

ADVANCE PROGRAM

THIRTY-EIGHTH ANNUAL PRECISE TIME AND TIME INTERVAL (PTTI) SYSTEMS AND APPLICATIONS MEETING



December 5 – 7, 2006

38 Years of Progress
1969 – 2006

Hyatt Regency Hotel
Reston, Virginia

SCHEDULE

Monday, December 4, 2006

0800-1300	Exhibition setup of booth for Exhibitors
0730-0830	Tutorial Breakfast
0830-1615	Tutorials
1300-1700	Exhibitor Set-up
1700-1830	Icebreaker-Exhibitor Area
1830-2100	Exhibitor Set-Up
1900-2100	Registration*

Tuesday, December 5, 2006

0700-1600	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-1700	Technical Exhibits**
0800-0805	Opening
0805-0820	Distinguished PTTI Award Presentation
0820-0910	Invited Speaker
0910-0915	Call to Session
0915-1015	Session I – PTTI Vendor Presentations
1015-1035	Intermission-Exhibits Area
1035-1145	Session II – Standards Laboratories Reports
1145-1300	Lunch
1300-1500	Session III – Performance of Clocks in Space
1500-1520	Intermission-Exhibit Area
1520-1620	Session IV – Measurement Technology
1620-1720	Panel Discussion – Leap Second
1830-2000	Reception

Wednesday, December 6, 2006

0700-1600	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-1700	Technical Exhibits**
0800-0920	Session V – Timing Systems
0920-0940	Intermission
0940-1150	Session VI – Precise Time Protocol (IEEE-1588)
1150-1300	Lunch
1300-1420	Session VII – Advanced Clocks
1420-1440	Intermission
1440-1640	Session VIII – Poster Session
1730-1830	Joint Executive and Advisory Board Meeting
1900-2030	Special Event

Thursday, December 7, 2006

0700-1200	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-0940	Session IX – Time Transfer
0940-1000	Intermission
1000-1140	Session X - Algorithms
1140-1330	Lunch
1300-1440	Session XI – Galileo & GPS
1440-1500	Intermission
1500-1620	Session XII – Two-Way Time & Frequency Transfer
1620-1640	General Discussion
1640	Close of Meeting

*Registration is available each day.

**Exhibits are open Tuesday and Wednesday only.

**REGISTRATION FOR THE
THIRTY-EIGHTH ANNUAL
PRECISE TIME AND TIME INTERVAL (PTTI)
SYSTEMS AND APPLICATIONS MEETING
DECEMBER 5 – 7, 2006**

NAME: _____
First _____ Last _____

AGENCY: _____
Company or Organization _____

ADDRESS: _____
Street _____

City, State, and Country _____

TELEPHONE: _____ FAX: _____

E-MAIL: _____
 Speaker Session Chairman Exhibitor

Register online: <http://tycho.usno.navy.mil/ptti/pttiregform.html>

If you are unable to register online, please fill out this Registration Card and send it to Ms. Nikki Jardine via fax (**202-767-2845**) or email (nikki.jardine@nrl.navy.mil).

Full Registration fee - \$475; \$425, if postmarked on or before November 3, 2006.
Includes entry to the sessions and exhibit hall, the Tuesday and Wednesday luncheons, the Monday evening Ice Breaker, the Tuesday evening Welcoming Reception, the Wednesday evening Special Event and one copy of the Proceedings.

Student/Retiree registration fee - \$50. The attendee must be fully retired or a full-time student to qualify for the reduced registration fee. **Includes entry to the sessions and exhibit hall only.**

Registration Fee \$ _____
 Tutorials Registration (\$250) \$ _____
 Reception Tickets (\$30 each) No. _____ \$ _____
 Lunch Tickets (\$25 each) No. _____ \$ _____
 Extra Proceedings (\$150.00) No. _____ \$ _____

Total Amount Due \$ _____ Payment enclosed Will pay on site

Mark here if purchasing Proceedings only and not attending conference.

Make checks payable to **Treasurer, PTTI**. If paying in advance, mail the payment and a copy of this registration card to: **Sachs Freeman Associates, Inc., c/o Mrs. Sheila Faulkner, 3159 Patrick Henry Drive, Falls Church, VA 22044, USA**.

PTTI cannot accept payment by credit card.

Questions? Call Ms. Jardine at 202-767-2595, DSN 297-2595

TABLE OF CONTENTS

ADVANCE PROGRAM

THIRTY-EIGHTH ANNUAL PRECISE TIME AND TIME INTERVAL (PTTI) SYSTEMS AND APPLICATIONS MEETING

Sponsored by

U.S. Naval Observatory
U.S. Naval Research Laboratory
NASA Jet Propulsion Laboratory
Defense Information Systems Agency
U.S. Coast Guard Navigation Center

December 5 – 7, 2006



Hyatt Regency Hotel
Reston, Virginia

Schedule	Inside Front Cover
Registration Card	Front of Book
Objectives.....	iii
Meeting Information	iv
Registration	iv
Cancellation Policy.....	iv
PTTI on the Web.....	iv
PTTI 2006 Tutorials (Reserve Early)	v
Questions	v
Registration Desk Hours	v
Hotel Reservations	vi
Transportation Information.....	vi
Parking	vi
Directions	vi
Messages	vii
Speakers' Room	viii
Presented Papers	viii
Temperature.....	viii
Exhibit Information	viii
List of Potential Exhibitors.....	viii
Panel Discussion.....	ix
PTTI 2006 Evening Activities	ix
Proceedings	ix
39th Annual PTTI Meeting	ix
PTTI Executive Committee	x
PTTI Advisory Board	xi
2006 Distinguished PTTI Service Award Committee	xii
PTTI 2006 Meeting Officers	xiii
PTTI 2006 Session Chairs	xiv
PTTI 2006 Agenda	xv-xxii
Hotel Registration Card.....	Rear of Book

