,I,ME
00 18	36	13	H,A	49	19	E,I,ME
00 34	18	12	WNA,ENA,H	10	4	E,I,ME
00 50	28	13	WNA,H	98	14	H,A
01 06	29	3	WNA,H	40	4	E,I,ME
01 22	36	14	H,A	28	3	WNA
01 38	20	13	WNA,ENA,H	40	20	E,I,ME
01 54	37	4	H	10	20	E,I,ME
02 10	34	3	WNA,H	40	5	E,I,ME
02 26	48	5	E,I,ME	84	19	A,I,SAF
02 42	28	4	WNA,H	10	5	E,I,ME
02 58	36	15	H,A,I	11	20	E,I,ME,SAF
03 14	98	16	A,I	84	5	I,ME
03 30	84	15	I	29	4	WNA
03 46	28	14	WNA,H	40	6	E,I,ME
04 02	84	16	A,I	20	14	WNA,ENA,H
04 18	36	4	H,A	48	6	E,I,ME
04 34	98	4	H,A	10	6	E,I,ME
04 50	28	15	WNA,H,I	11	6	E,I,ME
05 06	98	9	A,I	36	5	H,A,I
05 22	20	15	WNA,ENA,H	EE	6	EA
05 38	ED	9	EA	ED	15	EA
05 54	84	9	I,ME	19	15	WNA,ENA,H
06 10	98	5	H,A	10	16	E,H,I
06 26	ED	6	EA	10	7	E,I,ME
06 42	34	16	WNA,H,I	11	7	E,I,ME
06 58	90	10	I,SAF	ED	9	EA
07 14	ED	18	EA	20	16	WNA,ENA,H
07 30	84	6	A,I	10	9	E,I,ME
07 46	28	16	WNA,H	40	8	E,I,ME
08 02	34	19	WNA,H,A	10	8	E,I,ME
08 18	36	19	H,A	18	18	WNA,ENA,H
08 34	10	10	E,I,ME	29	9	WNA,H
08 50	84	7	A,I	84	8	I
09 06	28	19	WNA,H	98	20	H,A
09 22	36	20	H,A	84	10	I,ME
09 38	20	19	WNA,ENA,H	28	9	WNA,H
09 54	8C	8	I,ME,SAF	85	10	H,I
10 10	10	1	E,I,ME	40	11	E,I,ME
10 26	34	9	WNA,H	48	11	E,I,ME
10 42	28	10	WNA,H	10	11	E,I,ME
10 58	98	21	A,I	28	20	WNA,H
11 14	36	10	H	84	21	A,I
11 30	20	20	WNA,ENA,H	11	11	E,I,ME
11 46	98	22	A,I	84	11	I

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** East Asia ***

Start		Channel 1			Channel 2	
h m	Class	Slot	Connects	Class	Slot	Connects
12 02	34	20	WNA,H	40	12	E,I,ME
12 18	98	10	H,A	ED	21	EA
12 34	37	10	H,A	10	12	E,I,ME
12 50	29	21	WNA,H	36	11	H
13 06	98	23	A,I	84	22	I
13 22	37	11	H,A	41	13	E,I,ME
13 38	28	21	WNA,H	40	13	E,I,ME
13 54	98	11	H,A	20	21	WNA,ENA,H
14 10	34	21	WNA,H	10	13	E,I,ME
14 26	84	23	I,ME	11	13	E,I,ME
14 42	6C	22	WNA,H,I	49	13	E,I,ME
14 58	90	24	I,SAF	ED	23	EA
15 14	84	12	A,I	10	23	E,I,ME
15 30	20	22	WNA,ENA	84	13	I,ME
15 46	28	22	WNA,H	40	14	E,I,ME
16 02	10	14	E,I,ME	18	7	WNA,ENA,H
16 18	34	8	WNA,H,A	30	23	E,H,I
16 34	37	1	H,A	10	24	E,I,ME
16 50	98	13	A,I	8C	15	I,ME
17 06	28	8	WNA,H	28	23	WNA,H
17 22	98	1	H,A	84	14	I,ME
17 38	10	15	E,I,ME	36	1	H,A
17 54	84	24	H,I	36	8	H
18 10	98	2	A	20	8	WNA,ENA,H
18 26	34	23	WNA,H	40	17	E,I,ME
18 42	28	24	WNA	10	17	E,I,ME
18 58	85	2	A,I	40	15	E,I,ME,SAF
19 14	98	3	A,I	36	24	H
19 30	28	1	WNA,H	11	17	E,I
19 46	84	2	I	20	1	WNA,ENA
20 02	34	1	WNA,H	40	18	E,I,ME
20 18	84	3	A,I	98	24	H,A
20 34	36	17	H,I	10	18	E,I,ME
20 50	37	24	H,A	ED	4	EA
21 06	99	4	A,I	34	2	WNA,H
21 22	98	17	A	41	19	E,I,ME
21 38	28	2	WNA,H	40	19	E,I,ME
21 54	85	3	I	85	4	I
22 10	37	17	H,A	11	19	E,I,ME
22 26	30	3	E,H,I	84	18	I
22 42	35	3	WNA,H,I	12	19	E,I,ME
22 58	84	4	I	ED	5	EA
23 14	84	20	I	11	5	E,I,ME,SAF
23 30	20	3	WNA,ENA,H	98	18	A,I

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** Hawaii ***

Start h m	Channel 1 Class	Slot	Connects	Channel 2 Class	Slot	Connects
00 02	28	12	WNA,EA	33	1	ENA
00 18	36	13	EA,A	6C	3	WNA,I
00 34	F0	2	H	18	12	WNA,ENA,EA
00 50	28	13	WNA,EA	98	14	EA,A
01 06	F0	1	H	29	3	WNA,EA
01 22	30	12	WNA,ENA,E	36	14	EA,A
01 38	F0	2	H	20	13	WNA,ENA,EA
01 54	37	4	EA	3D	14	A
02 10	F0	13	H	34	3	WNA,EA
02 26	32	23	WNA,ENA,SAM	3C	2	A
02 42	28	4	WNA,EA	32	13	ENA
02 58	36	15	EA,A,I	18	23	WNA,ENA,SAM
03 14	00	13	WNA,ENA,E	F0	24	H
03 30	08	13	WNA,ENA,E	3C	3	A
03 46	30	13	WNA,ENA,E	28	14	WNA,EA
04 02	34	24	WNA	20	14	WNA,ENA,EA
04 18	36	4	EA,A	3D	3	A
04 34	98	4	EA,A	32	14	WNA,ENA
04 50	F0	5	H	28	15	WNA,EA,I
05 06	36	5	EA,A,I	18	24	WNA,ENA
05 22	20	15	WNA,ENA,EA	18	14	WNA,ENA
05 38	3C	18	A	F0	18	H
05 54	34	18	WNA,A	19	15	WNA,ENA,EA
06 10	98	5	EA,A	10	16	E,EA,I
06 26	F0	17	H	18	15	WNA,ENA
06 42	F0	18	H	34	16	WNA,EA,I
06 58	3B	14	SAM	3C	19	A
07 14	34	14	WNA	20	16	WNA,ENA,EA
07 30	30	17	WNA,ENA,E	32	15	WNA,ENA
07 46	F0	18	H	28	16	WNA,EA
08 02	34	19	WNA,EA,A	32	16	ENA
08 18	36	19	EA,A	18	18	WNA,ENA,EA
08 34	18	16	WNA,ENA	29	9	WNA,EA
08 50	F0	19	H	F0	15	H
09 06	28	19	WNA,EA	98	20	EA,A
09 22	36	20	EA,A	30	18	WNA,ENA,E
09 38	20	19	WNA,ENA,EA	28	9	WNA,EA
09 54	3C	20	A	85	10	EA,I
10 10	68	4	WNA,ENA,SAM	80	16	WNA,A
10 26	F0	19	H	34	9	WNA,EA
10 42	28	10	WNA,EA	32	4	ENA,SAM
10 58	08	19	WNA,ENA,E	28	20	WNA,EA
11 14	00	19	WNA,ENA,E	36	10	EA
11 30	38	21	I	20	20	WNA,ENA,EA
11 46	30	19	WNA,ENA,E	18	4	WNA,ENA

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** Hawaii ***

Start h m	Channel 1 Class	Slot	Connects	Channel 2 Class	Slot	Connects
12 02	30	4	WNA,ENA,E	34	20	WNA,EA
12 18	32	5	WNA,ENA	98	10	EA,A
12 34	37	10	EA,A	38	21	I
12 50	29	21	WNA,EA	36	11	EA
13 06	3C	7	A	34	6	WNA
13 22	18	5	WNA,ENA	37	11	EA,A
13 38	30	5	WNA,ENA,E	28	21	WNA,EA
13 54	98	11	EA,A	20	21	WNA,ENA,EA
14 10	34	21	WNA,EA	32	20	ENA,SAM
14 26	3B	20	SAM	80	7	WNA,A
14 42	F0	6	H	6C	22	WNA,EA,I
14 58	3B	20	SAM	18	21	WNA,ENA
15 14	34	7	WNA	68	20	WNA,ENA,SAM
15 30	3C	8	A	30	6	WNA,ENA,E
15 46	09	6	WNA,ENA,E	28	22	WNA,EA
16 02	18	7	WNA,ENA,EA	80	8	WNA,A
16 18	34	8	WNA,EA,A	30	23	E,EA,I
16 34	37	1	EA,A	32	22	WNA,ENA
16 50	F0	7	H	F0	21	H
17 06	28	8	WNA,EA	28	23	WNA,EA
17 22	98	1	EA,A	30	7	WNA,ENA,E
17 38	F0	23	H	36	1	EA,A
17 54	84	24	EA,I	36	8	EA
18 10	34	22	WNA,A	20	8	WNA,ENA,EA
18 26	34	23	WNA,EA	32	10	ENA
18 42	3B	10	SAM	3C	22	A
18 58	08	8	WNA,ENA,E	80	23	WNA,A
19 14	36	24	EA	18	10	WNA,ENA,SAM
19 30	30	8	WNA,ENA,E	28	1	WNA,EA
19 46	01	8	WNA,ENA,E	3C	23	A
20 02	30	10	WNA,ENA,E	34	1	WNA,EA
20 18	98	24	EA,A	32	11	WNA,ENA
20 34	36	17	EA,I	32	1	WNA,ENA
20 50	35	12	WNA	37	24	EA,A
21 06	F0	17	H	34	2	WNA,EA
21 22	18	1	WNA,ENA	18	11	WNA,ENA
21 38	30	11	WNA,ENA,E	28	2	WNA,EA
21 54	80	13	WNA,A	34	12	WNA
22 10	37	17	EA,A	34	13	WNA,A
22 26	30	3	E,EA,I	68	1	WNA,ENA,SAM
22 42	F0	2	H	35	3	WNA,EA,I
22 58	3B	1	SAM	3C	14	A
23 14	35	12	WNA	19	1	WNA,ENA,SAM
23 30	20	3	WNA,ENA,EA	09	12	WNA,ENA,E

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** Australia ***

Start h m	Channel 1 Class	Channel 1 Slot	Channel 1 Connects	Channel 2 Class	Channel 2 Slot	Channel 2 Connects
00 02	FA	17	A	FA	14	A
00 18	36	13	EA,H	FA	18	A
00 34	FA	17	A	FA	15	A
00 50	AC	18	I	98	14	EA,H
01 06	F9	15	A	FA	17	A
01 22	36	14	EA,H	CC	16	SAF
01 38	FA	18	A	FA	15	A
01 54	FA	2	A	3D	14	H
02 10	FA	15	A	FA	16	A
02 26	3C	2	H	84	19	EA,I,SAF
02 42	FA	3	A	CD	9	SAF
02 58	36	15	EA,H,I	F9	18	A
03 14	98	16	EA,I	FA	18	A
03 30	CC	19	SAF	3C	3	H
03 46	CC	9	SAF	FA	17	A
04 02	84	16	EA,I	FA	18	A
04 18	36	4	EA,H	3D	3	H
04 34	98	4	EA,H	AC	9	I,SAF
04 50	CC	10	SAF	FA	20	A
05 06	98	9	EA,I	36	5	EA,H,I
05 22	F9	4	A	F9	19	A
05 38	3C	18	H	CD	20	SAF
05 54	34	18	WNA,H	CC	20	SAF
06 10	80	18	WNA	98	5	EA,H
06 26	FA	5	A	FA	19	A
06 42	FA	6	A	FA	5	A
06 58	FA	5	A	3C	19	H
07 14	F9	5	A	CD	21	SAF
07 30	84	6	EA,I	FA	20	A
07 46	F9	20	A	FA	5	A
08 02	CC	21	SAF	34	19	WNA,EA,H
08 18	36	19	EA,H	FA	20	A
08 34	FA	6	A	FA	20	A
08 50	84	7	EA,I	F9	6	A
09 06	CC	22	SAF	98	20	EA,H
09 22	36	20	EA,H	AC	7	I
09 38	F9	21	A	FA	6	A
09 54	3C	20	H	FA	21	A
10 10	CD	22	SAF	80	16	WNA,H
10 26	F9	7	A	F9	22	A
10 42	FA	9	A	CC	8	SAF
10 58	98	21	EA,I	F9	16	A
11 14	FA	9	A	84	21	EA,I
11 30	CC	23	SAF	FA	8	A
11 46	98	22	EA,I	FA	6	A

*** Australia ***

Start h m	Channel 1 Class	Channel 1 Slot	Channel 1 Connects	Channel 2 Class	Channel 2 Slot	Channel 2 Connects
12 02	F9	9	A	FA	7	A
12 18	98	10	EA,H	AC	23	I,SAF
12 34	37	10	EA,H	FA	22	A
12 50	CC	24	SAF	FA	10	A
13 06	98	23	EA,I	3C	7	H
13 22	37	11	EA,H	CC	1	SAF
13 38	AC	24	I,SAF	F9	10	A
13 54	98	11	EA,H	FA	7	A
14 10	CD	1	SAF	F9	8	A
14 26	FA	11	A	80	7	WNA,H
14 42	FA	12	A	FA	11	A
14 58	F9	11	A	FA	1	A
15 14	84	12	EA,I	FA	11	A
15 30	3C	8	H	CC	2	SAF
15 46	F9	1	A	FA	11	A
16 02	FA	12	A	80	8	WNA,H
16 18	FA	13	A	34	8	WNA,EA,H
16 34	37	1	EA,H	FA	12	A
16 50	98	13	EA,I	F9	12	A
17 06	F9	2	A	FA	12	A
17 22	98	1	EA,H	AC	13	I
17 38	CC	3	SAF	36	1	EA,H
17 54	FA	2	A	FA	12	A
18 10	34	22	WNA,H	98	2	EA
18 26	F9	3	A	FA	13	A
18 42	AC	14	I,SAF	3C	22	H
18 58	85	2	EA,I	80	23	WNA,H
19 14	98	3	EA,I	F9	13	A
19 30	CC	14	SAF	FA	13	A
19 46	CC	4	SAF	3C	23	H
20 02	FA	12	A	FA	13	A
20 18	84	3	EA,I	98	24	EA,H
20 34	CD	4	SAF	FA	13	A
20 50	37	24	EA,H	CC	5	SAF
21 06	99	4	EA,I	CD	15	SAF
21 22	98	17	EA	FA	24	A
21 38	AC	5	I,SAF	F9	24	A
21 54	80	13	WNA,H	CC	15	SAF
22 10	37	17	EA,H	34	13	WNA,H
22 26	FA	17	A	FA	14	A
22 42	FA	18	A	FA	17	A
22 58	F9	17	A	3C	14	H
23 14	FA	17	A	CD	16	SAF
23 30	FA	15	A	98	18	EA,I

