

PROGRAM

**FORTY-SECOND ANNUAL
PRECISE TIME AND TIME INTERVAL (PTTI)
SYSTEMS AND APPLICATIONS MEETING**



November 15 – 18, 2010

**42 Years of Progress
1969 – 2010**

**Hyatt Regency
Reston, Virginia**

SCHEDULE

Monday, November 15, 2010

0800 – 1300 Exhibition setup of booth for Exhibitors
0730 – 0830 Tutorials Breakfast
0830 – 1630 Tutorials
1300 – 1700 Exhibitor Setup
1700 – 1830 Icebreaker - Exhibitor Area
1830 – 2100 Exhibitor Setup
1900 – 2100 Registration*

Tuesday, November 16, 2010

0700 – 1600 Registration*
0700 – 0800 Speakers' Breakfast
0700 – 1600 Speakers' Room
0700 – 0800 Attendees' Breakfast
0800 – 1700 Technical Exhibits**
0800 – 0805 Opening
0805 – 0810 Distinguished PTTI Service Award
0810 – 0815 In Memoriam – Harry Peters
0815 – 0830 Opening Remarks
0830 – 0835 Technical Chair Call to Session
0835 – 0950 Session I: National Laboratory Updates
0950 – 1010 Intermission
1010 – 1140 Session II: Vendor Presentations
1140 – 1300 Lunch
1300 – 1420 Session III: Atomic Standards
1420 – 1440 Intermission
1440 – 1600 Session IV: Space Clocks and GNSS
1600 – 1620 Introduction of Student Papers
1620 – 1740 Session V: Poster Session
1830 – 2000 Reception

Wednesday, November 17, 2010

0700 – 1600 Registration*
0700 – 0800 Speakers' Breakfast
0700 – 1600 Speakers' Room
0700 – 0800 Attendees' Breakfast
0800 – 1700 Technical Exhibits**
0800 – 0940 Session VI: Time Transfer
0940 – 1000 Intermission
1000 – 1140 Session VII: IEEE 1588 and NTP
1140 – 1150 Announcement of Student Paper Winners
1150 – 1320 Lunch
1320 – 1500 Session VIII: PTTI and Network Applications
1500 – 1520 Intermission
1520 – 1620 Session IX: Panel Discussion – GPS Mitigation in Challenged Environments
1700 – 1800 Joint Executive and Advisory Board Meeting
1900 – 2030 Special Event

Thursday, November 18, 2010

0700 – 1200 Registration*
0700 – 0800 Speakers' Breakfast
0700 – 1600 Speakers' Room
0700 – 0800 Attendees' Breakfast
0800 – 0940 Session X: Optical Time and Frequency Transfer
0940 – 1000 Intermission
1000 – 1140 Session XI: Clock Performance
1140 – 1310 Lunch
1310 – 1510 Session XII: Algorithms and Calibration
1510 – 1520 General Discussion
1520 Close of Meeting

*Registration is available each day. **Exhibits are open Tuesday and Wednesday only.

PROGRAM

FORTY-SECOND 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

November 15 — 18, 2010



**Hyatt Regency Reston Town Center
Reston, Virginia**

TABLE OF CONTENTS

Schedule.....	First Page
Registration Card	Second Page
Objectives.....	iii
Registration	iv
Cancellation Policy	iv
PTTI on the Web	iv
PTTI 2010 Tutorials Sessions	v
Registration Desk Hours	v
Questions	v
Hotel Reservations	vi
Messages	vi
Temperature.....	vi
Tours	vi
Transportation Information	vi
Parking	vii
Directions.....	vii
Speakers' Breakfast	viii
Presented Papers.....	viii
Exhibit Information.....	viii
List of Potential Exhibitors	viii
Student Poster Competition	ix
PTTI 2010 Evening Activities	ix
Proceedings.....	ix
43 rd Annual PTTI Meeting.....	ix
PTTI Executive Committee.....	x
PTTI Advisory Board	xi
2010 Distinguished PTTI Service Award Committee	xii
PTTI 2010 Meeting Officers	xiii
PTTI 2010 Session Chairs	xiv
PTTI 2010 Agenda	xv-xxii
Hotel Reservation Card	Last Page

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
- Time Transfer — Theory, Techniques and Applications
- PTTI in Current Applications
- Atomic and Advanced Clocks
- Novel PTTI Applications
- Time Scales, Algorithms & Methods
- Timing Systems & Applications
- Military Applications
- Global Navigation Satellite Systems (GNSS)
- Receivers — Timing and Calibration
- Student Poster Competition

WELCOME TO PTTI 2010

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

Treasurer, PTTI
c/o Mrs. Sheila Faulkner
3159 Patrick Henry Drive
Falls Church, VA 22044 USA

When paying by check, the envelope must be postmarked on or before **October 15** to receive all early discounts. All checks must be received no later than **November 1**.

