

# 47th CGSIC Meeting - Timing Subcommittee

**Fort Worth, Texas, 25 September 2007**

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Chair: **Włodzimierz Lewandowski, BIPM,**  
Co-Chair: **Victor Zhang, NIST**

- 14:00 Introduction – *Włodzimierz Lewandowski, BIPM*
- 14:20 Report from NIST – *Victor Zhang, NIST*
- 14:40 USNO Report – *Demetrios Matsakis, USNO*
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– *Carlene E. Stephens, National Museum of American History*
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- 17:10 Session End



## AREAS BEING SERVED

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- **International Atomic Time (TAI) and UTC**
- **International Timing Centers**
- **Global Navigation Satellite Systems**
- **Telecommunications Industries**
- **NASA/JPL Deep Space Network**
- **NIST Global Time Service**
- **Power Grids and other Industries**
- **As Research and Comparison Tool**
- **Other**

# Outline of presentation

- **Change in the definition of international time scales**
  - UTC
  - TAI
  - Leap second
- **Relation between satellite time scales**
  - GPS time
  - Glonass time
  - Galileo system time



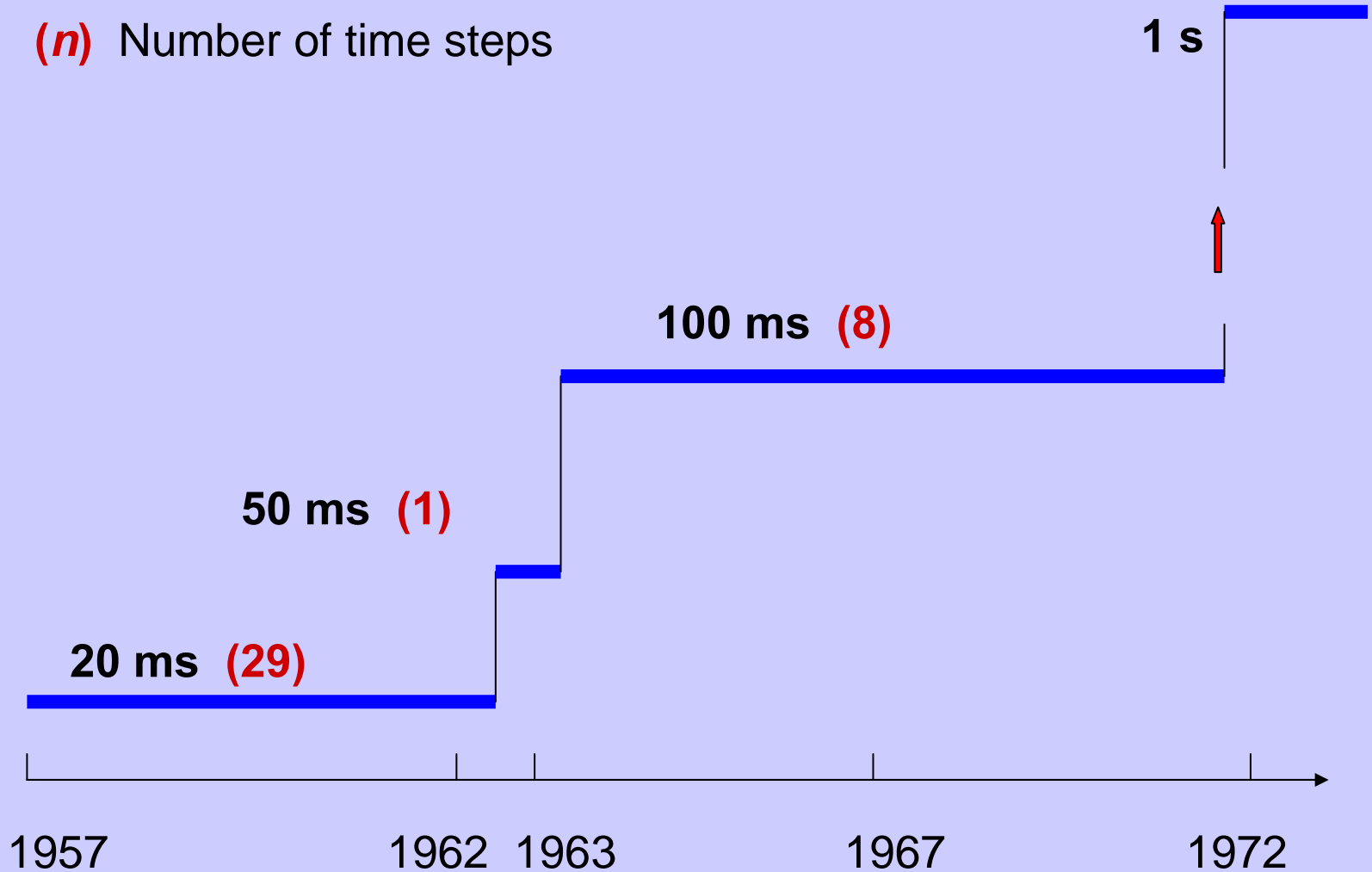
# *Unification of time*

- **1884 - Adoption of a prime meridian Greenwich and of an associated time - universal time, based on the rotation of the Earth**