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** India ***

Start	Channel 1			Channel 2		
	Class	Slot	Connects	Class	Slot	Connects
h m						
00 02	A4	5	ME,SAF	10	19	E,EA,ME
00 18	6C	3	WNA,H	49	19	E,EA,ME
00 34	A1	20	ME	10	4	E,EA,ME
00 50	AC	18	A	48	20	E,ME
01 06	F1	19	I	40	4	E,EA,ME
01 22	A0	5	ME	41	6	E,ME
01 38	A1	5	ME	40	20	E,EA,ME
01 54	A0	6	ME,SAF	10	20	E,EA,ME
02 10	58	21	ENA,ME	40	5	E,EA,ME
02 26	48	5	E,EA,ME	84	19	EA,A,SAF
02 42	A0	20	ME,SAF	10	5	E,EA,ME
02 58	36	15	EA,H,A	11	20	E,EA,ME,SAF
03 14	98	16	EA,A	84	5	EA,ME
03 30	84	15	EA	A1	21	ME
03 46	A0	21	ME,SAF	40	6	E,EA,ME
04 02	48	22	ENA,E,ME	84	16	EA,A
04 18	A0	7	ME	48	6	E,EA,ME
04 34	AC	9	A,SAF	10	6	E,EA,ME
04 50	28	15	WNA,EA,H	11	6	E,EA,ME
05 06	98	9	EA,A	36	5	EA,H,A
05 22	40	7	E,ME	40	22	E,ME,SAF
05 38	A4	22	SAF	F1	6	I
05 54	84	9	EA,ME	F2	10	I
06 10	A0	23	ME	10	16	E,EA,H
06 26	A4	10	ME,SAF	10	7	E,EA,ME
06 42	34	16	WNA,EA,H	11	7	E,EA,ME
06 58	90	10	EA,SAF	48	8	ENA,E,ME
07 14	F2	11	I	F1	7	I
07 30	84	6	EA,A	10	9	E,EA,ME
07 46	A0	10	ME	40	8	E,EA,ME
08 02	F1	11	I	10	8	E,EA,ME
08 18	A0	1	ME	44	9	E
08 34	10	10	E,EA,ME	48	1	ENA,E,ME
08 50	84	7	EA,A	84	8	EA
09 06	F1	10	I	41	11	E,ME
09 22	AC	7	A	84	10	EA,ME
09 38	48	12	E,ME,SAF	40	10	E,ME
09 54	8C	8	EA,ME,SAF	85	10	EA,H
10 10	10	1	E,EA,ME	40	11	E,EA,ME
10 26	58	2	ENA,ME	48	11	E,EA,ME
10 42	A0	12	ME,SAF	10	11	E,EA,ME
10 58	98	21	EA,A	40	1	E,ME,SAF
11 14	A0	2	ME	84	21	EA,A
11 30	38	21	H	11	11	E,EA,ME
11 46	98	22	EA,A	84	11	EA

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** India ***

Start	Channel 1			Channel 2		
	Class	Slot	Connects	Class	Slot	Connects
h m						
12 02	A0	13	ME,SAF	40	12	E,EA,ME
12 18	AC	23	A,SAF	48	3	ENA,E,ME
12 34	38	21	H	10	12	E,EA,ME
12 50	48	13	ENA,E,ME	40	2	E,ME,SAF
13 06	98	23	EA,A	84	22	EA
13 22	40	3	E,ME	41	13	E,EA,ME
13 38	AC	24	A,SAF	40	13	E,EA,ME
13 54	F1	23	I	4C	3	E,ME,SAF
14 10	A0	4	ME	10	13	E,EA,ME
14 26	84	23	EA,ME	11	13	E,EA,ME
14 42	6C	22	WNA,EA,H	49	13	E,EA,ME
14 58	90	24	EA,SAF	41	14	E
15 14	84	12	EA,A	10	23	E,EA,ME
15 30	F1	24	I	84	13	EA,ME
15 46	A4	17	SAF	40	14	E,EA,ME
16 02	10	14	E,EA,ME	F2	23	I
16 18	58	15	ENA,ME	30	23	E,EA,H
16 34	A0	17	ME,SAF	10	24	E,EA,ME
16 50	98	13	EA,A	8C	15	EA,ME
17 06	F1	14	I	48	17	E,ME,SAF
17 22	AC	13	A	84	14	EA,ME
17 38	10	15	E,EA,ME	A0	24	ME
17 54	84	24	EA,H	A0	18	ME,SAF
18 10	48	16	ENA,E,ME	48	18	E,ME,SAF
18 26	A0	15	ME	40	17	E,EA,ME
18 42	AC	14	A,SAF	10	17	E,EA,ME
18 58	85	2	EA,A	40	15	E,EA,ME,SAF
19 14	98	3	EA,A	F1	16	I
19 30	A1	19	ME	11	17	E,EA
19 46	84	2	EA	40	16	E,ME
20 02	A4	15	ME,SAF	40	18	E,EA,ME
20 18	48	9	ENA,E,ME	84	3	EA,A
20 34	36	17	EA,H	10	18	E,EA,ME
20 50	48	19	ENA,E,ME	41	16	E,ME
21 06	99	4	EA,A	F1	9	I
21 22	40	9	E,ME,SAF	41	19	E,EA,ME
21 38	AC	5	A,SAF	40	19	E,EA,ME
21 54	85	3	EA	85	4	EA
22 10	A0	9	ME,SAF	11	19	E,EA,ME
22 26	30	3	E,EA,H	84	18	EA
22 42	35	3	WNA,EA,H	12	19	E,EA,ME
22 58	84	4	EA	41	20	E
23 14	84	20	EA	11	5	E,EA,ME,SAF
23 30	A0	19	ME	98	18	EA,A

Table 12. GLONASS Schedule no 4, 1997 October 1 (Cont.)

*** Middle East ***

Start	Channel 1			Channel 2		
h m	Class	Slot	Connects	Class	Slot	Connects
00 02	A4	5	I,SAF	10	19	E,EA,I
00 18	C2	9	SAF,SAM	49	19	E,EA,I
00 34	A1	20	I	10	4	E,EA,I
00 50	54	10	ENA,E,SAF,SAM	48	20	E,I
01 06	01	21	WNA,ENA,E,SAM	40	4	E,EA,I
01 22	A0	5	I	41	6	E,I
01 38	A1	5	I	40	20	E,EA,I
01 54	A0	6	I,SAF	10	20	E,EA,I
02 10	58	21	ENA,I	40	5	E,EA,I
02 26	48	5	E,EA,I	F4	7	ME
02 42	A0	20	I,SAF	10	5	E,EA,I
02 58	BC	7	SAF	11	20	E,EA,I,SAF
03 14	84	5	EA,I	00	22	WNA,ENA,E
03 30	A1	21	I	48	7	E
03 46	A0	21	I,SAF	40	6	E,EA,I
04 02	48	22	ENA,E,I	48	21	E,SAF
04 18	A0	7	I	48	6	E,EA,I
04 34	BC	8	SAF,SAM	10	6	E,EA,I
04 50	01	23	WNA,ENA,E	11	6	E,EA,I
05 06	00	23	WNA,ENA,E	4C	8	E,SAF,SAM
05 22	40	7	E,I	40	22	E,I,SAF
05 38	F4	8	ME	48	23	E
05 54	84	9	EA,I	48	23	E
06 10	00	8	ENA,E	A0	23	I
06 26	A4	10	I,SAF	10	7	E,EA,I
06 42	48	24	WNA,ENA,E	11	7	E,EA,I
06 58	00	24	WNA,ENA,E	48	8	ENA,E,I
07 14	00	1	ENA,E,SAM	4C	23	E,SAF,SAM
07 30	F4	7	ME	10	9	E,EA,I
07 46	A0	10	I	40	8	E,EA,I
08 02	54	23	E,SAF,SAM	10	8	E,EA,I
08 18	A0	1	I	C2	24	SAM
08 34	10	10	E,EA,I	48	1	ENA,E,I
08 50	BC	12	SAF	00	17	WNA,ENA,E,SAM
09 06	54	24	ENA,E,SAM	41	11	E,I
09 22	00	2	WNA,ENA,E	84	10	EA,I
09 38	48	12	E,I,SAF	40	10	E,I
09 54	8C	8	EA,I,SAF	F4	11	ME
10 10	10	1	E,EA,I	40	11	E,EA,I
10 26	58	2	ENA,I	48	11	E,EA,I
10 42	A0	12	I,SAF	10	11	E,EA,I
10 58	BC	13	SAF	40	1	E,I,SAF
11 14	A0	2	I	00	3	WNA,ENA,E
11 30	01	3	WNA,ENA,E	11	11	E,EA,I
11 46	F4	13	ME	48	2	E,SAF

Table 12. GLONASS Schedule no 4, 1997 October 1 (Cont.)

*** Middle East ***

Start	Channel 1			Channel 2		
h m	Class	Slot	Connects	Class	Slot	Connects
12 02	A0	13	I,SAF	40	12	E,EA,I
12 18	4C	14	E,SAF,SAM	48	3	ENA,E,I
12 34	BC	2	SAF	10	12	E,EA,I
12 50	48	13	ENA,E,I	40	2	E,I,SAF
13 06	00	4	WNA,ENA,E	48	14	ENA,E,SAF,SAM
13 22	40	3	E,I	41	13	E,EA,I
13 38	C2	14	SAM	40	13	E,EA,I
13 54	00	14	ENA,E	4C	3	E,I,SAF
14 10	A0	4	I	10	13	E,EA,I
14 26	84	23	EA,I	11	13	E,EA,I
14 42	01	5	WNA,ENA,E	49	13	E,EA,I
14 58	00	5	WNA,ENA,E	BC	3	SAF
15 14	00	15	ENA,E,SAM	10	23	E,EA,I
15 30	48	4	E,SAF,SAM	84	13	EA,I
15 46	60	5	ENA,SAM	40	14	E,EA,I
16 02	10	14	E,EA,I	54	5	ENA,E,SAM
16 18	BC	17	SAF	58	15	ENA,I
16 34	A0	17	I,SAF	10	24	E,EA,I
16 50	8C	15	EA,I	00	6	WNA,ENA,E,SAM
17 06	4C	5	ENA,E,SAF,SAM	48	17	E,I,SAF
17 22	00	16	WNA,ENA,E	84	14	EA,I
17 38	10	15	E,EA,I	A0	24	I
17 54	BC	14	SAF	A0	18	I,SAF
18 10	48	16	ENA,E,I	48	18	E,I,SAF
18 26	A0	15	I	40	17	E,EA,I
18 42	F4	19	ME	10	17	E,EA,I
18 58	BC	19	SAF,SAM	40	15	E,EA,I,SAF
19 14	00	9	WNA,ENA,E	4C	19	E,SAF,SAM
19 30	A1	19	I	F4	16	ME
19 46	F4	15	ME	40	16	E,I
20 02	A4	15	I,SAF	40	18	E,EA,I
20 18	48	9	ENA,E,I	4C	20	E,SAF,SAM
20 34	F4	19	ME	10	18	E,EA,I
20 50	48	19	ENA,E,I	41	16	E,I
21 06	00	10	WNA,ENA,E	54	20	ENA,E,SAF,SAM
21 22	40	9	E,I,SAF	41	19	E,EA,I
21 38	C2	20	SAM	40	19	E,EA,I
21 54	48	10	ENA,E	01	20	ENA,E
22 10	A0	9	I,SAF	11	19	E,EA,I
22 26	BC	5	SAF	F4	4	ME
22 42	01	11	WNA,ENA,E	12	19	E,EA,I
22 58	00	11	WNA,ENA,E	BC	9	SAF
23 14	00	21	ENA,E,SAM	11	5	E,EA,I,SAF
23 30	4C	10	E,SAF,SAM	A0	19	I

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** South Africa ***

Start		Channel 1			Channel 2		
h	m	Class	Slot	Connects	Class	Slot	Connects
00	02	A4	5	I,ME	F5	6	SAF
00	18	C2	9	ME,SAM	F5	6	SAF
00	34	F5	10	SAF	F5	5	SAF
00	50	54	10	ENA,E,ME,SAM	F5	7	SAF
01	06	CA	7	SAM	F5	6	SAF
01	22	CB	10	SAM	CC	16	A
01	38	CB	10	SAM	F5	6	SAF
01	54	A0	6	I,ME	CB	8	SAM
02	10	CB	8	SAM	CB	7	SAM
02	26	CA	10	SAM	84	19	EA,A,I
02	42	A0	20	I,ME	CD	9	A
02	58	BC	7	ME	11	20	E,EA,I,ME
03	14	CB	7	SAM	CB	11	SAM
03	30	CC	19	A	CA	8	SAM
03	46	CC	9	A	A0	21	I,ME
04	02	F5	7	SAF	48	21	E,ME
04	18	CA	11	SAM	F5	20	SAF
04	34	BC	8	ME,SAM	AC	9	A,I
04	50	CC	10	A	CA	1	SAM
05	06	F5	21	SAF	4C	8	E,ME,SAM
05	22	CB	1	SAM	40	22	E,I,ME
05	38	A4	22	I	CD	20	A
05	54	4C	1	ENA,E,SAM	CC	20	A
06	10	F5	22	SAF	F5	10	SAF
06	26	A4	10	I,ME	CA	12	SAM
06	42	CB	12	SAM	69	23	ENA,SAM
06	58	90	10	EA,I	CB	23	SAM
07	14	CD	21	A	4C	23	E,ME,SAM
07	30	F5	11	SAF	F5	10	SAF
07	46	F5	22	SAF	F5	11	SAF
08	02	54	23	E,ME,SAM	CC	21	A
08	18	F5	11	SAF	F5	13	SAF
08	34	CA	13	SAM	F5	12	SAF
08	50	BC	12	ME	F5	24	SAF
09	06	CC	22	A	CA	23	SAM
09	22	F5	12	SAF	F5	13	SAF
09	38	48	12	E,I,ME	F5	13	SAF
09	54	8C	8	EA,I,ME	CB	14	SAM
10	10	CD	22	A	CA	24	SAM
10	26	CB	13	SAM	F5	12	SAF
10	42	A0	12	I,ME	CC	8	A
10	58	BC	13	ME	40	1	E,I,ME
11	14	CB	13	SAM	CB	14	SAM
11	30	CC	23	A	CA	14	SAM
11	46	CB	17	SAM	48	2	E,ME

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** South Africa ***

Start		Channel 1			Channel 2		
h	m	Class	Slot	Connects	Class	Slot	Connects
12	02	A0	13	I,ME	CB	15	SAM
12	18	4C	14	E,ME,SAM	AC	23	A,I
12	34	BC	2	ME	CA	17	SAM
12	50	CC	24	A	40	2	E,I,ME
13	06	CA	15	SAM	48	14	ENA,E,ME,SAM
13	22	CB	15	SAM	CC	1	A
13	38	AC	24	A,I	F5	3	SAF
13	54	F5	2	SAF	4C	3	E,I,ME
14	10	CD	1	A	F5	2	SAF
14	26	CA	18	SAM	F5	24	SAF
14	42	F5	24	SAF	F5	3	SAF
14	58	90	24	EA,I	BC	3	ME
15	14	F5	17	SAF	F5	3	SAF
15	30	48	4	E,ME,SAM	CC	2	A
15	46	A4	17	I	F5	3	SAF
16	02	F5	3	SAF	F5	19	SAF
16	18	BC	17	ME	CA	19	SAM
16	34	A0	17	I,ME	CA	4	SAM
16	50	F5	5	SAF	F5	18	SAF
17	06	4C	5	ENA,E,ME,SAM	48	17	E,I,ME
17	22	F5	18	SAF	F5	19	SAF
17	38	CC	3	A	CB	5	SAM
17	54	BC	14	ME	A0	18	I,ME
18	10	CB	20	SAM	48	18	E,I,ME
18	26	CB	20	SAM	F5	19	SAF
18	42	AC	14	A,I	CA	5	SAM
18	58	BC	19	ME,SAM	40	15	E,EA,I,ME
19	14	F5	20	SAF	4C	19	E,ME,SAM
19	30	CC	14	A	CB	20	SAM
19	46	CC	4	A	CA	20	SAM
20	02	A4	15	I,ME	F5	16	SAF
20	18	F5	21	SAF	4C	20	E,ME,SAM
20	34	CD	4	A	CA	21	SAM
20	50	CA	6	SAM	CC	5	A
21	06	CD	15	A	54	20	ENA,E,ME,SAM
21	22	40	9	E,I,ME	CB	21	SAM
21	38	AC	5	A,I	68	21	ENA,SAM
21	54	F5	16	SAF	CC	15	A
22	10	A0	9	I,ME	CB	7	SAM
22	26	BC	5	ME	F5	16	SAF
22	42	F5	9	SAF	69	10	ENA,SAM
22	58	CB	10	SAM	BC	9	ME
23	14	CD	16	A	11	5	E,EA,I,ME
23	30	4C	10	E,ME,SAM	F5	6	SAF