Register online: <http://pttimeeting.org/registration.html>. Online registration will be available until **November 1**. After that date, registration must be completed onsite.

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

PTTI accepts Visa, MasterCard and Discover via PayPal. A PayPal account is not required to complete the transaction. To pay with your credit card, please register online <http://pttimeeting.org/registration.html>. The resulting charge will appear on your statement as "PTTI Meeting."

The full registration fee is \$600 (early discounted fee is \$550). Full registration includes entry to the sessions and exhibit hall, the Tuesday and Thursday luncheons, the Monday evening Ice Breaker, the Tuesday evening Welcoming Reception and one copy of the Proceedings. The fee increases on **October 16**.

The registration fee for full-time students is \$75 and includes all Full Registration benefits. **The registration fee for full-time retirees is \$75** and includes entry to the sessions and exhibit area only. **The One Day registration fee is \$200** and includes entry to the sessions, exhibit hall and the offered lunch for that day ONLY.

The tutorials registration fee is \$300 (early discounted fee is \$250) and includes breakfast, lunch and a copy of the presentations. The fee increases on **October 16**. The tutorials will be held **Monday, November 15**.

Tickets for the luncheons (\$25 each) and the reception (\$55 each) can be purchased at the PTTI Registration Desk. Extra copies of the Proceedings are also available for purchase.

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.

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

Cancellation policy

All requests for cancellation must be received in writing before October 15, 2010. On or after October 15, there is a \$300 cancellation fee. Refunds are not given for "no shows"; however, substitutions are allowed.

PTTI on the Web

Access PTTI online: <http://www.pttimeeting.org>

PTTI 2010 Tutorials Session

The Tutorials Session will take place on **Monday, November 15**. The Tutorials are intended for engineers, mathematicians, scientists or anyone who is new to the field of PTTI, as well as those who have been a part of the PTTI community. Please contact **Francine Vannicola**, francine.vannicola@nrl.navy.mil, 202-404-4015 (DSN 754-4015) for information on the Tutorials Session. Additional information on the speakers and the presentations is also available on the PTTI website, <http://www.pttimeeting.org/tutorials.html>.

Time	Subject	Presenter
0830 – 0930	Time Recovery in the Field	Sam Stein Symmetricom, Inc.
0930 – 1030	Satellite Time & Frequency Transfer	Ron Beard U.S. Naval Research Laboratory
1045 – 1145	Traceability in Time and Frequency Metrology	Mike Lombardi National Institute of Standards and Technology
1330 – 1430	Advanced Clocks	Robert Lutwak Symmetricom, Inc.
1445 – 1545	IEEE-1588 Telecommunications Applications	Lee Cosart Symmetricom, Inc.

The registration fee for the Tutorials Session is **\$250 postmarked on or before October 15** and **\$300 on and after October 16**. The fee includes breakfast, lunch and a copy of the Tutorials presentations (notebook and CD).

Registration Desk Hours

The registration desk will be open during the following hours:

Monday, November 15, 1900 – 2100
Tuesday, November 16, 0700 – 1600
Wednesday, November 17, 0700 – 1600
Thursday, November 18, 0700 – 1200

Questions

Please contact the following people for information on matters concerning:

Technical questions

Francine Vannicola
202-404-4015
francine.vannicola@nrl.navy.mil

Exhibits

Gary Geil
949-361-0212
gary@gmasales.com

Don Mitchell
928-474-1088
don@gmasales.com

General

Sheila Faulkner
703-532-6411, Cell: 703-244-6346
bopenyan@aol.com

Registration

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

Hotel Reservations

Mail or FAX the hotel reservation card (located on the last page) to:

**Hyatt Regency Reston Town Center
(PTTI 2010 Room Block)
1800 Presidents Street
Reston, Virginia, USA 20190
703-709-1234, Fax 703-925-8295**

When making your reservations, be sure to mention PTTI 2010 to receive the group sleeping room rate. The PTTI rate is available November 10 – 22. Check-in time is 1500 (3:00 PM) and checkout time is Noon. Rooms will only be held if guaranteed with a credit card. The block of reserved rooms will be released **October 20**, so reserve early. 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.

The PTTI 2010 room rate is the government per diem rate of \$207.

Messages

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

Temperature

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

Tours

Tour information will be posted on the PTTI website, <http://pttimeeting.org>.