- **1948 - *International Astronomical Union* recommends the use of Universal Time (UT)**
- **1968 - *13th General Conference of Weights and Measures* adopted a definition of SI second, based on a caesium transition, and opened the way toward the formal definition of International Atomic Time (TAI).**
- **1971 - *International Astronomical Union, International Telecommunications Union, General Conference of Weights and Measures* recommend the use of Coordinated Universal Time (UTC) based on TAI. Introduction of leap seconds.**
- **2003 - Use of leap seconds under revision**

# *Coordinated Universal Time (UTC)*

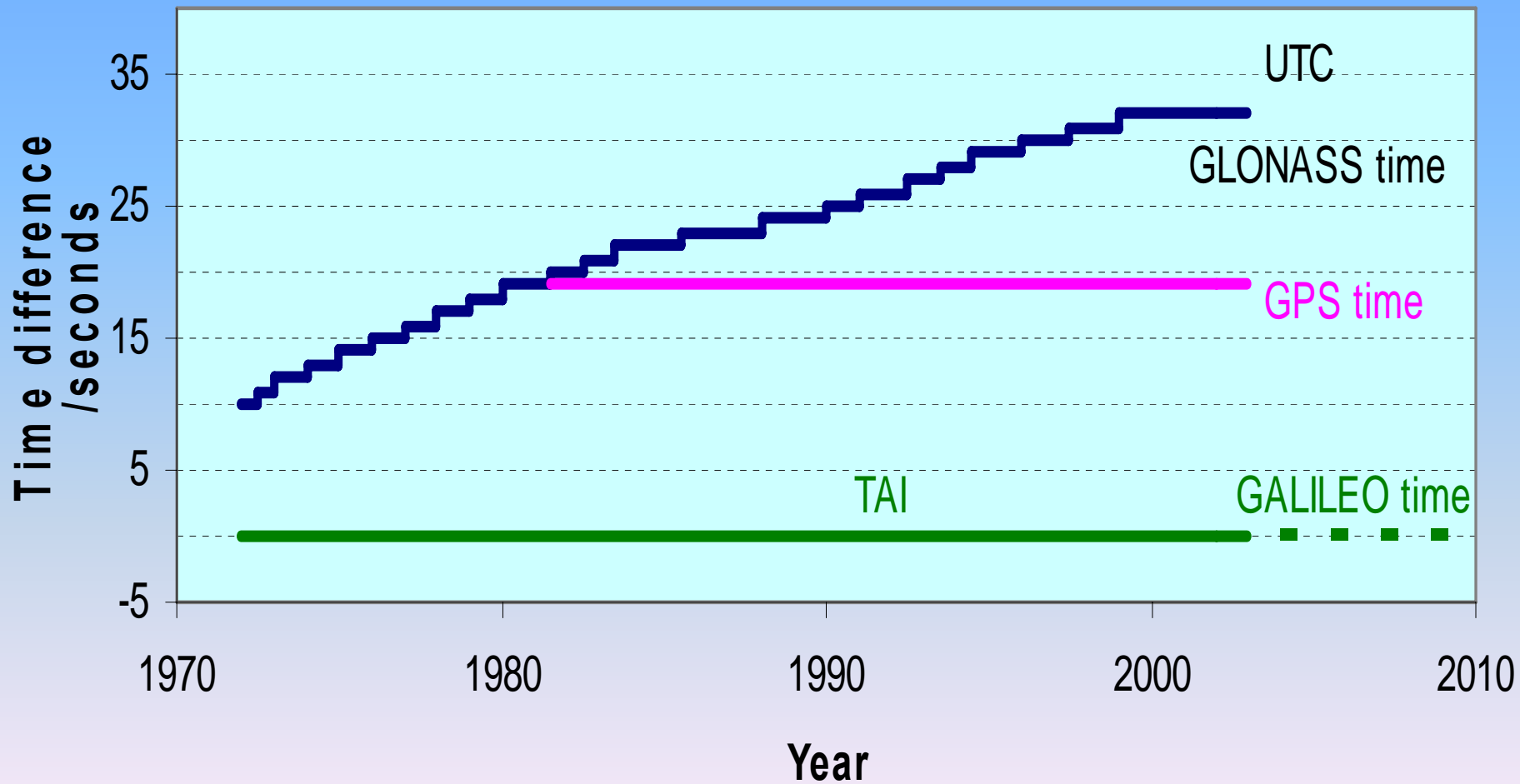
- **UTC is computed at the BIPM and made available every month in the BIPM *Circular T* through the publication of  $[UTC - UTC(k)]$** 
  - **International Atomic Time (TAI) is based on the readings of about 200 atomic clocks located in metrology institutes in about 45 countries around the world. TAI has scientific applications and is not represented by clocks. Consequently is not used for time dissemination.**
  - **UTC = TAI corrected for 1 second time steps (TAI - UTC = 33s today)**
- **Local realizations of UTC named UTC(k) are broadcast by time signals**
- **UTC is the basis for legal time worldwide**