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** South America ***

Start		Channel 1			Channel 2		
h	m	Class	Slot	Connects	Class	Slot	Connects
00	02	F8	10	SAM	F8	22	SAM
00	18	C2	9	ME,SAF	68	10	ENA
00	34	08	21	WNA,ENA,E	F8	11	SAM
00	50	54	10	ENA,E,ME,SAF	F8	22	SAM
01	06	01	21	WNA,ENA,E,ME	CA	7	SAF
01	22	CB	10	SAF	68	23	ENA
01	38	CB	10	SAF	F8	11	SAM
01	54	CB	8	SAF	18	22	WNA,ENA
02	10	CB	8	SAF	CB	7	SAF
02	26	32	23	WNA,ENA,H	CA	10	SAF
02	42	F8	12	SAM	F8	24	SAM
02	58	F8	24	SAM	18	23	WNA,ENA,H
03	14	CB	7	SAF	CB	11	SAF
03	30	F8	11	SAM	CA	8	SAF
03	46	F8	12	SAM	F8	1	SAM
04	02	F8	13	SAM	F8	12	SAM
04	18	CA	11	SAF	18	13	WNA,ENA
04	34	BC	8	ME,SAF	F8	1	SAM
04	50	F8	13	SAM	CA	1	SAF
05	06	F8	13	SAM	4C	8	E,ME,SAF
05	22	CB	1	SAF	F8	12	SAM
05	38	F8	2	SAM	F8	1	SAM
05	54	4C	1	ENA,E,SAF	F8	13	SAM
06	10	F8	14	SAM	68	13	WNA,ENA
06	26	F8	1	SAM	CA	12	SAF
06	42	CB	12	SAF	69	23	ENA,SAF
06	58	3B	14	H	CB	23	SAF
07	14	00	1	ENA,E,ME	4C	23	E,ME,SAF
07	30	F8	24	SAM	F8	2	SAM
07	46	F8	2	SAM	68	24	ENA
08	02	54	23	E,ME,SAF	68	2	WNA,ENA
08	18	F8	3	SAM	C2	24	ME
08	34	CA	13	SAF	F8	3	SAM
08	50	08	2	WNA,ENA,E	00	17	WNA,ENA,E,ME
09	06	54	24	ENA,E,ME	CA	23	SAF
09	22	F8	17	SAM	F8	3	SAM
09	38	F8	4	SAM	68	17	ENA
09	54	CB	14	SAF	54	3	WNA,ENA,E
10	10	68	4	WNA,ENA,H	CA	24	SAF
10	26	08	18	WNA,ENA,E	CB	13	SAF
10	42	F8	5	SAM	32	4	ENA,H
10	58	F8	5	SAM	68	18	ENA
11	14	CB	13	SAF	CB	14	SAF
11	30	F8	4	SAM	CA	14	SAF
11	46	CB	17	SAF	F8	18	SAM

TABLE 12. GLONASS SCHEDULE NO 4, 1997 OCTOBER 1 (CONT.)

*** South America ***

Start		Channel 1			Channel 2		
h	m	Class	Slot	Connects	Class	Slot	Connects
12	02	F8	19	SAM	CB	15	SAF
12	18	4C	14	E,ME,SAF	F8	15	SAM
12	34	F8	18	SAM	CA	17	SAF
12	50	F8	14	SAM	18	19	WNA,ENA
13	06	CA	15	SAF	48	14	ENA,E,ME,SAF
13	22	CB	15	SAF	F8	19	SAM
13	38	C2	14	ME	68	19	ENA
13	54	F8	15	SAM	F8	20	SAM
14	10	F8	16	SAM	32	20	ENA,H
14	26	3B	20	H	CA	18	SAF
14	42	F8	4	SAM	F8	15	SAM
14	58	3B	20	H	F8	16	SAM
15	14	00	15	ENA,E,ME	68	20	WNA,ENA,H
15	30	48	4	E,ME,SAF	F8	5	SAM
15	46	F8	16	SAM	60	5	ENA,ME
16	02	F8	9	SAM	54	5	ENA,E,ME
16	18	F8	9	SAM	CA	19	SAF
16	34	54	16	WNA,ENA,E	CA	4	SAF
16	50	08	16	WNA,ENA,E	00	6	WNA,ENA,E,ME
17	06	4C	5	ENA,E,ME,SAF	68	9	ENA
17	22	F8	10	SAM	F8	6	SAM
17	38	F8	19	SAM	CB	5	SAF
17	54	F8	6	SAM	54	9	WNA,ENA,E
18	10	CB	20	SAF	F8	10	SAM
18	26	08	7	WNA,ENA,E	CB	20	SAF
18	42	3B	10	H	CA	5	SAF
18	58	BC	19	ME,SAF	68	6	ENA
19	14	18	10	WNA,ENA,H	4C	19	E,ME,SAF
19	30	CB	20	SAF	68	7	ENA
19	46	F8	6	SAM	CA	20	SAF
20	02	F8	8	SAM	F8	7	SAM
20	18	7C	8	WNA	4C	20	E,ME,SAF
20	34	F8	7	SAM	CA	21	SAF
20	50	CA	6	SAF	18	8	WNA,ENA
21	06	F8	21	SAM	54	20	ENA,E,ME,SAF
21	22	F8	8	SAM	CB	21	SAF
21	38	C2	20	ME	68	21	ENA,SAF
21	54	F8	8	SAM	F8	21	SAM
22	10	CB	7	SAF	5C	1	ENA
22	26	68	1	WNA,ENA,H	54	21	ENA,E
22	42	F8	22	SAM	69	10	ENA,SAF
22	58	3B	1	H	CB	10	SAF
23	14	00	21	ENA,E,ME	19	1	WNA,ENA,H
23	30	4C	10	E,ME,SAF	F8	11	SAM

TABLE 13. [TAI - GLONASS TIME] AND [UTC - GLONASS TIME]

(File available on http://www.bipm.fr under the name UTCGLO97.AR)

The GLONASS satellites disseminate a common time scale designated as 'GLONASS time'. The relation between GLONASS time and UTC is :

$$[UTC - GLONASS\ time] = 0\ \mathrm{s} + C_1,$$

where the time difference 0 s is kept constant as a consequence of the leap seconds applied to GLONASS time in order to follow the UTC system, and C_1 is a quantity of order several hundreds of nanoseconds (tens of microseconds until 1997 July 1) which varies with time.

The relation between GLONASS time and TAI involves a variable number of seconds and is as follows :

from 1996 January 1, 0h UTC, until 1997 July 1, 0h UTC :

$$[TAI - GLONASS\ time] = 30\ \mathrm{s} + C_1,$$

from 1997 July 1, 0h UTC, until further notice :

$$[TAI - GLONASS\ time] = 31\ \mathrm{s} + C_1.$$

Here C_1 is given at 0h UTC every day.

C_1 is computed as follows: the GLONASS data taken at the NMi Van Swinden Laboratorium, Delft, The Netherlands, for highest elevation, are smoothed to obtain daily values of $[UTC(VSL) - GLONASS\ time]$ at 0h UTC. Daily values of C_1 are then derived from them using linear interpolation of $[UTC - UTC(VSL)]$ from Table 9.

A time correction of + 1285 ns is also applied in order to ensure continuity of C_1 estimates on 1997, January 1 (MJD = 50449). The global uncertainty of daily C_1 values is of order several hundreds nanoseconds.

In the following tables, the standard deviation σ characterizes the dispersion of individual measurements, and N is the number of measurements used on a given day for estimation of the corresponding daily C_1 value.

Note :

Several gaps in the results from 1997 August 18 to 1997 September 27 are due to missing data and not to the GLONASS system.

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jan 1	50449	-34825	25	5
Jan 2	50450	-34851	18	3
Jan 3	50451	-34870	-	-
Jan 4	50452	-34924	-	-
Jan 5	50453	-34939	20	14
Jan 6	50454	-34945	26	5
Jan 7	50455	-34959	24	3
Jan 8	50456	-34956	27	4
Jan 9	50457	-34989	-	-
Jan 10	50458	-34999	26	4
Jan 11	50459	-34991	25	4
Jan 12	50460	-34977	28	4
Jan 13	50461	-34996	22	4
Jan 14	50462	-34983	17	3
Jan 15	50463	-34880	26	4
Jan 16	50464	-34879	26	4
Jan 17	50465	-34903	24	4
Jan 18	50466	-34919	23	3
Jan 19	50467	-34907	21	3
Jan 20	50468	-34911	14	2
Jan 21	50469	-34911	19	3
Jan 22	50470	-34916	17	3
Jan 23	50471	-34922	21	3
Jan 24	50472	-34916	23	4
Jan 25	50473	-34919	24	4
Jan 26	50474	-34913	21	3
Jan 27	50475	-34922	21	3
Jan 28	50476	-34905	-	-
Jan 29	50477	-34904	18	3
Jan 30	50478	-34913	18	3
Jan 31	50479	-34917	17	3

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Feb 1	50480	-34915	19	3
Feb 2	50481	-34913	21	4
Feb 3	50482	-34912	-	-
Feb 4	50483	-34912	19	3
Feb 5	50484	-34911	15	2
Feb 6	50485	-34910	14	2
Feb 7	50486	-34908	17	3
Feb 8	50487	-34908	16	3
Feb 9	50488	-34907	23	5
Feb 10	50489	-34907	22	4
Feb 11	50490	-34907	19	4
Feb 12	50491	-34906	23	4
Feb 13	50492	-34907	13	5
Feb 14	50493	-34909	19	4
Feb 15	50494	-34909	18	3
Feb 16	50495	-34907	17	3
Feb 17	50496	-34906	17	3
Feb 18	50497	-34909	19	3
Feb 19	50498	-34913	22	4
Feb 20	50499	-34916	19	3
Feb 21	50500	-34916	19	3
Feb 22	50501	-34915	17	3
Feb 23	50502	-34914	17	3
Feb 24	50503	-34917	15	2
Feb 25	50504	-34918	19	3
Feb 26	50505	-34912	22	4
Feb 27	50506	-34909	15	9
Feb 28	50507	-34913	24	4

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Mar 1	50508	-34914	18	3
Mar 2	50509	-34916	13	2
Mar 3	50510	-34916	23	4
Mar 4	50511	-34913	20	3
Mar 5	50512	-34906	20	3
Mar 6	50513	-34904	24	4
Mar 7	50514	-34909	26	5
Mar 8	50515	-34913	19	3
Mar 9	50516	-34915	18	3
Mar 10	50517	-34914	19	4
Mar 11	50518	-34911	21	4
Mar 12	50519	-34906	21	3
Mar 13	50520	-34899	16	3
Mar 14	50521	-34896	25	5
Mar 15	50522	-34906	21	4
Mar 16	50523	-34916	22	4
Mar 17	50524	-34917	22	4
Mar 18	50525	-34914	19	4
Mar 19	50526	-34913	25	5
Mar 20	50527	-34915	21	3
Mar 21	50528	-34915	20	4
Mar 22	50529	-34910	26	5
Mar 23	50530	-34906	28	5
Mar 24	50531	-34909	21	3
Mar 25	50532	-34912	15	5
Mar 26	50533	-34912	19	4
Mar 27	50534	-34908	21	4
Mar 28	50535	-34906	20	3
Mar 29	50536	-34905	23	4
Mar 30	50537	-34909	28	5
Mar 31	50538	-34911	25	5

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Apr 1	50539	-34909	18	3
Apr 2	50540	-34906	18	3
Apr 3	50541	-34907	20	4
Apr 4	50542	-34909	22	4
Apr 5	50543	-34913	21	4
Apr 6	50544	-34919	23	5
Apr 7	50545	-34926	24	5
Apr 8	50546	-34934	22	4
Apr 9	50547	-34936	23	4
Apr 10	50548	-34935	14	3
Apr 11	50549	-34944	23	5
Apr 12	50550	-34954	18	3
Apr 13	50551	-34955	17	3
Apr 14	50552	-34952	19	4
Apr 15	50553	-34952	19	4
Apr 16	50554	-34951	21	4
Apr 17	50555	-34950	22	4
Apr 18	50556	-34948	15	3
Apr 19	50557	-34949	19	3
Apr 20	50558	-34952	18	3
Apr 21	50559	-34952	17	3
Apr 22	50560	-34949	21	4
Apr 23	50561	-34947	18	3
Apr 24	50562	-34944	21	4
Apr 25	50563	-34943	19	3
Apr 26	50564	-34946	20	4
Apr 27	50565	-34949	21	4
Apr 28	50566	-34945	16	4
Apr 29	50567	-34940	23	4
Apr 30	50568	-34938	17	3

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_1 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
May 1	50569	-34933	20	4
May 2	50570	-34928	17	3
May 3	50571	-34925	19	4
May 4	50572	-34931	17	3
May 5	50573	-34936	25	5
May 6	50574	-34927	16	3
May 7	50575	-34914	15	4
May 8	50576	-34913	14	3
May 9	50577	-34918	-	-
May 10	50578	-34920	21	4
May 11	50579	-34921	15	2
May 12	50580	-34922	18	3
May 13	50581	-34917	15	3
May 14	50582	-34907	18	3
May 15	50583	-34912	12	2
May 16	50584	-34916	16	3
May 17	50585	-34914	11	2
May 18	50586	-34919	18	3
May 19	50587	-34920	12	2
May 20	50588	-34919	11	3
May 21	50589	-34922	18	3
May 22	50590	-34928	13	3
May 23	50591	-34926	18	3
May 24	50592	-34916	19	4
May 25	50593	-34895	21	4
May 26	50594	-34879	18	4
May 27	50595	-34882	19	3
May 28	50596	-34888	17	3
May 29	50597	-34890	17	3
May 30	50598	-34897	22	5
May 31	50599	-34899	16	3

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_1 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jun 1	50600	-34904	19	4
Jun 2	50601	-34905	19	5
Jun 3	50602	-34896	23	10
Jun 4	50603	-34892	17	12
Jun 5	50604	-34904	14	3
Jun 6	50605	-34918	19	4
Jun 7	50606	-34914	-	-
Jun 8	50607	-34908	-	-
Jun 9	50608	-34903	31	12
Jun 10	50609	-34905	19	4
Jun 11	50610	-34909	15	3
Jun 12	50611	-34914	19	4
Jun 13	50612	-34918	19	4
Jun 14	50613	-34918	16	4
Jun 15	50614	-34918	14	3
Jun 16	50615	-34915	23	6
Jun 17	50616	-34919	15	3
Jun 18	50617	-34931	23	5
Jun 19	50618	-34937	20	4
Jun 20	50619	-34942	16	3
Jun 21	50620	-34950	15	3
Jun 22	50621	-34959	17	4
Jun 23	50622	-34968	15	4
Jun 24	50623	-34972	16	3
Jun 25	50624	-34981	20	4
Jun 26	50625	-34989	19	5
Jun 27	50626	-34999	25	5
Jun 28	50627	-35007	15	3
Jun 29	50628	-35009	24	5
Jun 30	50629	-35007	22	7