Transportation Information

Official Airline

American Airlines is the official airline for **PTTI 2010**. The Promotion Code is **35N9AI**.

U.S. and Canadian attendees: To make reservations, Please visit <http://www.AA.com> or call **800-433-1790** and refer to the Promotion Code.

International attendees: To make reservations, please call your local reservations number and refer to the Promotion Code (STARfile 35N9AI).

Please be advised that there is a separate ticketing charge of \$20.00 USD per ticket for tickets purchased via the phone or \$30.00 USD per ticket for tickets purchased at the airport (this amount is subject to change). At this time, there is no ticketing fee for reservations made and ticketed through the American Airlines website.

Official Rental Car

Avis is the official rental car agency for **PTTI 2010**. The Avis Worldwide Discount (AWD) Number is **G027999**. Please use this AWD number when calling Avis directly at **888-754-8878** to receive the best car rental rates available. The discount includes unlimited mileage and is available from seven days before to seven days after the meeting. To make your reservation online, visit <https://www.avis.com>.

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 \$24.00 overnight, with in/out privileges. Valet parking for the day only is \$12.00. Self parking is available at no charge. The parking areas are large enough to accommodate vans.

Directions

Washington Dulles International Airport (6.59 miles)

From airport take Dulles Access Road East toward Washington, DC. At Reston, use Exit 12, Reston Parkway / VA 602 and make a Left on to Reston Parkway. Third traffic light turn left onto Bluemont Way. Turn right onto Presidents Street to the Northern VA hotel.

Ronald Reagan Washington National Airport / Washington, DC (22 miles)

Head north on the George Washington Memorial Parkway (crossing over into Virginia). Take the VA-123 exit toward Chain Bridge / McLean. Keep right at the fork to go on VA -123 S. Merge onto VA-267 W toward I-495 N / Dulles Airport (Portions toll). Take Reston Parkway / VA-602 exit- Exit 12. At the second traffic light turn left onto Bluemont Way. Turn right onto Presidents Street to the hotel in Northern VA.

Baltimore and Points North (55.11 miles or more)

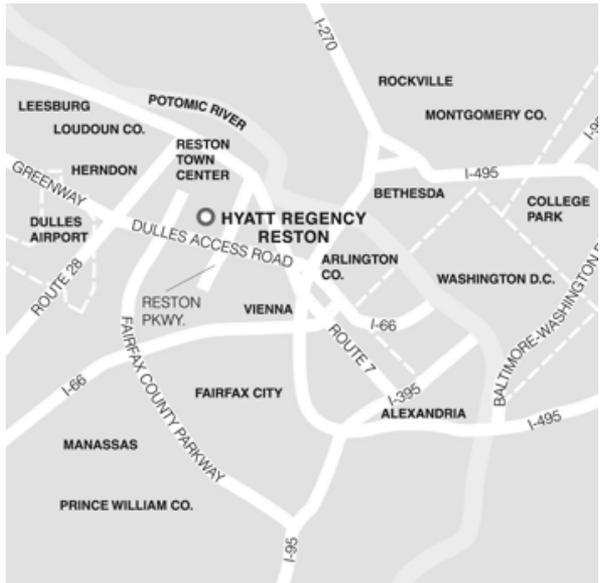
Follow I-95 South to Washington, DC beltway then exit right (west) onto I-495. Follow I -495 across the Potomac River into Virginia and exit right onto Rt. 267-Exit 45A toward Dulles Airport / Dulles Toll Road. Take Reston Parkway / VA-602 exit-Exit 12. At the second traffic light turn left onto Bluemont Way. Turn right onto Presidents Street to the Northern VA hotel.

Richmond and Points South (115.20 miles or more)

Follow I-95 North to Washington, DC beltway (at Springfield), then exit onto I-495 (north). Follow I-495 to Rt. 267-Exit 45A, toward Dulles Airport / Dulles Toll Road. Take Reston Parkway / VA-602 exit-Exit 12. Keep right at the fork to go on Reston Parkway / VA-602 N. Turn Left onto Bluemont Way. Turn right onto Presidents Street to the hotel in Northern VA.

Leesburg and Points West (19.72 miles or more)

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. Third traffic light turn left onto Bluemont Way. Turn right onto Presidents Street to the Northern VA hotel.



Speakers' Breakfast

The author giving the oral presentation must attend the Speakers' Breakfast on the morning of the presentation. Please ask at the PTTI Registration Desk for the location. The Speakers' Breakfast will be held from 0700-0800 on Tuesday, Wednesday and Thursday. The purpose of this breakfast is to allow the Session Chairs to meet each of the presenters and coordinate any last minute details. This is also the time when the audio-visual equipment and the timing lights will be demonstrated. The Speakers' Breakfast is a mandatory event for each speaker giving a scheduled paper that day. If the presenter is not in attendance, the Session Chairs will not know if the presenter is prepared to present and may be forced to cancel the presentation.