OBJECTIVES

The objectives of the PTTI Systems and Applications Meeting are to:

- Disseminate and coordinate PTTI information at the user level;
 - Review present and future PTTI requirements;
 - Inform Government engineers, technicians, and Managers of precise time and frequency technology and its problems, and;
 - Provide an opportunity for an active exchange of new technology associated with PTTI.
-

This year, the PTTI addresses:

- PTTI Vendor Presentations
- Time and Frequency Standards Laboratories: Activities and Updates
- Performance of Clocks in Space
- Measurement Technology
- Panel Discussion – Leap Second
- Timing Systems
- Precise Time Protocol (IEEE-1588)
- Advanced Clocks
- Time Transfer
- Algorithms
- Galileo & GPS
- Two-Way Time & Frequency Transfer

WELCOME TO PTTI 2006

MEETING INFORMATION

Registration

Register online: <http://tycho.usno.navy.mil/ptti/pttiregform.html>

If you are unable to register online, please fill out the attached Registration Card and send it to Ms. Nikki Jardine via fax (202-767-2845) or email (nikki.jardine@nrl.navy.mil).

Please make checks payable to **Treasurer, PTTI**. If paying in advance, mail the payment and a copy of the registration card to:

Sachs Freeman Associates, Inc.
c/o Mrs. Sheila Faulkner
3159 Patrick Henry Drive
Falls Church, VA 22044
USA

PTTI cannot accept credit cards.

The full registration fee is \$475. Note: If payment is received postmarked on or before November 3, 2006, the fee is \$425. Full registration includes entry to the sessions and exhibit hall, the Tuesday and Wednesday luncheons, the Monday evening Ice Breaker, the Tuesday evening Welcoming Reception, the Wednesday evening Special Event and one copy of the Proceedings. **Please remember to take advantage of the reduced early registration fee. Payment must be postmarked on or before November 3, 2006.**

The registration fee for students and full-time retirees is \$50 and includes entry to the scientific sessions and exhibit area only.

Tickets for the luncheons (\$25 each) and the reception (\$30 each) can be purchased at the PTTI Registration Desk. Extra copies of the Proceedings are also available for purchase.

The tutorials will be held **Monday, December 4**. The registration fee is \$250 and includes breakfast, lunch and a copy of the Tutorials presentations.

All attendees, including presenters and exhibitors, must register and receive a badge. The badge must be worn for admission to all sessions and functions and is not transferable.

The exhibit area is open to everyone; visitor badges can be picked up at the registration desk.

Cancellation policy

All requests for cancellation must be received in writing before November 3, 2006. On or after November 3, there is a \$225 cancellation fee. Refunds are not given for "no shows"; however, substitutions are allowed.

If you have special dietary or physical requirements, please contact Mrs. Faulkner at 703-532-6411, FAX 703-532-6338 or bopenyan@aol.com.

PTTI on the Web

Access PTTI online: <http://tycho.usno.navy.mil/ptti.html>

PTTI 2006 Tutorials

Tutorials take place prior to PTTI 2006 on Monday, December 4, 2006. For information regarding the tutorials, please contact Rachel Evans, rachel.evans@nrl.navy.mil.

The fee for the all-day tutorials is \$250. Breakfast, lunch and a copy of the Tutorials presentations are included. Please register using the attached Registration Card or online at the PTTI website.

0730-0830	Breakfast
0830-0930	GNSS – Mr. Ed Powers, U.S. Naval Observatory
0930-1030	The Future of Atomic Frequency Standards – Dr. Chris Ekstrom, U.S. Naval Observatory
1030-1045	Break
1045-1145	Clocks for Timing and Telecommunications – Mr. George Shaton, Department of Defense
1145-1300	Lunch
1300-1400	Time Recovery in the Field – Dr. Sam Stein, Timing Solutions Corporation
1400-1500	Time/Frequency Transfer – Dr. Judah Levine, National Institute of Standards and Technology

Questions

Please contact the following people for information on matters concerning:

Technical questions: Joe White
202-767-5111
joe.white@nrl.navy.mil

Exhibits: Gary Geil
949-361-0212
gary@gmaincc.cc

General: Sheila Faulkner
703-532-6411
bopenyan@aol.com

Registration: Nikki Jardine
202-767-2595
nikki.jardine@nrl.navy.mil

Registration Desk Hours

The registration desk will be open during the following hours:

Monday, December 4, 1900 – 2100
Tuesday, December 5, 0700 – 1600
Wednesday, December 6, 0700 – 1600
Thursday, December 7, 0700 – 1200

Hotel Reservations

Mail or FAX the hotel reservation card (located at the back of the book) to:

Hyatt Regency Reston
(PTTI 2006 Meeting Room Block)
1800 Presidents Street,
Reston, Virginia, USA 20190
703-709-1234, Fax: 703-925-8295

Reservations can also be made by calling 888-591-1234 or online via the Hyatt's Passkey system: https://resweb.passkey.com/Resweb.do?mode=welcome_ei_new&eventID=43071

The link is also available at the PTTI website: <http://tycho.usno.navy.mil/ptti.html>

When making your reservations, be sure to mention PTTI 2006 to receive the group sleeping room rate. The PTTI rate is available from November 29 through December 10, 2006. Check-in time is 1500 (3:00 PM EST) and checkout time is Noon. Rooms are held until 1700 (5:00 PM EST) if not guaranteed for late arrival by a credit card or one night's deposit. The block of reserved rooms will be released **November 15**, so reserve early. **If rooms are available after that date, reservations will be accepted at a higher rate.** If you leave before your scheduled departure date without informing the Hyatt, you will be charged an early departure fee. Reston offers a wide range of restaurants and shops.