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	G_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Jul 1	50630	299	-	-
Jul 2	50631	307	19	4
Jul 3	50632	309	20	5
Jul 4	50633	302	17	6
Jul 5	50634	291	24	6
Jul 6	50635	283	55	39
Jul 7	50636	280	-	-
Jul 8	50637	277	-	-
Jul 9	50638	269	28	9
Jul 10	50639	251	18	4
Jul 11	50640	231	-	-
Jul 12	50641	227	22	5
Jul 13	50642	239	-	-
Jul 14	50643	245	-	-
Jul 15	50644	244	-	-
Jul 16	50645	233	-	-
Jul 17	50646	206	15	4
Jul 18	50647	182	15	4
Jul 19	50648	177	18	4
Jul 20	50649	181	22	6
Jul 21	50650	172	21	6
Jul 22	50651	162	17	5
Jul 23	50652	163	16	5
Jul 24	50653	162	15	5
Jul 25	50654	150	29	8
Jul 26	50655	140	21	6
Jul 27	50656	136	17	5
Jul 28	50657	127	17	4
Jul 29	50658	122	23	6
Jul 30	50659	133	23	7
Jul 31	50660	143	-	-

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	G_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Aug 1	50661	141	21	6
Aug 2	50662	137	22	7
Aug 3	50663	142	21	6
Aug 4	50664	139	16	5
Aug 5	50665	142	12	4
Aug 6	50666	154	24	7
Aug 7	50667	155	29	11
Aug 8	50668	146	13	4
Aug 9	50669	145	29	10
Aug 10	50670	151	21	7
Aug 11	50671	156	20	7
Aug 12	50672	155	17	5
Aug 13	50673	150	16	5
Aug 14	50674	154	22	7
Aug 15	50675	164	22	7
Aug 16	50676	168	9	3
Aug 17	50677	152	23	9
Aug 18	50678	-		
Aug 19	50679		-	-
Aug 20	50680		-	-
Aug 21	50681		-	-
Aug 22	50682	157	13	4
Aug 23	50683	180	17	6
Aug 24	50684	184	15	5
Aug 25	50685	187	20	7
Aug 26	50686	194	12	4
Aug 27	50687	182	25	8
Aug 28	50688	-	-	-
Aug 29	50689	-	-	-
Aug 30	50690	-	-	-
Aug 31	50691	-	-	-

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Sep 1	50692	-	-	-
Sep 2	50693	-	-	-
Sep 3	50694	-	-	-
Sep 4	50695	-	-	-
Sep 5	50696	-	-	-
Sep 6	50697	-	-	-
Sep 7	50698	-	-	-
Sep 8	50699	-	-	-
Sep 9	50700	-	-	-
Sep 10	50701	221	16	7
Sep 11	50702	229	14	5
Sep 12	50703	233	20	7
Sep 13	50704	239	13	4
Sep 14	50705	248	28	9
Sep 15	50706	247	21	7
Sep 16	50707	237	23	8
Sep 17	50708	237	33	14
Sep 18	50709	227	22	8
Sep 19	50710	227	27	10
Sep 20	50711	-	-	-
Sep 21	50712	-	-	-
Sep 22	50713	-	-	-
Sep 23	50714	279	24	8
Sep 24	50715	272	7	3
Sep 25	50716	260	25	11
Sep 26	50717	257	15	7
Sep 27	50718	-	-	-
Sep 28	50719	268	21	7
Sep 29	50720	274	24	5
Sep 30	50721	278	19	3

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	C_i (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Oct 1	50722	266	29	6
Oct 2	50723	280	36	8
Oct 3	50724	291	23	4
Oct 4	50725	293	29	6
Oct 5	50726	293	29	5
Oct 6	50727	293	26	5
Oct 7	50728	305	18	3
Oct 8	50729	314	20	3
Oct 9	50730	308	19	3
Oct 10	50731	296	27	5
Oct 11	50732	298	33	7
Oct 12	50733	303	26	5
Oct 13	50734	298	-	-
Oct 14	50735	290	20	4
Oct 15	50736	290	31	6
Oct 16	50737	301	31	6
Oct 17	50738	309	22	4
Oct 18	50739	301	29	4
Oct 19	50740	296	38	7
Oct 20	50741	307	24	5
Oct 21	50742	324	36	7
Oct 22	50743	337	33	6
Oct 23	50744	344	37	7
Oct 24	50745	340	28	5
Oct 25	50746	332	32	5
Oct 26	50747	324	30	5
Oct 27	50748	318	34	7
Oct 28	50749	327	39	10
Oct 29	50750	359	29	6
Oct 30	50751	362	32	7
Oct 31	50752	357	24	4

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	G_1 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Nov 1	50753	354	23	4
Nov 2	50754	357	25	5
Nov 3	50755	362	19	3
Nov 4	50756	366	20	3
Nov 5	50757	369	21	4
Nov 6	50758	374	19	3
Nov 7	50759	371	15	3
Nov 8	50760	366	15	3
Nov 9	50761	367	15	3
Nov 10	50762	372	29	5
Nov 11	50763	378	21	3
Nov 12	50764	392	18	3
Nov 13	50765	405	23	4
Nov 14	50766	412	26	4
Nov 15	50767	408	18	4
Nov 16	50768	406	25	4
Nov 17	50769	406	15	3
Nov 18	50770	404	26	5
Nov 19	50771	396	19	3
Nov 20	50772	397	19	3
Nov 21	50773	408	12	2
Nov 22	50774	413	16	3
Nov 23	50775	404	20	3
Nov 24	50776	399	16	3
Nov 25	50777	400	23	3
Nov 26	50778	398	14	3
Nov 27	50779	394	15	2
Nov 28	50780	396	18	3
Nov 29	50781	394	21	3
Nov 30	50782	392	19	3

TABLE 13. (CONT.)

Date 1997 0h UTC	MJD	G_1 (ns)	σ (ns)	$\sigma/\sqrt{N}$ (ns)
Dec 1	50783	398	-	-
Dec 2	50784	394	21	4
Dec 3	50785	380	26	4
Dec 4	50786	379	30	5
Dec 5	50787	382	28	4
Dec 6	50788	375	20	3
Dec 7	50789	366	20	3
Dec 8	50790	363	25	4
Dec 9	50791	358	19	3
Dec 10	50792	342	23	4
Dec 11	50793	326	26	4
Dec 12	50794	323	26	5
Dec 13	50795	333	20	3
Dec 14	50796	346	18	3
Dec 15	50797	363	23	4
Dec 16	50798	382	24	6
Dec 17	50799	398	29	7
Dec 18	50800	394	24	4
Dec 19	50801	396	23	4
Dec 20	50802	403	27	5
Dec 21	50803	395	21	3
Dec 22	50804	378	24	4
Dec 23	50805	365	12	2
Dec 24	50806	353	22	4
Dec 25	50807	341	20	3
Dec 26	50808	345	21	3
Dec 27	50809	367	20	3
Dec 28	50810	377	21	4
Dec 29	50811	370	20	3
Dec 30	50812	363	19	3

TABLE 14A. RATES RELATIVE TO TAI OF CONTRIBUTING CLOCKS IN 1997

(File available on http://www.bipm.fr under the name RTAI97.AR)

Mean clock rates relative to TAI are computed for two-month intervals ending at the dates given in the table.
When an intentional frequency adjustment has been applied to a clock, the data prior to this adjustment are corrected, so that Table 14A gives homogeneous rates for the whole year 1997. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Reports for 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995 and 1996, and in the BIH Annual Reports for the previous years. These corrections are given in Table 14B.
Unit is ns/day, *** denotes that the clock was not used.

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
AMC	35	173	***	***	***	***	***	-17.65
AMC	35	231	***	***	***	11.40	11.04	10.54
AMC	35	266	***	***	***	-14.99	-14.94	-15.06
AMC	35	268	***	***	***	-20.15	-18.98	-20.38
AMC	35	389	***	***	***	***	***	-31.06
AMC	35	416	***	***	***	-15.61	-15.36	-16.27
AMC	35	703	***	***	***	-6.65	-5.94	-6.87
AMC	35	717	***	***	***	7.52	8.00	7.77
AMC	35	762	***	***	***	-22.20	-21.45	-22.42
AMC	35	763	***	***	***	-4.47	-5.56	-5.81
AMC	35	765	***	***	***	-6.15	-6.29	-6.55
AMC	40	713	***	***	***	-18.05	-17.60	-17.44
AMC	40	714	***	***	***	-39.83	-39.80	-40.01
AOS	23	67	0.40	-17.81	11.99	-22.30	-3.62	21.67
APL	14	793	***	***	16.49	***	5.62	9.50
APL	35	904	***	***	10.55	11.25	10.39	8.09
APL	40	3101	***	***	10.61	***	***	***
APL	40	3102	***	***	12.73	***	9.74	8.60
APL	40	3106	***	***	11.07	***	10.78	7.88
AUS	36	207	2.22	3.63	-1.17	-0.56	-1.25	1.04
AUS	36	249	-4.61	-4.04	-4.54	-5.19	-2.92	-3.79
AUS	36	340	1.32	2.62	***	***	***	***
AUS	36	379	15.75	13.75	18.01	11.73	19.36	20.21
AUS	36	424	-0.26	1.40	2.25	0.07	2.16	0.89
AUS	36	1035	***	***	***	***	***	8.26
AUS	40	5401	23.28	21.93	***	***	***	***
AUS	40	5403	***	***	***	2.01	-2.79	-5.47
AUS	40	5404	***	***	***	0.97	-1.61	-4.48
AUS	44	2	64.64	66.11	***	***	***	***
CAO	35	939	***	-5.71	-6.49	-6.85	-5.68	-5.51
CH	16	69	-166.10	-174.10	-181.42	-179.84	-165.09	***
CH	16	77	-146.66	-150.96	-160.40	-161.00	-161.49	-153.81
CH	16	140	161.88	157.98	153.09	***	***	***
CH	17	206	2.92	-1.71	5.28	-1.07	-3.31	-1.30
CH	21	179	***	***	***	***	-17.66	-8.86

TABLE 14A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
CH	21	194	***	***	***	***	-51.20	-52.18
CH	21	217	98.92	92.28	80.20	95.76	96.80	102.46
CH	21	243	31.49	26.05	25.17	17.60	30.52	59.21
CH	21	265	47.36	23.65	24.02	26.97	18.64	43.16
CH	31	403	-10.96	***	***	***	***	***
CH	35	413	12.67	13.49	14.30	14.84	16.29	15.28
CH	35	771	17.27	15.85	13.94	14.98	13.76	17.60
CH	36	354	43.86	44.43	45.68	45.47	43.45	44.07
CNM	35	236	***	-20.32	-21.03	-21.48	-22.28	***
CNM	35	237	***	-20.88	-16.66	-15.78	-14.69	-14.78
CNM	35	238	9.69	10.16	10.53	11.37	12.09	12.11
CNM	35	378	***	-22.86	-21.70	-22.73	-21.96	-22.12
CNM	35	381	***	-19.50	-19.95	-22.43	-18.70	-17.34
CNM	35	382	***	-32.57	-31.07	-28.80	-28.39	-28.46
CRL	35	112	-16.51	***	***	***	***	***
CRL	35	144	4.46	5.17	5.12	***	***	***
CRL	35	332	25.16	25.45	25.54	26.08	26.44	26.60
CRL	35	342	13.67	12.94	13.43	13.84	13.13	13.13
CRL	35	343	9.50	10.14	9.88	10.96	10.93	10.99
CRL	35	715	15.59	15.64	14.22	13.23	12.85	12.98
CRL	35	732	-10.89	-10.76	-11.90	-12.10	-12.30	-13.53
CRL	35	907	***	***	20.65	20.43	19.59	19.70
CRL	35	908	***	***	8.24	8.24	9.51	9.07
CSAO	12	1646	403.68	392.15	385.33	376.55	374.44	371.96
CSAO	12	1648	67.20	71.31	67.50	73.06	66.89	66.52
CSAO	12	2068	116.92	116.50	115.74	***	***	***
CSAO	30	152	562.30	552.04	554.52	552.17	553.84	548.58
CSAO	35	1007	***	***	***	***	***	-24.60
CSAO	35	1011	***	***	***	***	***	9.11
CSAO	35	1017	***	***	***	***	***	8.62
DLR	40	7416	-7.39	-7.31	-8.62	-8.51	-9.08	***
DLR	40	7424	2.38	-4.41	-7.09	-8.55	-9.35	-9.57
DTAG	36	136	7.17	9.16	9.53	10.41	9.01	10.74
DTAG	36	345	-1.48	-0.94	0.96	1.15	1.06	2.49
DTAG	36	465	-1.81	-0.87	-0.74	-1.80	-1.42	-1.37
F	14	51	-124.89	-122.20	-124.42	-113.77	***	***
F	14	134	54.26	66.05	55.03	47.81	65.80	66.39
F	14	1120	-53.46	-55.39	-50.22	-46.35	-49.43	-52.34
F	14	1645	74.88	76.18	73.87	56.56	75.27	72.33
F	16	106	-30.35	-26.62	-26.14	-25.21	-23.15	-20.86
F	16	187	-13.55	***	***	***	***	***
F	17	489	20.91	25.09	41.37	27.69	***	***
F	35	122	-19.26	-18.65	-17.90	-17.43	-17.06	-16.73
F	35	124	-4.21	-4.54	-3.42	-3.70	-3.46	-3.08
F	35	131	15.31	15.03	***	***	10.31	11.93

TABLE 14A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
F	35	158	11.84	12.43	12.58	13.09	12.96	12.51
F	35	172	-0.15	0.77	1.05	2.18	1.58	1.97
F	35	198	0.18	-0.36	0.99	0.58	0.49	1.13
F	35	385	1.84	***	***	***	2.67	1.86
F	35	396	6.55	6.11	6.45	6.34	6.44	6.43
F	35	536	-7.62	-6.84	-7.20	-8.17	-7.70	-8.13
F	35	609	11.49	12.31	13.27	13.98	14.10	16.39
F	35	770	***	***	11.40	11.26	12.18	12.20
F	35	781	***	-17.58	-19.00	-17.36	-18.05	-18.56
F	35	819	***	19.54	19.60	20.15	19.59	18.82
F	35	859	19.70	17.23	15.44	15.45	15.74	17.51
F	40	816	15.38	9.87	8.44	6.88	7.24	7.05
GUM	14	1144	-7.55	-2.09	-20.54	-11.61	-10.20	-0.60
GUM	31	652	-8.59	0.82	1.20	0.80	4.30	2.71
GUM	35	441	-4.09	-2.39	-1.34	-1.44	-1.41	-0.34
GUM	35	502	3.57	3.58	4.15	2.59	2.89	6.08
IEN	31	659	-38.13	-40.52	-28.87	-26.39	-27.68	-27.89
IEN	35	219	21.57	20.85	21.86	22.76	***	***
IEN	35	505	1.02	0.14	0.78	0.48	0.16	1.38
IFAG	14	1105	-59.38	-53.07	-30.57	-10.07	-24.22	-55.54
IFAG	16	131	14.14	14.60	10.69	13.49	10.99	17.05
IFAG	16	138	***	31.33	-2.25	17.38	***	***
IFAG	16	173	196.35	167.57	123.17	114.86	150.58	186.10
IFAG	16	274	27.73	33.84	50.14	65.06	75.65	65.87
IFAG	36	1031	***	***	***	***	***	-9.61
IFAG	40	4401	***	***	139.62	142.96	166.17	22.18
IFAG	40	4413	-79.54	-99.26	51.12	178.14	-71.20	-6.30
IGMA	14	2403	-12.46	-24.49	-13.21	-23.81	-31.47	-24.71
IGMA	16	112	47.35	45.62	45.93	45.74	45.19	43.31
IGMA	35	645	8.07	8.91	10.13	9.98	10.56	10.27
IGMA	35	647	17.36	17.41	17.67	17.49	17.84	18.09
INPL	14	2308	***	***	***	***	-6.98	-8.05
INPL	14	2426	29.10	31.19	35.99	***	52.02	55.10
INPL	31	145	-35.26	-36.88	***	***	-35.04	***
INPL	31	619	***	-45.31	***	***	***	***
IPQ	35	125	1.47	1.73	2.08	2.86	2.35	2.55
IPQ	35	615	4.64	5.70	6.37	6.43	6.54	5.87
IPQ	35	1030	***	***	***	***	***	2.06
KRIS	12	1406	-3.11	-27.04	62.48	***	***	***
KRIS	12	1902	110.95	***	***	***	***	***
KRIS	36	321	3.63	3.00	4.31	4.11	4.57	4.18
KRIS	36	739	-14.69	-14.74	-15.57	-14.57	-15.75	-13.98
KRIS	40	5623	10.21	12.90	16.74	18.48	18.25	17.87
LDS	35	289	-0.26	-0.88	0.00	1.45	0.44	0.32
MSL	12	933	-0.80	0.34	-0.19	-1.77	-6.28	-1.63