Presented Papers

Presenters must send their presentations in PowerPoint (versions accepted up to 2010: all files must be PC/Windows compatible) to **presentations@pttimeeting.org** by **November 8**. In the event this deadline cannot be met, a CD-ROM or flash drive containing the presentation must be delivered to Mr. Douglas Boehm **by 1800 the day before the presentation**.

Please send a Microsoft Word electronic version of your Paper (e-mail, CD-ROM), formatted according to the PTTI Paper Preparation Instructions included in the Author's Kit, to Dr. Lee Breakiron, Editorial Chairman (lee.breakiron@usno.navy.mil) **by November 18**. If prior arrangements have not been made, the Paper will not be published in the Proceedings. The Author's Kit can be downloaded from http://www.pttimeeting.org/author_kit.pdf

Exhibits

The exhibits co-chairs are:

Gary Geil and Don Mitchell

Geil Marketing Associates

934 Calle Negocio Suite B, San Clemente, CA 92673

949-361-0212, Fax 949-361-0312

gary@gmasales.com or don@gmasales.com

List of Potential Exhibitors for PTTI 2010

Astrogeodynamical Observatory	Morion, Inc.
AccuBeat, Ltd.	NavTech GPS Supply
Brandywine Communications	Noise eXtended Technologies S.A.S.
Brilliant Instruments, Inc.	OEwaves
Brilliant Telecommunications	Osborne Technologies
EndRun	Pascall
Evertz	PikTime Systems, LTD
Frequency Electronics, Inc.	Poseidon Scientific Instruments
Furuno GPS OEM	Precise Time and Frequency, Inc.
GMV Aerospace and Defence, S.A.	Quartzlock
GPS Networking	Sanders & Associates, Inc.
GPS World/Questex Media	SigNav
GPS Source	Spectracom Corp/Pendulum Instruments
GuideTech	SpectraDynamics, Inc.
The Historical Electronics Museum	SpectraTime
Inside GNSS	Spectrum Instruments, Inc.
The Institute of Navigation	Symmetricom – Timing Test and Measurements
ITT	Synergy Systems
Jackson Labs	Time & Frequency Solutions
JTime! Meinberg USA	TimeTech, LLC GmbH
Lange-Electronic GmbH	TRAK Microwave Corporation
Locus	Trimble Navigation
Military University of Technology	U.S. Naval Observatory
Mira Vista Technologies	XECO, Inc.
Masterclock, Inc.	

Student Poster Competition

The fourth annual PTTI Student Poster competition will take place at this year's PTTI. The goal is to get students thinking early in their careers about the engineering and scientific applications of precise timing (in the broadest sense) and in that way maintain the vitality of our field in the 21st century. The competition also offers an opportunity for students to meet future employers and for employers to get a better sense of what skills young engineers and scientists are bringing to the marketplace.

The competition has an undergraduate and graduate division and submitted abstracts will cover any area dealing with "precise" timekeeping systems or applications. In light of the competition's goal, there is a wide range of topics that students might address (i.e., biological to geophysical to astronomical). Consequently, the specific meaning of the word "precise" is taken in context. Abstracts can be submitted for posters dealing with literature reviews, laboratory work, or computational investigations.

Questions concerning the Student Poster Competition should be addressed to Mrs. Rachel Evans-Binfield, rachel.binfield@jhuapl.edu.

PTTI 2010 Evening Activities

On Monday, November 15 at 1700, the "Get Acquainted" Icebreaker function will be held in the Exhibits Hall. Refreshments will be served.

The Welcoming reception will be held Tuesday, November 16 at 1830.

On Wednesday, November 17 at 1900, PTTI 2010 is pleased to have Mrs. Carlene E. Stephens, Curator, Division of Work and Industry from the Smithsonian's National Museum of American History. Mrs. Stephens will provide a preview of "Time and Navigation," a new exhibit opening in late 2012 at the Smithsonian's National Air and Space Museum. Refreshments will be served.

Proceedings

The Proceedings will be available on CD and mailed to the attendees in 2011. 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.

Forty-third Annual PTTI Meeting

The 43rd Annual PTTI Systems and Applications Meeting (PTTI 2011) will be held November 14 — 17, 2011, at the Hyatt Regency, Long Beach, California.