Transportation Information

Rental Car

Avis is the official rent-a-car company for PTTI 2006. Call 800-331-1600 to book your reservation; be sure to mention the Avis Worldwide Discount (AWD) Number which is J628452. Special meeting rates are available from November 27 through December 14, 2006.

Airport Shuttle

The hotel offers a complimentary shuttle that arrives at the top of each hour from 6 am to 10 pm. It takes you directly to **Dulles Airport**; the drop off and pick up point will be at curbs 2A and 2H, adjacent to the lower level baggage claim level.

Parking

Covered valet and self parking are available. Valet parking is \$22.00 overnight, with in/out privileges. Valet parking for the day only is \$10.00. Self parking is available at no charge. The parking areas are large enough to accommodate vans.

Directions

From Dulles International Airport

From the airport take Dulles Access Road East toward Washington, DC. At Reston, use Exit 12, Reston Parkway and follow it north $\frac{1}{4}$ mile to third stoplight. Hotel is on the left.

From Washington National Airport & Washington, DC

Follow signs to I-66 West. (Be alert to later afternoon HOV restrictions.) From I-66 West, take Exit 67, Dulles Airport Toll Road and follow it west to Exit 12, Reston Parkway. Turn right and continue $\frac{1}{4}$ mile to second stop light. Hotel is on the left.

From Baltimore/New York

Follow I-95 South to Washington, DC beltway then exit right (west) onto I-495. Follow I-495 across the Potomac River into Virginia and exit right onto RT. 267, Dulles Toll Road. At Reston, use Exit 12, Reston Parkway; turn right and proceed $\frac{1}{4}$ mile to second stoplight. Hotel is on the left.

From Fredericksburg/Richmond

Follow I-95 North to Washington, DC beltway (at Springfield), then exit onto I-495 (north). Follow I-495 to RT. 267, Dulles Toll Road. At Reston, use Exit 12, Reston Parkway; turn right and proceed $\frac{1}{4}$ mile to second stoplight. Hotel is on the left.

From Leesburg/Loudoun County

Two choices: (A) Follow Rt. 7 East to Dranesville and turn right onto Reston Parkway (RT. 602). Proceed south approximately 3 miles. Hotel will be on the right. (B) Take Dulles Greenway Toll Road East past Dulles International Airport to Exit 12, Reston Parkway. Turn left onto Reston Parkway and follow it north $\frac{1}{4}$ mile to third stoplight. Hotel is on the left.



Messages

Messages may be left for PTTI attendees through the hotel's telephone number:
703-709-1234.

Speakers' Room

Please check the PTTI Registration Desk or the hotel's Function Board for the location of the Speakers' Room. Speakers are expected to attend the Speakers' Breakfast on the morning of their scheduled presentation. This breakfast meeting allows the Session Chairs to confirm that their presenters are present and to share important information the Speakers will need to ensure a successful presentation. It also provides the Speakers the opportunity to provide the final version of their presentation slides to the A/V Chairman for installation on the computer.

Presented Papers

Papers in electronic form (Word or TEX) must be submitted by e-mail, CD, or on a diskette to Dr. Lee A. Breakiron, Editorial Chairman, (breakiron.lee@usno.navy.mil) by December 6, 2006, unless prior arrangements have been made with him. If prior arrangements have not been made, the paper will not be published in the Proceedings. For the PTTI style sheet, see the Authors' Kit on the Web: http://tycho.usno.navy.mil/ptti/author_kit.html.

Temperature

The climate during December in the Washington, DC area will be cold. A coat or raincoat is recommended.

Exhibit Information

The exhibit area is adjacent to the general session. For exhibit information, please contact:

Gary Geil or Don Mitchell
Geil Marketing Associates, Inc.
1064 Calle Negocio, Suite D
San Clemente, CA 92673
949-361-0212, FAX 949-361-0312
gary@gmainc.cc

List of Potential Exhibitors for PTTI 2006

Astrogeodynamical Observatory
Brandywine
EndRun
FEI-Zyfer, Inc.
Frequency Electronics
GPS Networking
GPS World
Guide Technology
Inside GNSS
ITT (formally Allen Osborne Associates)
JTime Meinberg USA
Lange-Electric GmbH
Locus
Military University of Technology

Navtech Seminars & GPS Supply
Precise Time and Frequency
Quartzlock, U.K. , Ltd.
SpectraDynamics
Symmetricom Timing Test & Measurement
Synergy Systems, LLC
Temex Time
TimeTech, GmbH
Timing Solutions
Trak Microwave Corporation
Trimble Navigation
U.S. Naval Observatory

Panel Discussion

On Tuesday, December 5, PTTI is pleased to offer an interactive Panel Discussion which gives conference attendees the opportunity to learn about the most recent developments in the ongoing discussion regarding possible changes in the definition of UTC. Panel members will discuss the status of the international proposals and answer related questions.

PTTI 2006 Evening Activities

On Monday, December 4, 1700, the Icebreaker, a "Get Acquainted" function, will be held in the Exhibits Hall. Refreshments will be served.

The Welcoming reception will be held Tuesday, December 5, 1830.