# Evolution of UTC time steps



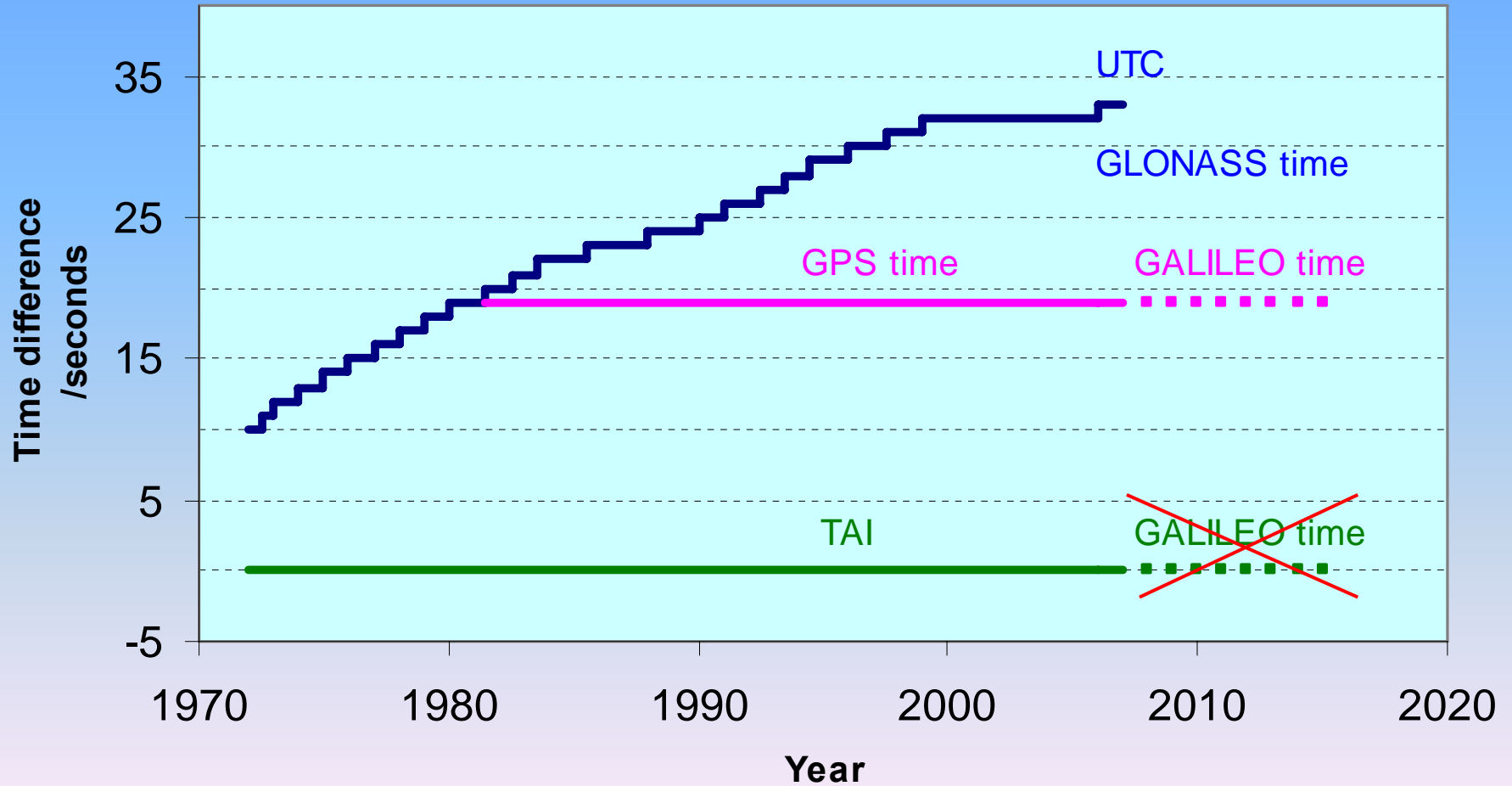


# $[TAI - \text{Time scale}(i)]$





# [TAI - Time scale (i)]



**International Committee on Global  
Navigation Satellite Systems (ICG)  
Bangalore, India  
4 - 7 September 2007**

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## ICG Draft Recommendation

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### International Committee on Global Navigation Satellite Systems (ICG)

#### *considering*

- the international value of having many GNSS operational with a composite contribution of several tens of satellites,
- the desirability of using all systems interchangeably,
- the use by GPS of references very close to UTC and ITRF,
- the GLONASS efforts to approach UTC and ITRF,
- the Galileo design referring to UTC and ITRF,
- that other important satellite navigation systems are now being designed and developed\*),

#### *recommends*

- that the reference times (modulo 1 s) of satellite navigation systems be synchronized as closely as possible to UTC,
- that the reference frames for these systems be in conformity with the ITRF,
- that these systems broadcast, in addition to their own System Time (ST):
  1. the time difference between ST and a real-time realization of UTC,
  2. a prediction of the time differences between ST and UTC.

\*) Compass, IRNSS, QZSS, various SBAS, ...

# **ITU meeting on redefinition of UTC Geneva, 11-14 September 2007**

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# INTERNATIONAL TELECOMMUNICATION UNION

*Radiocommunication Bureau*



7 December 2005

Ref: See distribution

Contact: **Alexandre Vassiliev**