TABLE 14A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
MSL	36	274	2.04	-0.26	2.10	1.44	1.94	***
NAO	14	1315	***	***	***	***	-57.67	-71.25
NAO	34	1075	-12.17	-14.18	-21.13	***	***	***
NAO	34	2146	-79.07	***	***	***	***	***
NAO	35	779	18.43	18.75	21.55	21.05	21.84	22.40
NIM	12	614	***	14.91	15.68	9.47	13.71	26.49
NIM	30	277	***	347.19	376.38	374.47	406.46	397.41
NIM	35	479	***	6.90	6.07	6.43	5.05	8.52
NIST	14	1316	-26.60	-25.21	-23.69	-25.39	-24.63	-18.80
NIST	35	132	-8.53	-8.34	-8.45	-8.13	-8.00	-8.38
NIST	35	182	-7.39	-7.62	-7.78	-7.61	-7.04	-6.45
NIST	35	408	-12.41	-12.97	-12.91	-12.33	-12.42	-12.13
NIST	35	1074	***	***	***	***	-10.51	-10.40
NIST	40	201	13.73	14.01	14.45	15.33	***	***
NIST	40	203	31.24	***	***	***	***	***
NIST	40	204	***	***	-9.71	-8.95	-8.29	-8.06
NIST	40	222	-738.29	-738.41	-738.51	-738.59	-738.52	-738.74
NIST	50	2008	-47.07	-52.43	-55.20	-60.59	-63.17	-48.96
NML	36	340	***	***	***	1.91	3.17	1.24
NML	40	7501	***	***	***	22.78	***	20.02
NML	40	7502	***	***	***	69.56	***	***
NPL	14	418	-4.84	-3.07	2.35	4.77	***	***
NPL	14	1334	-98.45	-88.54	-81.86	-77.50	-77.56	-78.76
NPL	14	1813	-32.46	-28.22	-24.65	-13.05	-21.68	-26.82
NPL	35	123	1.25	1.41	2.24	2.28	1.93	2.80
NPL	35	784	3.59	4.03	3.99	4.99	5.15	5.53
NPL	36	404	2.54	2.91	1.73	0.58	1.94	2.97
NPL	40	1701	-0.40	-0.11	0.01	0.29	0.83	0.77
NPL	40	1708	0.53	0.08	-0.02	-0.03	-0.51	-0.17
NRC	35	234	3.77	4.69	4.19	5.65	5.85	6.14
NRC	35	372	12.61	12.15	9.21	7.69	***	***
NRC	40	303	27.35	30.83	32.35	***	***	***
NRC	40	304	-4.11	-2.98	-1.56	-0.98	1.05	2.19
NRC	90	61	8.48	8.59	8.57	8.73	9.50	9.70
NRC	90	63	-2.46	-2.99	-0.49	-1.55	-1.52	-1.35
NRLM	35	224	12.72	13.23	12.80	12.09	12.61	12.70
NRLM	35	459	0.57	0.79	0.66	1.05	1.16	0.84
NRLM	35	523	0.63	1.06	1.28	1.29	1.35	1.27
OMH	12	1067	***	***	2.67	3.91	2.17	3.10
ONRJ	35	903	***	***	***	***	3.23	2.87
ORB	35	201	-0.99	-0.99	-0.63	-1.75	0.83	1.80
ORB	35	202	5.52	5.54	4.56	5.13	4.99	2.65
ORB	35	593	30.87	30.08	29.11	29.18	28.34	29.21
ORB	40	2601	-184.76	-185.75	-185.05	-182.94	-177.79	-168.27
PSB	35	267	***	***	***	***	***	16.86

TABLE 14A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
PSB	35	277	***	***	***	***	***	5.58
PTB	14	2379	-60.04	-57.99	***	***	***	***
PTB	35	128	14.09	14.30	14.48	14.58	14.71	14.66
PTB	35	271	5.87	5.35	6.41	6.68	7.09	7.24
PTB	35	415	0.86	-2.02	-2.65	-1.45	-0.46	-0.45
PTB	35	1072	***	***	***	***	5.06	4.08
PTB	40	502	***	-31.59	-34.01	-31.58	-31.86	-31.09
PTB	40	505	***	-4.06	-2.21	0.12	1.48	4.78
PTB	40	537	1.55	4.07	6.34	10.59	12.68	12.48
PTB	92	1	***	***	***	***	***	2.10
PTB	92	2	-0.94	-0.99	-0.82	1.10	0.29	1.03
PTB	92	3	-3.26	-2.32	-2.65	-1.36	-1.71	-0.61
ROA	12	1223	-104.07	-85.80	-79.90	-48.91	-58.01	-91.57
ROA	14	896	14.28	16.28	17.51	22.68	25.61	26.64
ROA	14	1569	-4.51	2.82	0.47	15.85	19.70	13.16
ROA	16	113	2.29	-9.26	2.74	-3.16	5.75	8.24
ROA	31	422	-5.94	-5.98	3.30	-3.23	1.48	-1.41
ROA	35	583	-0.18	1.17	0.15	-0.49	-0.53	-0.39
ROA	35	718	2.79	3.13	***	5.03	5.16	6.21
SCL	14	2127	90.23	90.02	***	***	***	***
SCL	31	838	-164.67	-168.40	***	***	***	***
SCL	35	764	4.97	3.27	***	***	***	***
SO	12	2067	-121.15	***	***	***	***	***
SO	40	5101	-70.97	-68.85	-69.24	-72.82	-75.46	-72.24
SP	14	1376	***	10.89	9.67	***	***	***
SP	16	137	***	43.23	42.31	***	48.51	***
SP	35	641	***	-17.06	-16.98	***	-15.70	***
SU	40	3802	9.49	7.93	8.64	8.75	8.54	8.56
SU	40	3805	-28.68	***	***	***	***	***
SU	40	3806	0.12	0.36	1.21	1.89	2.30	2.13
SU	40	3807	-6.69	-6.70	-6.53	-6.49	***	***
SU	40	3808	-37.37	-38.43	-39.21	-39.92	-40.70	-40.47
SU	40	3811	-18.62	-18.14	-18.25	-18.37	-18.30	-17.96
SU	40	3812	-21.78	-23.93	-24.90	-24.70	-24.41	-24.23
TL	16	283	***	***	76.56	44.13	81.85	***
TL	34	317	***	-4.99	***	***	***	***
TL	34	438	***	93.45	112.88	143.13	163.54	163.70
TL	34	2276	***	-101.21	-97.42	-110.85	-108.74	***
TL	35	300	***	12.11	13.11	12.47	13.15	13.88
TL	35	474	***	-1.13	-0.91	-0.04	-0.80	-0.34
TL	35	809	***	-8.22	-8.44	-8.65	-8.04	-8.41
TL	35	1012	***	***	***	***	-13.99	-14.41
TP	12	335	-90.91	-93.67	-106.43	***	***	***
TP	36	154	13.43	13.39	13.80	14.28	12.80	13.90
TP	36	163	0.49	2.29	-0.54	0.71	-2.05	1.14

TABLE 14A. (CONT.)

LAB.	CLOCK	50504	50564	50629	50689	50749	50809
TP	36 326	-6.98	-8.05	-7.45	-6.47	-7.19	-7.94
TUG	14 1654	***	28.05	29.37	31.50	30.65	28.46
TUG	18 108	***	461.93	530.78	***	***	***
TUG	35 107	6.34	7.65	7.47	7.98	8.52	8.79
TUG	35 247	***	-2.04	-3.78	-5.67	-7.31	-7.90
UME	35 251	15.73	15.44	16.43	16.97	16.62	16.59
UME	35 252	2.03	1.87	1.34	2.12	2.39	1.91
USNO	34 1710	-41.66	-41.52	***	***	***	***
USNO	34 2314	27.21	***	***	***	***	***
USNO	35 101	18.29	18.64	18.18	18.29	17.97	17.51
USNO	35 104	14.05	14.16	14.57	14.56	14.76	14.52
USNO	35 106	14.11	14.39	14.62	15.16	***	***
USNO	35 108	17.02	17.02	16.91	17.39	17.54	17.42
USNO	35 114	22.99	21.76	21.33	21.95	20.41	19.75
USNO	35 120	***	6.29	5.66	5.66	5.12	5.14
USNO	35 142	1.61	2.46	3.26	3.83	5.83	6.57
USNO	35 146	3.79	3.76	3.67	4.02	4.39	4.35
USNO	35 148	-24.92	-25.36	-26.14	-26.25	-26.54	-28.24
USNO	35 150	22.12	22.11	22.33	22.29	23.68	22.47
USNO	35 152	-1.19	-1.03	-0.76	-1.14	-0.88	-1.64
USNO	35 153	19.75	19.76	19.78	19.63	20.09	***
USNO	35 156	14.55	15.55	***	***	***	39.13
USNO	35 161	3.13	3.77	3.23	3.57	4.62	3.95
USNO	35 164	***	***	***	5.79	5.15	4.86
USNO	35 165	***	18.77	18.63	19.15	19.07	18.69
USNO	35 166	7.06	7.40	7.31	9.13	8.59	8.26
USNO	35 167	10.29	9.55	9.70	9.33	9.17	9.64
USNO	35 169	-4.77	-4.20	-3.63	-3.19	-2.49	***
USNO	35 171	23.42	23.75	24.02	24.19	24.33	23.41
USNO	35 213	-7.56	-6.80	-6.64	-6.58	-5.92	-6.61
USNO	35 217	-5.81	-5.95	-6.77	-7.49	-7.36	-7.40
USNO	35 225	9.45	9.73	9.91	9.97	9.94	10.07
USNO	35 226	3.04	3.23	3.09	4.22	3.25	2.64
USNO	35 227	11.40	11.26	12.11	12.54	13.10	12.75
USNO	35 229	14.53	15.11	16.59	19.02	20.56	20.91
USNO	35 233	5.00	4.77	4.54	5.05	4.72	5.42
USNO	35 242	16.43	17.47	16.62	16.60	16.93	16.97
USNO	35 244	14.57	14.81	15.02	14.78	15.42	15.49
USNO	35 249	-3.37	-2.99	-3.53	-2.85	-2.30	-2.56
USNO	35 253	-8.69	-8.76	-7.97	-7.66	-7.28	-7.83
USNO	35 254	-1.67	-1.32	-1.42	-0.98	-0.77	-0.76
USNO	35 255	-11.90	-11.82	-11.93	***	***	-13.19
USNO	35 256	-13.51	-13.63	-12.96	-13.14	***	***
USNO	35 260	5.37	5.62	6.56	6.34	6.67	7.06
USNO	35 270	5.30	5.24	5.86	5.90	5.98	6.42

TABLE 14A. (CONT.)

LAB.	CLOCK	50504	50564	50629	50689	50749	50809
USNO	35 279	-11.38	-11.97	-11.92	-11.47	-10.67	-10.51
USNO	35 392	2.67	2.16	2.23	2.50	2.67	2.69
USNO	35 394	10.99	11.52	11.43	11.92	12.20	11.93
USNO	35 417	11.05	10.84	11.02	11.34	11.79	12.32
USNO	35 496	-16.31	-15.81	-16.06	-16.18	-16.06	-15.82
USNO	35 1096	***	***	***	***	15.34	10.91
USNO	35 1097	***	***	***	***	8.81	8.22
USNO	35 1125	***	***	***	***	***	24.21
USNO	40 701	***	-24.56	-25.44	-25.85	-26.37	-27.37
USNO	40 702	-5.82	-5.86	-5.92	-5.79	-5.67	-5.98
USNO	40 703	-2.91	-2.78	-2.68	-2.40	-2.21	-2.25
USNO	40 704	-52.84	-52.26	-52.65	-51.96	***	***
USNO	40 705	-31.98	-31.33	-31.13	-30.38	-30.07	-30.19
USNO	40 708	-0.49	-0.28	-0.13	0.16	0.35	0.30
USNO	40 709	-50.29	-49.82	-49.41	-48.62	-47.55	-47.25
USNO	40 710	-7.02	-5.39	-3.39	-1.38	0.18	1.47
USNO	40 711	***	30.12	32.59	35.28	37.98	40.35
USNO	40 712	-6.47	-6.71	-7.12	-7.23	-7.40	-7.80
USNO	40 715	-9.53	-11.89	-15.28	-15.41	***	-18.57
USNO	40 718	***	***	***	***	-9.33	-10.85
USNO	40 719	***	-2.98	***	***	***	***
USNO	40 723	***	***	***	***	-72.16	***
VSL	35 179	16.39	16.11	16.97	15.90	16.41	15.61
VSL	35 456	25.49	26.41	25.91	25.76	26.56	27.07
VSL	35 548	3.06	3.01	2.94	3.16	3.08	2.76
VSL	35 731	10.95	11.42	11.69	12.46	12.47	12.81

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
18 FREQ. AND TIME SYSTEMS INC. 4000
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A

TABLE 14B. CORRECTIONS FOR AN HOMOGENEOUS USE OF THE CLOCK RATES PUBLISHED IN THE CURRENT AND PREVIOUS ANNUAL REPORTS.

Each line refers to the same clock working without interruption.