On Wednesday, December 6, 1900, this year's Special Event, **Project GREAT: General Relativity Einstein/Essen Anniversary Test**, will be presented by Tom Van Baak of LeapSecond.com. Refreshments will be served.

Proceedings

The Proceedings, on a CD in Adobe Acrobat (PDF) format, will be mailed to the attendees in 2007. If you cannot attend, but wish to reserve a copy of the Proceedings, please return the Registration Card with a check for \$150 made out to **Treasurer, PTTI**. Please note on the card that you are not attending. Your reserved copy will be sent to you. If you wish extra copies, they will also be available at \$150.

Thirty-Ninth Annual PTTI Meeting

The Thirty-Ninth Annual PTTI Systems and Applications Meeting will be held at the Hyatt Regency Hotel, Long Beach, CA, November 26 – 29, 2007.

PTTI EXECUTIVE COMMITTEE

DR. JOSEPH D. WHITE, CHAIRMAN
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MR. PAOLO BASSO-LUCA
Defense Information Systems Agency

MR. RONALD L. BEARD
U.S. Naval Research Laboratory

CAPT MATTHEW BLIZARD
U.S. Coast Guard Navigation Center

DR. LEE A. BREAKIRON
U.S. Naval Observatory

LT DERREK BURRUS
U.S. Coast Guard Navigation Center

MR. RICHARD CAMP
Defense Information Systems Agency

DR. DENNIS D. MCCARTHY
U.S. Naval Observatory

LT KIRK W. MONTGOMERY
U.S. Coast Guard Navigation Center

DR. ROBERT J. TJOELKER
NASA Jet Propulsion Laboratory

MR. GEORGE SHATON
Department of Defense

MS. FRANCINE M. VANNICOLA
U.S. Naval Observatory

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Symmetricom

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Geil Marketing Associates, Inc.

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Boeing Space Systems

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Stanford University

DR. VICTOR S. REINHARDT

Raytheon Space and Airborne Systems

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Temex Time

MR. RONALD C. ROLOFF

Geil Marketing Associates, Inc.

DR. LARA S. SCHMIDT

The RAND Corporation

DR. SAMUEL R. STEIN

Timing Solutions Corporation

DR. ANDY WU

The Aerospace Corporation

2006 DISTINGUISHED PTTI SERVICE AWARD

SELECTION COMMITTEE

DR. JOSEPH D. WHITE, CHAIRMAN

U.S. Naval Research Laboratory

DR. LEONARD S. CUTLER

Agilent Technologies

DR. DENNIS D. MCCARTHY

U.S. Naval Observatory

MR. DON H. MITCHELL

Geil Marketing Associates

DR. RICHARD L. SYDNOR

NASA Jet Propulsion Laboratory (Retired)

RECIPIENTS OF THE DISTINGUISHED PTTI SERVICE AWARD

1994

DR. GERNOT M. R. WINKLER
U.S. Naval Observatory (Retired)

1995

DR. JAMES A. BARNES
National Institute of Standards and
Technology (Retired)

1996

PROFESSOR SIGFRIDO M. LESCHIUTTA
Politecnico di Torino and
Istituto Elettrotecnico Nazionale Galileo
Ferraris

1997

PROFESSOR BERNARD RENE GUINOT
Honorary Astronomer
Paris Observatory

1998

DR. JACQUES VANIER
National Research Counsel (Retired)

1999

DR. LEONARD S. CUTLER
Agilent Technologies

2000

MR. ROGER EASTON
U.S. Naval Research Laboratory (Retired)

2001

DR. ROBERT F. C. VESSOT
Smithsonian Astrophysical Observatory
(Retired)

2002

MR. HARRY PETERS
Sigma Tau, Incorporated (Retired)

2003

MR. S. CLARK WARDRIP
National Aeronautics and Space
Administration (Retired)

2005

DR. NORMAN F. RAMSEY
Harvard University

PTTI 2006 MEETING OFFICERS

GENERAL CHAIRMAN

DR. KENNETH L. SENIOR
U.S. Naval Research Laboratory

TECHNICAL PROGRAM COMMITTEE CHAIRMAN

LT KIRK MONTGOMERY

U.S. Coast Guard Navigation Center

TECHNICAL PROGRAM COMMITTEE CO-CHAIRMAN

MR. JAMES CAMPARO

The Aerospace Corporation

TECHNICAL PROGRAM ADVISOR

MR. S. CLARK WARDRIP

Sachs Freeman Associates, Inc.

EDITORIAL COMMITTEE CHAIRMAN

DR. LEE A. BREAKIRON

U.S. Naval Observatory

EXHIBITS AND PUBLICITY CHAIRMAN

MR. GARY GEIL

Geil Marketing Associates, Inc.

EXHIBITS AND PUBLICITY CO-CHAIRMAN

MR. DON MITCHELL

Geil Marketing Associates, Inc.

TECHNICAL ASSISTANCE

LT DERREK BURRUS

U.S. Coast Guard Navigation Center

MEETING ARRANGEMENTS

MRS. SHEILA FAULKNER

Sachs Freeman Associates, Inc.