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E-Mail: [alexandre.vassiliev@itu.int](mailto:alexandre.vassiliev@itu.int)

Subject: Documentation of 2005 leap second experience

Dear Sir,

Since 2000, ITU-R Radiocommunication Study Group 7 (SG 7) "Science services" has undertaken studies on a possible revision of Recommendation ITU-R TF.460-6, which defines and describes the use of Coordinated Universal Time (UTC) for radiocommunication and telecommunication purposes. The implication of changes to the UTC time-scale, or identification of an alternative time-scale, could have a significant impact on

In addition, WP 7A recognized that the forthcoming leap second just prior to 01 January 2006 00:00:00 hours UTC – the first for seven years – provides an opportunity to further document potential problems. In this respect, we would like to request the assistance of your members, customers and staff to document their experiences, both positive and negative, in coping with the addition of the aforementioned leap second. We would also encourage the widest possible distribution of this request, in order to benefit from maximum participation in this study.

We would request, please, that your responses are sent to the BR by e-mail at [alexandre.vassiliev@itu.int](mailto:alexandre.vassiliev@itu.int). The resulting information will be subsequently submitted to WP 7A for further consideration and your organization will, of course, also receive the results as soon as they are available.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'V. Timofeev', with a long, sweeping horizontal line extending to the right.