	1997	1996		1995		1994	
	clock nø	clock nø	corr. (ns/d)	clock nø	corr. (ns/d)	clock nø	corr. (ns/d)
AUS	36 340	36 340		36 340	-11.49	36 340	-11.49
CH	16 69	16 69		16 69		16 69(1)	
	17 206	17 206		17 206		17 206(2)	+78.00
CSAO	12 1648	12 1648		12 1648		12 1648(3)	
GUM	35 441	35 441	+5.53	35 441	+5.53		
IEN	35 505	35 505		35 505	-3.83		
NIST	14 1316	14 136		14 1316		14 1316(4)	
NPL	14 418	14 418	-4.50	14 418	-4.50	14 418(5)	+17.50
	14 1334	14 1334	+47.00	14 1334	+76.00	14 1334(6)	+76.00
	14 1813	14 1813		14 1813	+19.20	14 1813(7)	+19.20
	36 404	36 404		35 404	-13.70	35 404	-13.70
	35 123	35 123		35 123	-3.30	35 123(8)	-3.30
	40 1701	40 1701	-1.20	40 1701	+2.45	40 1701(9)	+2.45
	40 1708	40 1708	+2.40				
NRC	40 303	40 303		40 303	-19.87		
	40 304	40 304	-17.28	40 304	-17.28		
NRLM	35 523	35 523		35 523	+2.76		
ROA	12 1223	35 1223		12 1223		12 1223	+124.00
	14 896	14 896		14 896		14 896	-31.00
	14 1569	14 1569		14 1569		14 1569	-6.00
	16 113	16 113	-79.00	16 113	-79.00	16 113(10)	-79.00
	35 583	35 583	+2.70	35 583	+2.70		
SU	40 3802	40 3802(11)	+9.00				

(1) A correction of -28.00 ns/d has to be applied in 1992, 1991, 1990 and in 1989.
(2) A correction of +78.00 ns/d has to be applied in 1993 and in 1992.
(3) A correction of +98.60 ns/d has to be applied in 1986 and 1985.
(4) A correction of +10.70 ns/d has to be applied in 1990. A correction of +27.63 ns/d has to be applied in 1989, 1988, 1987, 1986, 1985 and for the last three two-month intervals of 1984.
(5) A correction of +17.50 ns/d has to be applied in 1993, 1992 and 1991.
(6) A correction of +76.00 ns/d has to be applied in 1993, 1992, 1991, 1990, 1989, 1988 and 1987.
(7) A correction of -20.80 ns/d has to be applied in 1993, 1992, 1991, 1990 and for the last four two-month intervals of 1989.
(8) A correction of -3.30 ns/d has to be applied in 1993.
(9) A correction of +2.45 ns/d has to be applied in 1993 and 1992, and a correction of +29.45 ns/d has to be applied in 1991.
(10) A correction of -79.00 ns/d has to be applied in 1993, 1992, 1991 and 1990.
(11) A correction of +9.00 ns/d has to be applied for the last three two-month of 1996.

TABLE 15A. WEIGHTS OF CONTRIBUTING CLOCKS IN 1997

(File available on http://www.bipm.fr under the name WTAI97.AR)

Clock weights are computed for two-month intervals ending at the dates given in the table. Since 1995 May 2, the absolute weight of a given clock cannot exceed the value 2500. For the year 1997, it corresponds to a maximum relative weight of about 0.7 % .

**** denotes that the clock was not used

LAB.	CLOCK	50504	50564	50629	50689	50749	50809
AMC	35 173	****	****	****	****	****	0
AMC	35 231	****	****	****	0	0	2500
AMC	35 266	****	****	****	0	0	2500
AMC	35 268	****	****	****	0	0	2500
AMC	35 389	****	****	****	****	****	0
AMC	35 416	****	****	****	0	0	2500
AMC	35 703	****	****	****	0	0	2500
AMC	35 717	****	****	****	0	0	2500
AMC	35 762	****	****	****	0	0	2500
AMC	35 763	****	****	****	0	0	2500
AMC	35 765	****	****	****	0	0	2500
AMC	40 713	****	****	****	0	0	2500
AMC	40 714	****	****	****	0	0	2500
AOS	23 67	245	99	76	45	47	36
APL	14 793	****	****	0	****	0	0
APL	35 904	****	****	0	0	2500	2500
APL	40 3101	****	****	0	****	****	****
APL	40 3102	****	****	0	****	0	0
APL	40 3106	****	****	0	****	0	0
AUS	36 207	1065	1044	1912	1813	2106	2111
AUS	36 249	2500	2500	2500	2500	2500	2500
AUS	36 340	2500	2500	****	****	****	****
AUS	36 379	1817	1193	2500	1696	1348	1000
AUS	36 424	2500	2500	2500	2500	2500	2500
AUS	36 1035	****	****	****	****	****	0
AUS	40 5401	2500	2500	****	****	****	****
AUS	40 5403	****	****	****	0	0	319
AUS	40 5404	****	****	****	0	0	595
AUS	44 2	2500	2500	****	****	****	****
CAO	35 939	****	0	0	2500	2500	2500
CH	16 69	44	64	87	188	212	****
CH	16 77	13	16	23	239	188	246
CH	16 140	0	44	53	****	****	****
CH	17 206	1162	848	1280	964	844	849
CH	21 179	****	****	****	****	0	0

TABLE 15A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
CH	21	194	****	****	****	****	0	0
CH	21	217	0	138	155	161	221	172
CH	21	243	0	20	21	41	95	0
CH	21	265	0	35	38	38	51	72
CH	31	403	1139	****	****	****	****	****
CH	35	413	1207	2500	2500	2500	2500	2500
CH	35	771	2500	2500	2500	2500	2500	2500
CH	36	354	2500	2500	2500	2500	2500	2500
CNM	35	236	****	0	0	2500	2500	****
CNM	35	237	****	0	0	761	1065	1562
CNM	35	238	0	2500	2500	2500	2500	2500
CNM	35	378	****	0	0	2500	2500	2500
CNM	35	381	****	0	0	1650	2500	2500
CNM	35	382	****	0	0	1680	2178	2500
CRL	35	112	1480	****	****	****	****	****
CRL	35	144	2500	2500	2500	****	****	****
CRL	35	332	2500	2500	2500	2500	2500	2500
CRL	35	342	2500	2500	2500	2500	2500	2500
CRL	35	343	2500	2500	2500	2500	2500	2500
CRL	35	715	2500	2500	2500	2500	2500	2500
CRL	35	732	2500	2500	2500	2500	2500	2500
CRL	35	907	****	****	0	0	2500	2500
CRL	35	908	****	****	0	0	2500	2500
CSAO	12	1646	1	2	2	3	10	64
CSAO	12	1648	95	136	157	315	692	1248
CSAO	12	2068	32	39	51	****	****	****
CSAO	30	152	10	16	24	46	68	428
CSAO	35	1007	****	****	****	****	****	0
CSAO	35	1011	****	****	****	****	****	0
CSAO	35	1017	****	****	****	****	****	0
DLR	40	7416	2500	2500	2500	2500	2500	****
DLR	40	7424	2500	1414	614	378	318	426
DTAG	36	136	2500	2500	2500	2500	2500	2500
DTAG	36	345	2500	2500	2500	2500	2500	2500
DTAG	36	465	0	0	2500	2500	2500	2500
F	14	51	0	0	2433	0	****	****
F	14	134	30	30	121	84	145	164
F	14	1120	2500	1572	1685	1103	1108	1053
F	14	1645	2500	2500	2500	0	177	177
F	16	106	132	107	114	156	1404	1163
F	16	187	37	****	****	****	****	****
F	17	489	584	615	0	150	****	****
F	35	122	2500	2500	2500	2500	2500	2500
F	35	124	2500	2500	2500	2500	2500	2500
F	35	131	2500	2500	****	****	0	0

TABLE 15A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
F	35	158	2500	2500	2500	2500	2500	2500
F	35	172	2500	2500	2500	2500	2500	2500
F	35	198	2500	2500	2500	2500	2500	2500
F	35	385	2500	****	****	****	0	0
F	35	396	2500	2500	2500	2500	2500	2500
F	35	536	2500	2500	2500	2500	2500	2500
F	35	609	2500	2500	2500	2500	2500	2500
F	35	770	****	****	0	0	2500	2500
F	35	781	****	0	0	2500	2500	2500
F	35	819	****	0	0	2500	2500	2500
F	35	859	0	0	956	1372	1993	2500
F	40	816	2500	0	638	501	532	808
GUM	14	1144	0	1028	0	137	175	193
GUM	31	652	0	268	427	633	556	544
GUM	35	441	2500	2500	2500	2500	2500	2500
GUM	35	502	0	0	2500	2500	2500	2500
IEN	31	659	742	1078	0	208	173	292
IEN	35	219	2500	2500	2500	2500	****	****
IEN	35	505	2500	2500	2500	2500	2500	2500
IFAG	14	1105	21	39	45	30	28	25
IFAG	16	131	225	303	505	700	1707	1806
IFAG	16	138	****	0	0	17	****	****
IFAG	16	173	8	12	7	6	6	9
IFAG	16	274	19	31	48	48	31	28
IFAG	36	1031	****	****	****	****	****	0
IFAG	40	4401	****	****	0	0	0	0
IFAG	40	4413	24	19	0	0	1	1
IGMA	14	2403	26	22	21	19	80	172
IGMA	16	112	252	254	251	321	360	2500
IGMA	35	645	0	2500	2500	2500	2500	2500
IGMA	35	647	2500	2500	2500	2500	2500	2500
INPL	14	2308	****	****	****	****	0	0
INPL	14	2426	131	164	172	****	0	0
INPL	31	145	22	25	****	****	0	****
INPL	31	619	****	0	****	****	****	****
IPQ	35	125	2500	2500	2500	2500	2500	2500
IPQ	35	615	2500	2500	2500	2500	2500	2500
IPQ	35	1030	****	****	****	****	****	0
KRIS	12	1406	0	0	11	****	****	****
KRIS	12	1902	1331	****	****	****	****	****
KRIS	36	321	2500	2500	2500	2500	2500	2500
KRIS	36	739	2500	2500	2500	2500	2500	2500
KRIS	40	5623	0	0	510	536	728	1016
LDS	35	289	2500	2500	2500	2500	2500	2500
MSL	12	933	1213	1643	2265	2500	1488	1511

TABLE 15A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
MSL	36	274	2500	2500	2500	2500	2500	****
NAO	14	1315	****	****	****	****	0	0
NAO	34	1075	0	2500	0	****	****	****
NAO	34	2146	897	****	****	****	****	****
NAO	35	779	0	2500	2500	2500	2500	2500
NIM	12	614	****	0	0	0	803	0
NIM	30	277	****	0	0	19	12	16
NIM	35	479	****	0	0	2500	2500	2500
NIST	14	1316	636	875	685	662	2500	1579
NIST	35	132	2500	2500	2500	2500	2500	2500
NIST	35	182	2500	2500	2500	2500	2500	2500
NIST	35	408	0	0	2500	2500	2500	2500
NIST	35	1074	****	****	****	****	0	0
NIST	40	201	0	2500	2500	2500	****	****
NIST	40	203	0	****	****	****	****	****
NIST	40	204	****	****	0	0	2500	2500
NIST	40	222	2500	2500	2500	2500	2500	2500
NIST	50	2008	97	83	83	93	125	237
NML	36	340	****	****	****	0	0	2500
NML	40	7501	****	****	****	0	****	0
NML	40	7502	****	****	****	0	****	****
NPL	14	418	366	397	438	875	****	****
NPL	14	1334	0	210	263	184	162	155
NPL	14	1813	148	131	149	161	238	235
NPL	35	123	2500	2500	2500	2500	2500	2500
NPL	35	784	2500	2500	2500	2500	2500	2500
NPL	36	404	2500	2500	2500	2500	2500	2500
NPL	40	1701	2500	2500	2500	2500	2500	2500
NPL	40	1708	2500	2500	2500	2500	2500	2500
NRC	35	234	2500	2500	2500	2500	2500	2500
NRC	35	372	2500	2500	2500	1747	****	****
NRC	40	303	807	592	700	****	****	****
NRC	40	304	2500	2500	2500	2500	2500	2338
NRC	90	61	1910	2456	2500	2500	2500	2500
NRC	90	63	0	693	768	1441	1600	2500
NRLM	35	224	2500	2500	2500	2500	2500	2500
NRLM	35	459	2500	2500	2500	2500	2500	2500
NRLM	35	523	2500	2500	2500	2500	2500	2500
OMH	12	1067	****	****	0	0	2500	2500
ONRJ	35	903	****	****	****	****	0	0
ORB	35	201	2500	2500	2500	2500	2500	2500
ORB	35	202	2500	2500	2500	2500	2500	2500
ORB	35	593	2500	2500	2500	2500	2500	2500
ORB	40	2601	72	90	155	394	794	0
PSB	35	267	****	****	****	****	****	0

TABLE 15A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
PSB	35	277	****	****	****	****	****	0
PTB	14	2379	488	835	****	****	****	****
PTB	35	128	2500	2500	2500	2500	2500	2500
PTB	35	271	2500	2500	2500	2500	2500	2500
PTB	35	415	2500	2500	2500	2500	2500	2500
PTB	35	1072	****	****	****	****	0	0
PTB	40	502	****	0	0	2500	2500	2500
PTB	40	505	****	0	0	1353	1336	848
PTB	40	537	1896	2500	2224	738	445	527
PTB	92	1	****	****	****	****	****	0
PTB	92	2	2500	2500	2500	2500	2500	2500
PTB	92	3	2500	2500	2500	2500	2500	2500
ROA	12	1223	60	60	62	30	25	23
ROA	14	896	545	522	772	538	383	422
ROA	14	1569	277	425	658	0	110	114
ROA	16	113	171	192	187	351	358	262
ROA	31	422	1200	1244	0	751	717	739
ROA	35	583	2500	2500	2500	2500	2500	2500
ROA	35	718	2500	2500	****	0	0	2500
SCL	14	2127	114	163	****	****	****	****
SCL	31	838	0	109	****	****	****	****
SCL	35	764	2500	1953	****	****	****	****
SO	12	2067	46	****	****	****	****	****
SO	40	5101	1674	1862	1842	1999	1403	1392
SP	14	1376	****	0	0	****	****	****
SP	16	137	****	0	0	****	0	****
SP	35	641	****	0	0	****	0	****
SU	40	3802	2500	2500	2500	2500	2500	2500
SU	40	3805	2500	****	****	****	****	****
SU	40	3806	2500	2500	2500	2500	2500	2500
SU	40	3807	2500	2500	2500	2500	****	****
SU	40	3808	2386	1907	1751	1856	2216	2500
SU	40	3811	2500	2500	2500	2500	2500	2500
SU	40	3812	1413	998	911	1070	2145	2500
TL	16	283	****	****	0	0	12	****
TL	34	317	****	0	****	****	****	****
TL	34	438	****	0	0	8	7	9
TL	34	2276	****	0	0	101	159	****
TL	35	300	****	0	0	2500	2500	2500
TL	35	474	****	0	0	2500	2500	2500
TL	35	809	****	0	0	2500	2500	2500
TL	35	1012	****	****	****	****	0	0
TP	12	335	464	680	0	****	****	****
TP	36	154	0	2500	2500	2500	2500	2500
TP	36	163	2144	2500	2500	2500	2500	2500

TABLE 15A. (CONT.)

LAB.	CLOCK		50504	50564	50629	50689	50749	50809
TP	36	326	2500	2500	2500	2500	2500	2500
TUG	14	1654	****	0	0	2031	2500	2500
TUG	18	108	****	0	0	****	****	****
TUG	35	107	2500	2500	2500	2500	2500	2500
TUG	35	247	****	0	0	1263	1059	1132
UME	35	251	2500	2500	2500	2500	2500	2500
UME	35	252	2500	2500	2500	2500	2500	2500
USNO	34	1710	2500	2500	****	****	****	****
USNO	34	2314	2105	****	****	****	****	****
USNO	35	101	2500	2500	2500	2500	2500	2500
USNO	35	104	2500	2500	2500	2500	2500	2500
USNO	35	106	2500	2500	2500	2500	****	****
USNO	35	108	2500	2500	2500	2500	2500	2500
USNO	35	114	2500	2500	2500	2500	2500	2500
USNO	35	120	****	0	0	2500	2500	2500
USNO	35	142	1661	2258	2500	2500	2500	2500
USNO	35	146	2500	2500	2500	2500	2500	2500
USNO	35	148	2500	2500	2500	2500	2500	2500
USNO	35	150	2500	2500	2500	2500	2500	2500
USNO	35	152	2500	2500	2500	2500	2500	2500
USNO	35	153	2500	2500	2500	2500	2500	****
USNO	35	156	248	361	****	****	****	0
USNO	35	161	2500	2500	2500	2500	2500	2500
USNO	35	164	****	****	****	0	0	2500
USNO	35	165	****	0	0	2500	2500	2500
USNO	35	166	2500	2500	2500	2500	2500	2500
USNO	35	167	2500	2500	2500	2500	2500	2500
USNO	35	169	2500	2500	2500	2500	2500	****
USNO	35	171	2500	2500	2500	2500	2500	2500
USNO	35	213	2500	2500	2500	2500	2500	2500
USNO	35	217	2500	2500	2500	2500	2500	2500
USNO	35	225	2500	2500	2500	2500	2500	2500
USNO	35	226	2500	2500	2500	2500	2500	2500
USNO	35	227	2500	2500	2500	2500	2500	2500
USNO	35	229	2500	2500	2500	1846	1611	1657
USNO	35	233	2500	2500	2500	2500	2500	2500
USNO	35	242	2500	2500	2500	2500	2500	2500
USNO	35	244	2500	2500	2500	2500	2500	2500
USNO	35	249	2500	2500	2500	2500	2500	2500
USNO	35	253	2500	2500	2500	2500	2500	2500
USNO	35	254	2500	2500	2500	2500	2500	2500
USNO	35	255	2500	2500	2500	****	****	0
USNO	35	256	2500	2500	2500	2500	****	****
USNO	35	260	2500	2500	2500	2500	2500	2500
USNO	35	270	2500	2500	2500	2500	2500	2500

TABLE 15A. (CONT.)