REGISTRATION

MS. NICOLETTE JARDINE

U.S. Naval Research Laboratory

PTTI 2006 SESSION CHAIRS

SESSION I – PTTI Vendor Presentations

REED SEARLE
Symmetricom

SESSION II – Standards Laboratories Reports

ED POWERS
U.S. Naval Observatory

SESSION III – Performance of Clocks in Space

EDOARDO DETOMA
SEPA S.p.A

SESSION IV – Measurement Technology

TOM CELANO
Timing Solutions Corporation

SESSION V – Timing Systems

FRANCINE VANNICOLA
U.S. Naval Observatory

SESSION VI – Precise Time Protocol (IEEE 1588)

GEORGE SHATON
Department of Defense

SESSION VII – Advanced Clocks

JAQUES VANIER
University of Montreal

SESSION VIII – Poster Session

RAIMOND MELKERS
L3/Titan Corporation

SESSION IX – Time Transfer

KEVIN SHMULIK
U.S. Coast Guard LORAN Support Unit

SESSION X – Algorithms

JIM SKINNER
U.S. Naval Observatory

SESSION XI – Galileo & GPS

PASCAL ROCHAT
Temex Time

SESSION XII – Two-Way Time & Frequency Transfer

VICTOR ZHANG
National Institute of Standards and Technology

PTTI 2006
THIRTY-EIGHTH ANNUAL
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SYSTEMS AND APPLICATIONS MEETING

TUESDAY, DECEMBER 5, 2006

0800 – 0805	OPENING Ken Senior, <i>U.S. Naval Research Laboratory</i>
0805 – 0820	DISTINGUISHED PTTI SERVICE AWARD Presented by Joe White, <i>U.S. Naval Research Laboratory</i>
0820 – 0910	OPENING REMARKS Michael Shaw, <i>Director of the National Coordination Office for Space-Based Positioning, Navigation and Timing (PNT)</i>
0910 – 0915	CALL TO SESSION Kirk W. Montgomery, <i>U.S. Coast Guard Navigation Center</i>
SESSION I	PTTI VENDOR PRESENTATIONS Chairman: Reed Searle, <i>Symmetricom</i>
0915 – 1015	
1015 – 1035	INTERMISSION
SESSION II	STANDARDS LABORATORIES REPORTS Chairman: Ed Powers, <i>U.S. Naval Observatory</i>
1035 – 1145	
1145 – 1300	LUNCH
SESSION III	PERFORMANCE OF CLOCKS IN SPACE Chairman: Edoardo Detoma, <i>SEPA S.p.A.</i>
1300 – 1320	Paper 1: GPS/GALILEO INTEROPERABILITY: GGTO, TIMING BIASES AND GIOVE-A EXPERIENCE Ricardo Píriz, <i>GMV S.A., Madrid, Spain</i> ; Patrizia Tavella, <i>Istituto Nazionale di Ricerca Metrologica (INRIM), Torino, Italy</i> ; Jörg H. Hahn, <i>Galileo Project Office, ESA/ESTEC, Noordwijk, The Netherlands</i>
1320 – 1340	Paper 2: A HISTORICAL REVIEW OF ATOMIC FREQUENCY STANDARDS USED IN SPACE SYSTEMS – 10 YEAR UPDATE Joseph White, <i>US Naval Research Lab; Temex Neuchâtel Time</i> ; Leo A. Mallette, <i>Boeing</i>
1340 – 1400	Paper 3: LONG TERM CLOCK BEHAVIOR OF GPS IIR SATELLITES Marvin Epstein, Todd Dass, John Rajan, and Paul Gilmour, <i>ITT Industries</i>
1400 – 1420	Paper 4: VERIFICATION AND OPTIMIZATION OF THE PHYSICS PARAMETERS OF THE ONBOARD GALILEO PASSIVE HYDROGEN MASER Q. Wang, P. Mosset, F. Droz, and P. Rochat, <i>Temex Neuchatel Time</i> ; G. Busca, <i>Kytime Sarl, Switzerland</i>

TUESDAY, DECEMBER 5, 2006

SESSION III **PERFORMANCE OF CLOCKS IN SPACE (cont.)**

1420 – 1440	Paper 5: GIOVE-A ONBOARD CLOCK PERFORMANCE CHARACTERIZATION: FIRST RESULTS Jörg H. Hahn, Francisco Gonzales, Pierre Waller, Daniel Navarro-Reyes, and Marco Falcone, <i>Galileo Project Office, European Space Agency; Ricardo Piriz, GMV, Madrid, Spain</i> ; Patricia Tavella and Ilaria Sesia, <i>Istituto Nazionale di Ricerca Metrologica (INRIM), Torino, Italy</i>
1440 – 1500	Paper 6: PROGRESS TOWARD A 10^{-15} STABLE ION CLOCK FOR SPACE APPLICATIONS John Prestage, Sang Chung, Lawrence Lim, and Lute Maleki, <i>Jet Propulsion Lab</i>
1500 – 1520	INTERMISSION
SESSION IV	MEASUREMENT TECHNOLOGY Chairman: Tom Celano, <i>Timing Solutions Corporation</i>
1520 – 1540	Paper 7: A MULTI-CHANNEL STABILITY ANALYZER FOR FREQUENCY STANDARDS IN THE DEEP SPACE NETWORK C. A. Greenhall, A. Kirk, and R. L. Tjoelker, <i>Jet Propulsion Laboratory/California Institute of Technology</i>
1540 – 1600	Paper 8: COMPARING TWO TYPES OF VHF LOW NOISE FREQUENCY SOURCE FOR MICROWAVE AND HIGHER FREQUENCY SYNTHESIS Takeo Oita, Fumio Asamura, Katsuaki Sakamoto, and Nihon Dempa Kogyo, <i>Co. Ltd.</i>
1600 – 1620	Paper 9: QUADRUPOLE TRANSITION SPECTRUM MEASUREMENT OF SINGLE Ca^+ IONS TOWARD OPTICAL FREQUENCY STANDARDS Kensuke Matsubara, Ying Li, Kyoya Fukuda, Hiroyuki Ito, Shigeo Nagano, Masatoshi Kajita, Kazuhiro Hayasaka, and Mizuhiko Hosokawa, <i>National Institute of Information and Communications Technology, Tokyo, Japan</i> ; Shinji Urabe, <i>Graduate School of Engineering Science, Osaka University, Osaka, Japan</i>
1620 – 1720	PANEL DISCUSSION – LEAP SECOND Dennis McCarthy, <i>U.S. Naval Observatory</i> ; Ron Beard, <i>Naval Research Laboratory</i>
1830 – 2000	RECEPTION