Valery Timofeev  
Director, Radiocommunication Bureau

Distribution:

BIPM; COSPAR; ESA; EUMETSAT; IAU; JAXA; Ministry of Transport, Japan; URSI; CIPM; CCTF; GLONASS; ICAO; ICSU; IERS; IMO; IUGG; IUPAP; NASA; RFSA; WMO

Louis Essen :

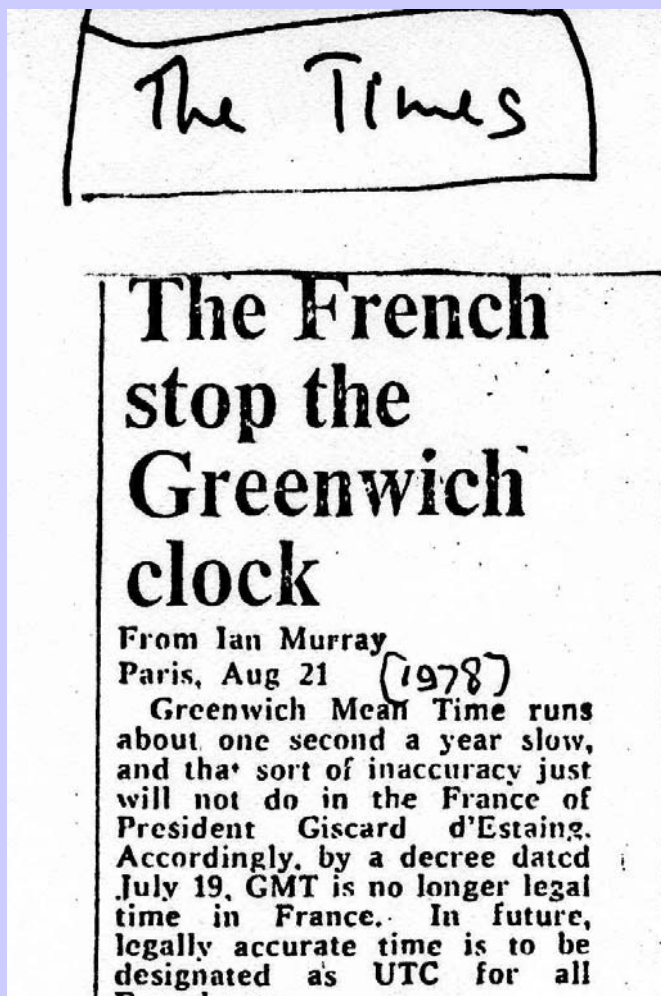
“..... In 1960s there was a suggestion that astronomical time should be used for sea navigation and domestic purposes, and atomic time for air navigation and scientific work. My experiences with time signals and standard frequency transmissions convinced me that this would cause endless confusion as well as involving duplication of equipment and I argued strongly that a method of combining all the information in one set of transmission must be found.....”

# To avoid proliferation of time scales ITU plans to stop application of leap seconds to UTC

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- **April 2008: ITU Working Party 7A will submit to ITU Study Group 7 project recommendation on stopping leap second**
- **During 2008 Study Group 7 will conduct a vote through mail among member states**
- **2011: if 70 % member states agree World Radio Conference will approve recommendation**
- **2013: application of leap second will stop and UTC will become a continuous time scale**

## Reactions against the UTC...



Greenwich Mean Time runs about one second a year slow. And that sort of inaccuracy just will not do in the France of President Giscard d'Estaing.

...

The International Office of Time is not in Greenwich - it is based in the Observatory at Paris, where President Giscard d'Estaing can watch it more closely.

# ITU will not move as fast as others ...



Reuters Photo: Venezuelan President Hugo Chavez is seen in Maturin September 17, 2007. Chavez wants Venezuelan clocks...

By Saul Hudson

Wed Sep 19, 2:58 PM ET

CARACAS (Reuters) - President Hugo Chavez wants Venezuelan clocks turned back half an hour and he wants it done in record time -- next Monday.

"I don't care if they call me crazy, the new time will go ahead, let them call me whatever they want," Chavez said on his weekly TV show. "I'm not to blame. I received a recommendation and said I liked the idea."

ADVERTISEMENT

The shift will allow children to wake up for school in daylight instead of before sunrise, Chavez said.

# RELEVANT MEETINGS

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## *Past*

- **International Committee on Global Navigation Satellite Systems (ICG) WG, Bangalore, India, 4 - 7 September 2007**
- **ITU Working Party 7A, Geneva, 11-14 September 2007**
- **CCTF WG on TWSTFT, Bern, 17-19 September 2007**

## *Coming*

- **Scientific and Fundamental Aspects of the Galileo Programme, Toulouse, 1-4 October 2007**
- **PTTI, Long Beach CA, 26 –29 November 2007**
- **EFTF, Toulouse, 23-25 April 2008**

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