LAB.	CLOCK	50504	50564	50629	50689	50749	50809
USNO	35 279	2500	2500	2500	2500	2500	2500
USNO	35 392	2500	2500	2500	2500	2500	2500
USNO	35 394	2500	2500	2500	2500	2500	2500
USNO	35 417	2500	2500	2500	2500	2500	2500
USNO	35 496	2500	2500	2500	2500	2500	2500
USNO	35 1096	****	****	****	****	0	0
USNO	35 1097	****	****	****	****	0	0
USNO	35 1125	****	****	****	****	****	0
USNO	40 701	****	0	0	2500	2500	2500
USNO	40 702	2500	2500	2500	2500	2500	2500
USNO	40 703	2500	2500	2500	2500	2500	2500
USNO	40 704	2500	2500	2500	2500	****	****
USNO	40 705	2500	2500	2500	2500	2500	2500
USNO	40 708	2500	2500	2500	2500	2500	2500
USNO	40 709	2500	2500	2500	2500	2500	2500
USNO	40 710	1264	1183	1125	1047	1054	1136
USNO	40 711	****	0	0	863	665	573
USNO	40 712	2500	2500	2500	2500	2500	2500
USNO	40 715	0	562	415	484	****	0
USNO	40 718	****	****	****	****	0	0
USNO	40 719	****	0	****	****	****	****
USNO	40 723	****	****	****	****	0	****
VSL	35 179	2500	2500	2500	2500	2500	2500
VSL	35 456	0	0	2500	2500	2500	2500
VSL	35 548	2500	2500	2500	2500	2500	2500
VSL	35 731	2500	2500	2500	2500	2500	2500

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
18 FREQ. AND TIME SYSTEMS INC. 4000
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A

TABLE 15B. STATISTICAL DATA ON THE WEIGHTS ATTRIBUTED TO THE CLOCKS IN 1997

Interval	Number of clocks			Number of clock with a given weight								
				0*weight			0**weight			maximum weight		
1997	HM	5071A	total	HM	5071A	Total	HM	5071A	total	HM	5071A	Total
Jan-Feb	33	94	201	4	7	15	0	0	10	21	84	121
Mar-Apr	36	109	223	5	20	39	1	0	2	20	86	124
May-Jun	38	109	220	5	20	41	1	0	7	17	88	123
Jul-Aug	40	117	221	4	20	27	0	0	4	19	95	131
Sep-Oct	38	122	228	8	20	37	1	0	1	17	97	133
Nov-Dec	38	129	232	5	19	33	2	0	4	20	107	146

* A priori null weight (test interval of new clocks).
** Null weight resulting from the statistics.
HM designates hydrogen masers and 5071A designates Hewlett-Packard 5071A units with high performance tube.
Clocks with missing data during a two-month interval of computation are excluded.

TIME SIGNALS

The time signal emissions reported here follow the UTC system, in accordance with the Recommendation 460-4 of the Radiocommunication Bureau (RB) of the International Telecommunication Union (ITU) unless otherwise stated.

Their maximum departure from the Universal Time UT1 is thus 0.9 second.

The following tables are based on information received at the BIPM in January and February 1998.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
ATA	National Physical Laboratory Dr. K.S. Krishnan Road New Delhi - 110012, India
BPM	Shaanxi Astronomical Observatory Chinese Academy of Sciences P.O. Box 18 - Lintong Shaanxi, China
BSF	National Standard Time and Frequency Laboratory Telecommunication Laboratories Chunghwa Telecom. Co., Ltd. P.O. Box 71 - Chung-Li 320 Taiwan, Rep. of China
CHU	National Research Council of Canada Institute for National Measurement Standards - Time Standards Ottawa, Ontario, K1A OR6, Canada
DCF77	Physikalisch-Technische Bundesanstalt Lab. Zeit-und Frequenzuebertragung Bundesallee 100 D-38116 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada 11100 San Fernando Cadiz, Spain
HBG	Service horaire HBG Observatoire Cantonal CH - 2000 Neuchâtel, Suisse
HLA	Time and Frequency Laboratory Korea Research Institute of Standards and Science Yusong P.O. Box 102, Taejon 305-600 Republic of Korea

Signal	Authority
IAM	Istituto Superiore delle Comunicazioni e delle Tecnologie dell'Informazione Viale America, 201 00144 - Roma, Italia
JG2AS, JJY	Standards and Measurements Division Communications Research Laboratory 2-1, Nukui-kitamachi 4-chome Koganei-shi, Tokyo 184 Japan
LOL	Servicio de Hidrografia Naval Observatorio Naval Av. España 2099 1107 - Buenos-Aires, Argentina
MSF	National Physical Laboratory Centre for Time Metrology Teddington, Middlesex TW11 OLW United Kingdom
PPR	Departamento Serviço da hora Observatorio Nacional (CNPq) Rua General Bruce, 586, Sao Cristovao 20921-030 - Rio de Janeiro, Brasil
RAB-99, RBU, RJH-63, RJH-69, RJH-77, RJH-86, RJH-90,RTZ, RWM, ULA-4	Institute of Metrology for Time and Space (IMVP), GP "VNIIFTRI" Mendeleevo, Moscow Region 141570 Russia
TDF	France Telecom Centre National d'Etudes des Télécommunications DTD/ECG Etalons de Fréquence et de Temps 196, avenue Henri Ravéra 92220 - Bagneux, France

Signal	Authority
VNG	National Standards Commission P.O. Box 282 North Ryde NSW 2113 Australia
WWV, WWVB, WWVH	Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80303, U.S.A.
YVTO	Direccion de Hidrografia y Navegacion Observatorio Cagigal Apartado Postal No 6745 Caracas, Venezuela

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
ATA	Greater Kailash New Delhi India 28° 34'N 77° 19'E	10 000	continuous	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration. The time signals are advanced by 50 ms on UTC.
BPM	Pucheng China 35° 0'N 109° 31'E	2 500 5 000 10 000 15 000	7 h 30 m to 1 h continuous continuous 1 h to 9 h	Signals emitted in advance on UTC by 20 ms. Second pulses of 10 ms duration with 1 kHz modulation. Minute pulses of 300 ms duration with 1 kHz modulation. UTC time signals are emitted from minute 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minute 25 to 29, 55 to 59.
BSF	Chung-Li Taiwan Rep. of China 24° 57'N 121° 09'E	5 000 15 000	continuous except interruption between minutes 35 and 40	From minute 5 to 10, 15 to 20, 25 to 30, 45 to 50, 55 to 60, second pulses of 5 ms duration without 1 kHz modulation. From minute 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5 ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40 ms before and after the pulses. Minute pulses are extended to 300 ms duration. DUT1: ITU-R code by pulse lengthening.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 330 7 335 14 670	continuous	Second pulses of 300 cycles of a 1 kHz modulation, with 29th and 51st to 59th pulses of each minute omitted. Minute pulses are 0.5 s long. Hour pulses are 1.0 s long, with the following 1st to 10th pulses omitted. A bilingual (Fr. Eng.) announcement of time (UTC) is made each minute following the 50th second pulse. FSK code (300 bps, Bell 103) after 10 cycles of 1 kHz on seconds 31 to 39. Year, DUT1, leap second information, TAI-UTC and Canadian summer time format on 31, and time code on 32-39. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
DCF77	Mainflingen Germany 50° 1'N 9° 0'E	77.5	continuous	At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25 % for a duration of 0.1 s or 0.2 s. Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker No 21 to No 58 (The second marker durations of 0.1 s or 0.2 s correspond to a binary 0 or a binary 1 respectively). The coded time information is related to legal time of Germany and second markers 17 and 18 indicate if the transmitted time refers to UTC(PTB) + 2 h (summer time) or UTC(PTB) + 1 h (winter time). Second marker No 15 is prolonged to 0.2 s if the reserve antenna is in use. To achieve a more accurate time transfer and better use of the frequency spectrum available, an additional pseudo-random phase-shift keying of the carrier is superimposed to the AM second markers. No transmission of DUT1.
EBC	San Fernando Spain 36° 28'N 6° 12'W	15006 4998	10 h 00 m to 10 h 25 m 10 h 30 m to 10 h 55 m	Second pulses of 0.1 s duration of a 1 kHz modulation. Minute pulses of 0.5 s duration of 1 250 Hz modulation. DUT1: ITU-R code by double pulse.
HBG	Prangins Switzerland 46° 24'N 6° 15'E	75	continuous	Interruption of the carrier at the beginning of each second during 100 ms. The minutes are identified by a double pulse, the hours by a triple pulse. No transmission of DUT1. Time code and other coded information.
HLA	Taedok Science Town Rep. of Korea 36° 23'N 127° 22'E	5 000	continuous	Pulses of 9 cycles of 1 800 Hz modulation. 29th and 59th second pulses omitted. Hour identified by 0.8 s long 1 500 Hz tone. Beginning of each minute identified by a 0.8 s long 1 800 Hz tone. Voice announcement of hours and minutes each minute following the 52nd second pulse. BCD time code given on 100 Hz subcarrier. DUT1: ITU-R code by double pulse.
IAM	Roma Italy 41° 47'N 12° 27'E	5 000	7 h 30 m to 8 h 30 m 10h 30 m to 11 h 30 m except Sunday and national holidays. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles. Voice announcements every 15 minutes beginning at 0 h 0 m. DUT1: ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
JG2AS	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	40	continuous, except interruption during communications.	During experimental coded transmission of the total day, hour, minute and DUT1, second pulses are 0.2 s, 0.5 s and 0.8 s long. In case of no coded transmission, A1A type second pulses of 0.5 s duration.
JJY	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	5 000 8 000 10 000	continuous, except interruption between minutes 35 and 39.	Second pulses of 8 cycles of 1 600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1: ITU-R code by lengthening.
LOL1	Buenos-Aires Argentina 34° 37'S 58° 21'W	5 000 10 000 15 000	11 h to 12 h 14 h to 15 h 17 h to 18 h 20 h to 21 h 23 h to 24 h	Second pulses of 5 cycles of 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 ms of 1 000 Hz or 440 Hz modulation. DUT1: ITU-R code by lengthening.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	60	continuous, except interruption for maintenance from 10 h 0 m to 14 h 0 m on the first Tuesday of each month. A longer period of maintenance during summer is announced annually.	Interruptions of the carrier of 100 ms for the second pulses and of 500 ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 1 bit/s (year, month, day of the month, day of the week, hour, minute) from second 17 to 59 in each minute, following the seconds interruption. The 100 bit/s BCD NRZ code during the minutes interruption may be discontinued. DUT1: ITU-R code by double pulse.
PPR	Rio de Janeiro Brazil 22° 59'S 43° 11'W	435 4 244 8 634 13 105 17 194.4	1 h 30 m, 14 h 30 m, 21 h 30 m.	Second ticks, of A1 type, during the five minutes preceding the indicated times. The minute ticks are longer.
RAB-99	Khabarovsk Russia 48° 30'N 134° 50'E	25	Winter schedule 2 h 13 m to 2 h 22 m 8 h 13 m to 8 h 22 m 14 h 13 m to 14 h 22 m Summer schedule 1 h 13 m to 1 h 22 m 7 h 13 m to 7 h 22 m 13 h 13 m to 13 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RBU	Moscow Russia 55° 44'N 38° 12'E	200/3	continuous	

Station	Location Latitude Longitude	Frequency (KHz)	Schedule (UTC)	Form of the signal
RJH-63	Krasnodar Russia 44° 46'N 39° 34'E	25	Winter schedule 9 h 13 m to 9 h 22 m 17 h 13 m to 17 h 22 m Summer schedule 8 h 13 m to 8 h 22 m 20 h 13 m to 20 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RJH-69	Molodechno Belarus 54° 28'N 26° 47'E	25	Winter schedule 7 h 13 m to 7 h 22 m 13 h 13 m to 13 h 22 m Summer schedule 6 h 13 m to 6 h 22 m 12 h 13 m to 12 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RJH-77	Arkhangelsk Russia 64° 22'N 41° 35'E	25	Winter schedule 11 h 13 m to 11 h 22 m 21 h 13 m to 21 h 22 m Summer schedule 2 h 13 m to 2 h 22 m 20 h 13 m to 10 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RJH-86	Bishkek Kirgizstan 43° 03'N 73° 37'E	25	Winter schedule 4 h 13 m to 4 h 22 m 10 h 13 m to 10 h 22 m 16 h 13 m to 16 h 22 m Summer schedule 3 h 13 m to 3 h 22 m 9 h 13 m to 9 h 22 m 19 h 13 m to 19 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RJH-90	Nizhni Novgorod Russia 56° 11'N 43° 57'E	25	Winter schedule 5 h 13 m to 5 h 22 m 19 h 13 m to 19 h 22 m Summer schedule 4 h 13 m to 4 h 22 m 18 h 13 m to 18 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s, 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
RTZ (1)	Irkutzk Russia 52° 32'N 103° 52'E	50	between minutes 0 and 5 0 h to 21 h 05 m 23 h to 23 h 05 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RWM (1)	Moscow Russia 55° 44'N 38° 12'E	4 996 9 996 14 996	The station operates simultaneously on the three frequencies.	A1X type second pulses are transmitted between minutes 10 and 20, 40 and 50. The pulses at the beginning of the minute are prolonged to 0.5 s. DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1: by double pulse.
ULA-4 (1)	Tashkent Uzbekistan 41° 19'N 69° 15'E	2 500 5 000 10 000	0 h to 3 h 50 m 5 h to 23 h 50 m 0 h to 3 h 50 m 14 h to 23 h 50 m 5 h to 13 h 20 m	A1X type second pulses are transmitted between minutes 0 and 10, 30 and 40. The pulses at the beginning of the minute are prolonged to 0.5 s. A1N type 0.1 second pulses of 0.02 s duration are transmitted between minutes 10 and 20, 40 and 50. The pulses at the beginning of the second are prolonged to 0.04 s and of the minute to 0.5 s. DUT1+dUT1: by double pulse.
TDF	Allouis France 47° 10'N 2° 12'E	162	continuous, except every Tuesday from 1 h to 5 h	Phase modulation of the carrier by +1 and -1 rd in 0.1 s every second except the 59th second of each minute. This modulation is doubled to indicate binary 1. The numbers of the minute, hour, day of the month, day of the week, month and year are transmitted each minute from the 21st to the 58th second, in accordance with the French legal time scale. In addition, a binary 1 at the 17th second indicates that the local time is 2 hours ahead of UTC (summer time); a binary 1 at the 18th second indicates that the local time is 1 hour ahead of UTC (winter time); a binary 1 at the 14th second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13th second indicates that the current day is a day before a public holiday.