WEDNESDAY, DECEMBER 6, 2006**SESSION V TIMING SYSTEMS**

Chairman: Francine Vannicola, *U.S. Naval Observatory*

- 0800 – 0820 **Paper 10:** AF/NGA GPS MONITOR STATION HIGH-PERFORMANCE CESIUM FREQUENCY STANDARD STABILITY
Dennis M. Manning, *NGA/GPS Division*
- 0820 – 0840 **Paper 11:** GROUND EXPERIMENTS OF REMOTE SYNCHRONIZATION FOR ONBOARD CRYSTAL OSCILLATOR OF QUASI-ZENITH SATELLITES - USE OF MULTIPLE POSITIONING SIGNALS FOR FEEDBACK CONTROL
Toshiaki Iwata, Michito Imae, Tomonari Suzuyama, and Yoshikatsu Kawasaki, *National Institute of Advanced Industrial Science and Technology (AIST), Japan*; Naoto Takasaki, Kenji Kokubu, and Akira Iwasaki, *University of Tokyo, Japan*; Satoshi Fukushima and Yuji Hashibe, *Space Engineering Development Co., Ltd., Japan*; Fabrizio Tappero and Andrew Dempster, *University of New South Wales, Australia*
- 0840 – 0900 **Paper 12:** CHARACTERISTICS OF TIME SYNCHRONIZATION RESPONSE OF NTP CLIENTS ON MS WINDOWS OS AND LINUX OS
K. H. Sato and K. Asari, *Mizusawa VERA Observatory*
- 0900 – 0920 **Paper 13:** USNO MASTER CLOCK DESIGN ENHANCEMENTS
P. Koppang, J. Skinner, and D. Johns, *U.S. Naval Observatory*
- 0920 – 0940 **INTERMISSION**
- SESSION VI PRECISE TIME PROTOCOL (IEEE-1588)**
Chairman: George Shaton, *Department of Defense*
- 0940 – 1010 **INVITED PAPER:** IEEE 1588: AN UPDATE ON THE STANDARD AND ITS APPLICATION
John C. Eidson, *Agilent Technologies and Chair IEEE*
- 1010 – 1030 **Paper 14:** CHARACTERIZATION OF TIME TRANSFER PERFORMANCE OVER ETHERNET USING IEEE-1588
Harrell Huckeba and Doug Arnold, *Symmetricom*
- 1030 – 1050 **Paper 15:** INTERNAL AND EXTERNAL CLOCK SYNCHRONIZATION IN A POWER LINE NETWORK
Georg Gaderer, Patrick Loschmidt, *Research Unit for Integrated Sensor Systems, Austrian Academy of Sciences*; Nikolaus Kerö, *Oregano Systems*
- 1050 – 1110 **Paper 16:** DESIGN OF AN IEEE-1588 INTERFACE FOR SUB-NANOSECOND PERFORMANCE
Marek Christer, Steve Passee, and Samuel Stein, *Timing Solutions Corporation*

WEDNESDAY, DECEMBER 6, 2006**SESSION VI PRECISE TIME PROTOCOL (IEEE-1588) (cont.)**

- 1110 – 1130 **Paper 17:** APPLICATIONS AND OPPORTUNITIES FOR THE IEEE 1588 STANDARD IN MILITARY APPLICATIONS
John MacKay, *Progeny Systems Corporation*
- 1130 – 1150 **Paper 18:** INVESTIGATIONS ON SECURITY ASPECTS IN CLOCK SYNCHRONIZED INDUSTRIAL ETHERNET
Georg Gaderer, Albert Treytl, and Patrick Loschmidt, *Research Unit for Integrated Sensor Systems, Austrian Academy of Sciences*; Nikolaus Kerö, *Oregano Systems*
- 1150 – 1300 **LUNCH**
- SESSION VII ADVANCED CLOCKS**
Chairman: Jacques Vanier, *University of Montreal*
- 1300 – 1320 **Paper 19:** ON THE LONG-TERM FREQUENCY INSTABILITY OF CHIP-SCALE ATOMIC CLOCKS
S. Knappe, H. Robinson, L. Hollberg, and J. Kitching, *NIST, Time and Frequency Division*; V. Gerginov, *Department of Physics, University of Notre Dame*; V. Shah, *Department of Physics, University of Colorado*
- 1320 – 1340 **Paper 20:** g-COMPENSATED, MINIATURE, HIGH PERFORMANCE QUARTZ CRYSTAL OSCILLATORS
Hugo Fruehauf, *Frequency Electronics, Inc.*
- 1340 – 1400 **Paper 21:** A CPT BASED ATOMIC CLOCK
Ido Ben-Aroya, Matan Kahanov, and Gadi Eisenstein, *Electrical Engineering Department, Technion*
- 1400 – 1420 **Paper 22:** SUB- 10^{-16} FREQUENCY STABILITY FOR CONTINUOUSLY RUNNING CLOCKS: JPL'S MULTI-POLE LITS FREQUENCY STANDARD
E.A. Burt, R.T. Wang, D.G. Enzer and R.L. Tjoelker, *Jet Propulsion Laboratory, California Institute of Technology*
- 1420 – 1440 **INTERMISSION**
- SESSION VIII POSTER SESSION**
Chairman: Raimond Melkers, *AFSPC/SMC/MCL/L-3/Titan Corporation*
(tentative list; if necessary, additional poster papers will be added)
- Poster 1:** TIME AND FREQUENCY ACTIVITIES AT THE U.S. NAVAL OBSERVATORY
D. Matsakis, *U.S. Naval Observatory*

WEDNESDAY, DECEMBER 6, 2006**SESSION VIII POSTER SESSION (cont.)****Poster 2: UPDATE OF RESEARCH ACTIVITIES ON TIME AND FREQUENCY AT THE NATIONAL INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY (NICT)**

Kensuke Matsubara, Shin'ichi Hama, Kuniyasu Immura, Yasuhiro Koyama, Hiroshi Toriyama, and Mizuhiko Hosokawa, *National Institute of Information and Communications Technology, Tokyo, Japan*

Poster 3: NEW CLOCKS COMPARISON, TIME SCALES GENERATION AND MASTER CLOCK DISTRIBUTION SYSTEMS AT METAS TIME & FREQUENCY LABORATORY

Laurent-Guy Bernier, Gregor Dudle, Christian Chlunegger, *METAS Swiss Federal Office of Metrology*

Poster 4: PTB'S TIME AND FREQUENCY ACTIVITIES IN 2006

D. Piester, J. Becker, T. Polewka, M. Rost, D. Sibold, E. Staliniene, *Physikalisch-Technische Bundesanstalt, Braunschweig, Germany*

Poster 5: LONG BASELINE TWSTFT BETWEEN NICT AND PTB

M. Fujieda, T. Gotoh, M. Aida, J. Amagai, and H. Maeno, *National Institute of Information and Communications Technology, Tokyo, Japan*; D. Piester and A. Bauch, *Physikalisch-Technische Bundesanstalt, Braunschweig, Germany*

Poster 6: EFFECTS OF THE ROOFTOP ENVIRONMENT ON GPS TIME TRANSFER

Michael A. Lombardi and Andrew N. Novick, *Time and Frequency Division, National Institute of Standards and Technology*

Poster 7: ESTIMATE THE RECEIVER DELAY FOR IONOSPHERE-FREE CODE (P3) GPS TIME TRANSFER

Victor Zhang, *Time and Frequency Division, National Institute of Standards and Technology*

Poster 8: ENHANCEMENTS TO TIME.GOV: THE NATIONAL WEB CLOCK FOR THE UNITED STATES
Andrew N. Novick, *National Institute of Standards and Technology***Poster 9: AN APPROACH TO PRIMARY NTP BY USING THE LINUX KERNEL**

Carsten Rieck, *Swedish National Testing and Research Institute*

1730 – 1830 **JOINT EXECUTIVE AND ADVISORY BOARD MEETING**

1900 – 2030 **SPECIAL EVENT – PROJECT GREAT: GENERAL RELATIVITY EINSTEIN/ ESSEN ANNIVERSARY TEST**
Presented by Tom Van Baak, LeapSecond.com

THURSDAY, DECEMBER 7, 2006**SESSION IX TIME TRANSFER**

Chairman: Kevin Shmulik, *U.S. Coast Guard LORAN Support Unit*

0800 – 0820 Paper 23: STABILIZED PHOTONIC LINKS FOR FREQUENCY AND TIME TRANSFER IN ANTENNA ARRAYS

S. Huang and R. L. Tjoelker, *Jet Propulsion Laboratory, California Institute of Technology*

0820 – 0840 Paper 24: RELATIVISTIC TRANSFORMATIONS FOR TIME SYNCHRONIZATION AND DISSEMINATION IN THE SOLAR SYSTEM

Robert A. Nelson, *Satellite Engineering Research Corporation*; Todd Ely, *Jet Propulsion Laboratory*

0840 – 0900 Paper 25: TIME DISSEMINATION ALTERNATIVES FOR THE NASA SPACE EXPLORATION PROGRAM
Al Gifford, *NASA Headquarters*; Robert A. Nelson, *Satellite Engineering Research Corporation*; Richard S. Orr, *SATEL LLC*; A.J. Oria and Beryl L. Brodsky, *Overlook Systems Technologies***0900 – 0920 Paper 26: T2L2 ON JASON-2, FIRST EVALUATION OF THE FLYING MODEL**

Ph. Guillemot and I. Petitbon, *Microwave & Time-Frequency Department, CNES, Toulouse, France*; E. Samain, P. Vrancken, J. Weick, D. Albanese, F. Para, and J.-M. Torre, *R&D Metrology CNRS/GEMINI – Observatoire de la Côte d'Azur, Caussol, France*

0920 – 0940 Paper 27: COMPARISON PRECISE TIME TRANSFER WITH USAGE OF MULTI-CHANNEL GPS CV RECEIVERS AND OPTICAL FIBRE AT DISTANCE ABOUT 3 KM

Albin Czubla, Janusz Konopka, and Marcin Górnik, *Time and Frequency Laboratory, Electrical Metrology Division, Central Office of Measures (GUM), Warsaw, Poland*; Waldemar Adamowicz, Janusz Struc, Tadeusz Pawszak, and Józef Romsicki, *Research & Development Center, Polish Telecom (TP S.A.), Warsaw, Poland*; Marcin Lipiński, *Chair of Electronics, AGH University of Science and Technology (AGH), Kraków, Poland*