(1) RTZ, RMW, ULA-4. CIS radiostation emitting DUT1 information in accordance with the ITU-R code and also giving an additional information, dUT1, which specifies more precisely the difference UT1-UTC down to multiples of 0.02 s, the total value of the correction being DUT1+dUT1.
Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 21st and 24th second so that dUT1 = +px0.02 s.
Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31st and 34th second, so that dUT1 = -qx0.02 s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
VNG	Llandilo New South Wales Australia 33° 43'S 150° 48'E	2 500 5 000 8 638 12 984 16 000	continuous continuous continuous continuous 22 h to 10 h	Second pulses of 50 ms of 1 kHz modulation. Second pulses 55 to 58 of 5 ms of 1 kHz modulation. Minute pulses of 0.5 s of 1 kHz modulation. During minutes 5, 10, 15, ..., second pulses 50 to 58 are 5 ms long with 1 kHz modulation. BCD time code giving day of the year, hour and minute at the next minute is given between seconds 20 and 46. Voice announcement on 2 500, 5 000 and 16 000 kHz during minutes 15, 30, 45 and 60. Morse station identification on 8 638 and 12 984 kHz during minutes 15, 30, 45 and 60. DUT1: ITU-R code by double pulse.
WWV	Fort-Collins CO, USA 40° 41'N 105° 2'W	2 500 5 000 10 000 15 000 20 000	continuous	Pulses of 5 cycles of 1 kHz modulation. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tone. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins CO, USA 40° 40'N 105° 3'W	60	continuous	Second pulses given by reduction of the amplitude of the carrier, coded announcement of the date, time, DUT1 correction, daylight saving time in effect, leap year and leap second.
WWVH	Kauai HI, USA 21° 59'N 159° 46'W	2 500 5 000 10 000 15 000	continuous	Pulses of 6 cycles of 1 200 Hz modulation. 29th and 59 th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tone. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
YVTO	Caracas Venezuela 10° 30'N 66° 56'W	5 000	continuous	Second pulses of 1 kHz modulation with 0.1 s duration. The minute is identified by a 800 Hz tone and a 0.5 s duration. Second 30 is omitted. Between seconds 40 and 50 of each minute, voice announcement of the identification of the station. Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second.

ACCURACY OF THE CARRIER FREQUENCY

Station	Relative uncertainty of the carrier frequency in 10^{-10}
ATA	0.1
BPM	0.1
BSF	0.1
CHU	0.05
DCF77	0.005 (10d-mean)
EBC	0.1
HBG	0.005
HLA	0.1
IAM	0.5
JG2AS, JJY	0.1
LOL	0.1
MSF	0.02
RAB-99, RBU	0.05
RWM, ULA-4	0.5
RJH-63, RTZ	0.05
RJH-69, RJH-77	0.05
RJH-86, RJH-90	0.05
TDF	0.02
VNG	0.1
WWV	0.1
WWVB	0.1
WWVH	0.1

December 1997

COMITE INTERNATIONAL DES POIDS ET MESURES

REPORT OF THE 86TH MEETING, 1997, TOME 65
(BIPM Publications)

Director's Report on the scientific work of the BIPM
October 1996-September 1997

TIME

1 International Atomic Time (TAI) and Coordinated Universal Time (UTC)

Reference time scales TAI and UTC have been computed regularly and have been published in the monthly *Circular T*. Definitive results for 1996 have been available, in the form of computer-readable files on the BIPM Time section Internet anonymous FTP, since 22 February 1997 and printed volumes of the *Annual Report of the BIPM Time Section* for 1996 (Volume 9) were distributed in April 1997.

2 Algorithms for time scales (J. Azoubib, C. Thomas)

Research concerning time scale algorithms includes studies which aim to improve the long-term stability of EAL and the accuracy of TAI.

2.1 EAL stability

Since January 1996, access to TAI and UTC has been provided for the MJDs ending in 4 and 9, which corresponds to an update period of 5 days instead of the 10 days used previously. The replacement of clocks of older design by new ones of type HP 5071A continues with consequent improvement in the stability of the free atomic time scale EAL, the first step in the calculation of TAI. The medium-term stability of EAL, expressed in terms of the Allan standard deviation σ_y, is estimated to be 1.1×10^{-15} for averaging times of about 40 days. This improves the predictability of UTC for averaging times of between 1 and 2 months, a scale attribute of fundamental importance for institutions charged with the dissemination of real-time time scales.

To improve the stability of EAL further, the algorithm which produces it may need to be revised. With this in view, experiments on real clock data collected at the BIPM are being carried out to show the advantage of simultaneously using an upper limit on relative weights, rather than one on absolute weights, and a basic interval of computation of one month, rather than one of two months. The BIPM reported on these studies to the CCTF* working group on TAI which decided the implementation of consequent changes in January 1998.

* CCTF: Comité Consultatif du Temps et des Fréquences, formerly Comité Consultatif pour la Définition de la Seconde.

2.2 TAI accuracy

To characterize the accuracy of TAI, estimates are made of the relative departure, and of its uncertainty, of the duration of the TAI scale interval from the SI second as produced on the rotating geoid by primary frequency standards. Since July 1996, individual measurements of the TAI frequency have been provided by three primary frequency standards:

- NIST-7, which is the optically pumped primary frequency standard developed at the NIST, Boulder. In the period covered by this report, it provided three measurements. These cover three 10 day periods in December 1996, June 1997, and October 1997. The type B uncertainty of NIST-7 was 7×10^{-15} ($1\ \sigma$) for the two first measurements and 1.0×10^{-14} ($1\ \sigma$) for the last measurement.
- PTB CS2 and PTB CS3, which are classical primary frequency standards operating continuously as clocks at the PTB. Frequency measurements are taken over successive two-month periods and the standard type B uncertainties ($1\ \sigma$) are respectively 1.5×10^{-14} and 1.4×10^{-14}.

As large frequency steps were observed in PTB CS3 in September 1996 (about 3×10^{-14}) and March 1997 (about 1.5×10^{-14}), its data are not yet used in the processing. No measurements from the caesium fountain LPTF-FO1, developed at the BNM-LPTF (type B standard uncertainty 2×10^{-15}), was received at the BIPM during the period covered by this report, but data is expected for December 1997. The global treatment of individual measurements [6] leads to a relative departure of the duration of the TAI scale unit from the SI second on the geoid, for September-October 1997, of 1.2×10^{-14} with an uncertainty of 1.0×10^{-14}. This discrepancy is smaller than that resulting from uniform application of the correction for the black-body radiation frequency shift in 1995, for which a procedure for compensation was applied immediately and still continues (cumulative frequency steering corrections, each of relative amplitude 1×10^{-15} or 2×10^{-15} applied on dates separated by 60 day intervals). Current results suggest that this procedure has now compensated for the natural drift of the scale and that it is now compensating for the 'black-body step'. Additive frequency steering corrections will be applied in 1998.

Work has been initiated in the framework of the CCTF working group on the expression of uncertainties in primary frequency standards. The aim is to develop a better understanding between laboratories that evaluate the accuracy of their primary frequency standards and the BIPM which uses the measurements provided by these standards. The first problems to be resolved concern the length of the averaging time over which measurements should be taken and the classification of uncertainty components into types A and B as recommended by the *ISO Guide to the expression of uncertainty in measurement.*

3 Time links (J. Azoubib, W. Lewandowski, J. Nawrocki*, G. Petit, C. Thomas)

Since the beginning of 1995, the GPS common-view technique has been the sole means of time transfer used for TAI computation. Nevertheless, the BIPM Time section is interested in any other time comparison method which has the potential for nanosecond accuracy, in particular GLONASS common views and two-way time transfer via geostationary satellites.

* Guest worker from the AOS (Poland).

3.1 Global Positioning System (GPS)

The BIPM still issues, twice a year, GPS international common-view schedules. Schedule No. 28 was implemented in GPS time receivers on 3 January 1997 and Schedule No. 29 on 1st October 1997. Rough GPS data are collected and treated regularly following well-known procedures. The international network of GPS time links used by the BIPM is organized to follow a pattern of local stars within a continent, together with two long-distance links, NIST-OP and CRL-OP, for which data is corrected to take account of on-site ionospheric measurements and post-processed precise satellite ephemerides. Only strict common-views are used in order to overcome effects due to the implementation of Selective Availability on satellite signals.

The BIPM also publishes an evaluation of the daily time differences [*UTC – GPS time*] in its monthly *Circular T*. These differences are obtained by smoothing data taken at the OP from a selection of satellites observed with an angle of elevation greater than 30°. The standard deviation of the daily results is about 10 ns, as the procedure does not fully eliminate Selective Availability.

An important part of our current work is to check the differential delays between GPS receivers which operate on a regular basis in collaborating timing centres or, on special request, in other laboratories. In August-November 1996, GPS equipment in operation in the CRL and in major time laboratories in Australia and New Zealand, was differentially calibrated with respect to the OP receiver [21]. Another series of differential calibrations of GPS equipment, involving the OP and European time laboratories equipped with two-way time transfer stations, was carried out in June-August 1997 [23].

GPS time and frequency transfer may be carried out using dual-frequency carrier-phase measurements. It is expected that an uncertainty of one part in 10^{15} in frequency transfer will be obtained over a period of one day. Such data are obtained from the Allen Osborne Associates TTR-4P receiver in operation at the BIPM. A first experiment, using this and similar receivers, has shown that the technique has great potential for frequency comparison but is limited by the sensitivity of the hardware to environmental variations [7]. A newly acquired Ashtech Z12-T receiver is expected to be more suitable for metrological work and collaborative work with other laboratories equipped with this kind of receiver has begun. Our intention is to demonstrate the performance of this technique for frequency comparison and then to apply it to the comparison of primary frequency standards.

Technical directives, agreed in 1993, for the standardization of GPS time receiver software, are now widely implemented. In May 1997, more than half of the timing centres contributing to TAI provided data according to the new data format. Within the CCTF sub-group on GPS and GLONASS time transfer standards, the BIPM is working to reduce the sensitivity to outside temperature of some types of receiver currently in operation. Three temperature-controlled ovens have been built at the BIPM and used to protect antennas: some improvement in time transfer data has been demonstrated [8, 9]. In addition, the BIPM will soon be equipped with a commercial temperature-stabilized antenna for one of its 3S Navigation receivers.

The BIPM is also conducting studies on multichannel receivers: software which fulfils all standards agreed for accurate time transfer is being developed for one of these, the Motorola Oncore 8-channel receiver [10].

3.2 Global Navigation Satellite System (GLONASS)

The BIPM issues, twice a year, GLONASS international common-view schedules. Schedule No. 3 was implemented in GLONASS time receivers on 3 January 1997 and Schedule No. 4 on 1 October 1997. Rough GLONASS data taken by eight time laboratories are collected and studied at the BIPM, but are not yet used in the current TAI computation.

Since January 1997, the BIPM has published an evaluation of the daily time differences [*UTC – GLONASS time*] in its monthly *Circular T*. These differences are obtained by smoothing data taken at the NMi-VSL, from a selection of satellites at high elevation. The standard deviation of the daily results is about 5 ns. This value is smaller than that obtained for the daily time differences [*UTC – GPS time*] mainly because GLONASS signals are not affected by intentional degradation such as the Selective Availability of GPS. However, the combined standard uncertainty of the daily values [*UTC – GLONASS time*] is not better than several hundred of nanoseconds as there are no absolutely calibrated GLONASS time receivers.

The BIPM is equipped with two GLONASS time receivers from the 3S Navigation company: a two-channel C/A-code single-frequency GLONASS unit, and a multichannel GPS/GLONASS receiver with two-channel P-code double-frequency for GLONASS observation together with twelve channels for C/A-code single-frequency GPS or GLONASS observation. Results from these receivers make it possible to conduct research on the use of GPS and GLONASS for international time transfer in single and multichannel modes [11, 12]. A recent study has demonstrated a stability gain between one-channel GPS observations and multichannel GPS and GLONASS observations for averaging times less than 10^4 seconds [13].

Within the CCTF sub-group on GPS and GLONASS time transfer standards, the BIPM has helped to adapt the standard GPS data format for use in dual-system, dual-frequency, dual-code observation [14].

3.3 Two-way time transfer

The CCDS working group on two-way satellite time transfer met for the fourth time in Turin (Italy), on 3-4 October 1996. A more technical meeting of representatives of the European two-way stations was held on 5 March 1997 in Neuchâtel (Switzerland), during the 11th EFTF. At these meetings the main topics of discussion were: preparation for routine operation, station calibration problems, and the new format for reporting data. Regular time transfer sessions began on 20 January 1997 using the INTELSAT 706 satellite on a commercial basis. The first months of operation were dedicated to testing. The BIPM is involved in the calibration of two-way time transfer links by comparison with GPS.

4 Application of general relativity to time metrology (G. Petit, C. Thomas, P. Wolf)

A summary of the research on general relativity and the metrology of time carried out over the last four years in the BIPM Time section was published in the form of a doctoral thesis by P. Wolf. It was presented and accepted for the degree of Ph.D. at Queen Mary and Westfield College (University of London) on 30 March 1997 [15]. This work was also published as a *BIPM Monographie* [22].

A novel test of the second postulate of special relativity (the universality of the speed of light) has been carried out using data from clock comparisons between hydrogen maser clocks on the ground, and caesium and rubidium clocks on 25 GPS satellites [17, 18, 19]. The clocks were compared via carrier-phase measurements of the GPS signal using Allen Osborne Associates Rogue and Turbo-Rogue geodetic receivers at a number of stations of the International GPS Service for Geodynamics (IGS) spread world-wide. A violation of the second postulate can be modelled by an anisotropy of c along a particular spatial axis with experiments setting a limit on the value of $\delta c/c$ along this axis. Within this model the experiment is sensitive to a possible anisotropy in any spatial direction, and on a non-laboratory scale (baselines $\geq$ 20 000 km). The results presented set an upper limit on the anisotropy of c of $\delta c/c < 5 \times 10^{-9}$ when considering all spatial directions and $\delta c/c < 2 \times 10^{-9}$ for the component in the equatorial plane. These are the most stringent limits on this parameter reported so far.

5 **Pulsars** (G. Petit, B. Rougeaux*)

Millisecond pulsars can be used as stable clocks to realize a time scale by means of a stability algorithm. The work carried out over recent years on how such a pulsar time scale could be realized and what implications it would have for atomic time is an on-going subject of presentations. Collaboration is maintained with radio-astronomy groups observing pulsars and analysing pulsar data. The Time section provided these groups with the latest version of its post-processed realization of Terrestrial Time TT(BIPM97) in April 1997. This collaboration also continues through the working group on pulsar timing of the IAU Commission 31 (Time), which is chaired by G. Petit.

A new technique which could be used at radio observatories to obtain more pulsar data is being developed with the collaboration of the Centre National d'Études Spatiales, CNES (France). The use of this technique to search for new pulsars is the subject of the doctoral work undertaken by B. Rougeaux at the BIPM, in collaboration with the CNES, the Observatoire Midi-Pyrénées, Toulouse (France) and the Paris Observatory, OP, Meudon (France). Test observations have been made and processed.

6 **Space-time references** (G. Petit, P. Wolf)

Studies have been initiated to unify the work on space-time references being carried out at the BIPM, within the CCTF working group on the application of relativity to metrology, and in working groups within the IAU, the IUGG, and the IERS.

The IAU and the BIPM have created the Joint Committee on general relativity for space-time reference systems and metrology [IAU Resolution B3 (1997)]. The membership is being established, and the Joint Committee will start its work under the Chairmanship of G. Petit. Steps are being taken to extend this collaboration towards the IAG.

* Research student (partly supported through a contract with CNES).

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