0940 – 1000 INTERMISSION**SESSION X ALGORITHMS**

Chairman: Jim Skinner, *U.S. Naval Observatory*

1000 – 1020 Paper 28: UNBIASED FIR ESTIMATES VS. THE SAWTOOTH-CORRECTED GPS-BASED MEASUREMENTS: EXPERIMENTAL EVALUATION

Yuriy S. Shmalij, Jorge Munoz-Diaz, Luis Arceo-Miquel, and Oscar Ibarra-Manzano, *Electronics, FIMEE, Guanajuato University, Salamanca, Gto., Mexico*

THURSDAY, DECEMBER 7, 2006**SESSION X ALGORITHMS (cont.)**

- 1020 – 1040 **Paper 29:** AN ENSEMBLE OF ULTRA-STABLE QUARTZ OSCILLATORS TO IMPROVE SPACECRAFT ON-BOARD FREQUENCY STABILITY
Mihran Miranian, Gregory L. Weaver, and Matthew J. Reinhart, *JHU/Applied Physics Laboratory*
- 1040 – 1100 **Paper 30:** ANALYSIS OF CLOCK MODELING TECHNIQUES FOR THE USNO CESIUM MEAN
J. Skinner, P. Koppang, *U.S. Naval Observatory*
- 1100 – 1120 **Paper 31:** STEERING UTC(AOS) BY TA(PL)
Jerzy Nawrocki and P. Ligêza, *Astrogeodynamical Observatory (AOS), Borowiec, Poland*; Z. Rau, *National Institute of Telecommunications (ITL), Warsaw, Poland*; W. Lewandowski, *Bureau International des Poids et Mesures (BIPM), Sèvres*
- 1120 – 1140 **Paper 32:** TIME DILATION AND THE LENGTH OF THE SECOND: WHY TIMESCALES DIVERGE
Steven D. Deines, *SiRF Technology, Inc.*; Carol A. Williams, *Mathematics Department, University of South Florida*
- 1140 – 1300 **LUNCH**
- SESSION XI GALILEO & GPS**
Chairman: Pascal Rochat, *Temex Time*
- 1300 – 1320 **Paper 33:** GALILEO SYSTEM TIME PHYSICAL GENERATION
X. Stehlín, Q. Wang, F. Jeanneret, and P. Rochat, *Temex Neuchâtel Time*
- 1320 – 1340 **Paper 34:** GALILEO IOV SYSTEM INITIALIZATION AND LCVTT TECHNIQUE EXPLOITATION
M. Gotta, F. Gottifredi, S. Piazza, and D. Cretoni, *Alcatel Alenia Space*; E. Detoma, *Sepa*
- 1340 – 1400 **Paper 35:** GPS CHANGES DURING THE LEGACY ACCURACY IMPROVEMENT INITIATIVE
Marc A. Weiss and Judah Levine, *NIST Time and Frequency Division*
- 1400 – 1420 **Paper 36:** TIME COORDINATION THROUGHOUT THE AMERICAS VIA THE SIM COMMON-VIEW GPS NETWORK
Michael A. Lombardi and Andrew N. Novick, *National Institute of Standards and Technology*; J. Mauricio Lopez R, *Centro Nacional de Metrología (CENAM)*; Jean-Simon Boulanger and Raymond Pelletier, *National Research Council (NRC)*, Carlos Donado M, *Centro Nacional de Metrología de Panamá (CENAMEP)*

THURSDAY, DECEMBER 7, 2006**SESSION XI GALILEO & GPS (cont.)**

- 1420 – 1440 **Paper 37:** IMPROVING THE PERFORMANCE OF LOW COST GPS TIMING RECEIVERS
Thomas A Clark, *(NASA/GSFC Retired)*; Richard M Hambly, *CNS Systems, Inc.*
- 1440 – 1500 **INTERMISSION**
- SESSION XII TWO-WAY TIME & FREQUENCY TRANSFER**
Chairman: Victor Zhang, *National Institute of Standards and Technology*
- 1500 – 1520 **Paper 38:** REAL-TIME TWO-WAY TIME TRANSFER TO AIRCRAFT
Jeremy Warriner, John Hein, and Tom Celano, *Timing Solutions Corporation*; CAPT Richard Beckman, *United States Air Force*
- 1520 – 1540 **Paper 39:** A LONG-TERM COMPARISON OF GPS CARRIER-PHASE FREQUENCY TRANSFER AND TWO-WAY SATELLITE TIME/FREQUENCY TRANSFER
Christine Hackman, *JILA - University of Colorado*; Judah Levine and Thomas E. Parker, *National Institute of Standards and Technology*
- 1540 – 1600 **Paper 40:** TWO-WAY TIME TRANSFER USING LOW POWER VSAT
Jeremy Warriner and Tom Celano, *Timing Solutions Corporation*; CAPT Richard Beckman, *U.S. Air Force*; Angela Davis-McKinley, *U.S. Naval Observatory*
- 1600 – 1620 **Paper 41:** CARRIER PHASE TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER DEVELOPMENT PLAN AT NMIIJ
Tomonari Suzuyama, Michito Imae, Yasuhisa Fujii, and Masaki Amemiya, *National Metrology Institute of Japan (NMIIJ)/National Institute of Advanced Industrial Science and Technology (AIST)*
- 1620 – 1640 **GENERAL DISCUSSION**
Joe White, *U.S. Naval Research Laboratory*
- 1640 **CLOSE OF MEETING**

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