PTTI EXECUTIVE COMMITTEE

MS. FRANCINE M. VANNICOLA, CHAIRMAN
U.S. Naval Research Laboratory

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

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

MR. RICHARD CAMP
Defense Information Systems Agency

MS. NANCY C. HAMILTON
Department of Defense

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

CAPT. FRED PARKER
U.S. Coast Guard Navigation Center

DR. ROBERT L. TJOELKER
NASA Jet Propulsion Laboratory

DR. JOSEPH D. WHITE
U.S. Naval Research Laboratory

PTTI ADVISORY BOARD MEMBERS

MR. S. CLARK WARDRIP, CHAIRMAN

Global Strategies Group (North America) (GSGNA), Inc.

MR. MARTIN B. BLOCH, TREASURER

Frequency Electronics, Inc.

DR. EDOARDO DETOMA
SEPA S.p.A

DR. BRADFORD W. PARKINSON
Stanford University

MRS. SHEILA FAULKNER
GSGNA, Inc.

DR. VICTOR S. REINHARDT
Raytheon Space and Airborne Systems

DR. HENRY F. FLIEGEL
The Aerospace Corporation

MR. PASCAL ROCHAT
SpectraTime

MR. HUGO FRUEHAUF
ViaLogy LLC

MR. RONALD C. ROLOFF
Geil Marketing Associates, Inc.

DR. R. MICHAEL GARVEY
Symmetricom

DR. LARA S. SCHMIDT
The RAND Corporation

MR. GARY GEIL
Geil Marketing Associates, Inc.

DR. SAMUEL R. STEIN
Symmetricom, Inc

DR. WILLIAM J. KLEPCZYNSKI
U.S. Naval Observatory (Retired)

DR. PATRIZIA TAVELLA
INRIM

MR. WERNER R. LANGE
Lange-Electronic GmbH

PROFESSOR JACQUES VANIER
University of Montreal

DR. LEO A. MALLETTE
The Aerospace Corporation

DR. YAKOV L. VOROKHOVSKY
Morion, Inc.

MR. DONALD H. MITCHELL
Geil Marketing Associates, Inc.

DR. ANDY WU
The Aerospace Corporation

**2010 DISTINGUISHED PTTI SERVICE AWARD
SELECTION COMMITTEE**

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

DR. LEO A. MALLETTE
The Aerospace Corporation

MR. DON H. MITCHELL
Geil Marketing Associates

DR. JACQUES VANIER
University of Montreal

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

2006
PROFESSOR DAVID L. MILLS
University of Delaware

2007
DR. R. MICHAEL GARVEY
Symmetricom

2008
DR. PATRIZIA TAVELLA
Istituto Nazionale di Ricerca Metrologica

2009
DR. JUDAH LEVINE
National Institute of Standards and
Technology

PTTI 2010 MEETING OFFICERS

GENERAL CHAIRMAN
DR. LEO A. MALLETTE
The Aerospace Corporation

TECHNICAL PROGRAM COMMITTEE CHAIRMAN
MRS. RACHEL EVANS-BINFIELD
Johns Hopkins University/Applied Physics Laboratory

TECHNICAL PROGRAM COMMITTEE CO-CHAIRMAN
DR. STEVEN JEFFERTS
National Institute of Standards and Technology

TUTORIALS CHAIRMAN
MS. FRANCINE VANNICOLA
U.S. Naval Research Laboratory

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
MR. DOUG BOEHM
U.S. Naval Research Laboratory

MEETING ARRANGEMENTS
MRS. SHEILA FAULKNER
Global Strategies Group (North America), Inc.

REGISTRATION
MS. NICOLETTE JARDINE
U.S. Naval Research Laboratory

PTTI 2010 SESSION CHAIRS

SESSION I: National Laboratory Updates

GREG WEAVER

Johns Hopkins University/Applied Physics Laboratory

SESSION II: Vendor Presentations

RYAN DUPUIS

PerkinElmer Inc.

SESSION III: Atomic Standards

STEVEN JEFFERTS

National Institute of Standards and Technology

SESSION IV: Space Clocks and GNSS

DENNIS MANNING

National Geospatial-Intelligence Agency

SESSION V: Poster Session

JAMES CAMPARO

The Aerospace Corporation

SESSION VI: Time Transfer

CHRISTINE HACKMAN

U.S. Naval Observatory

SESSION VII: IEEE 1588 and NTP

GEORGE SHATON

Northrup Grumman

SESSION VIII: PTTI and Network Applications

JAMES WRIGHT

L-3 Communications

SESSION IX: Panel Discussion – GPS Mitigation in Challenged Environments

DENNIS MCCARTHY

U.S. Naval Observatory

RONALD BEARD

U.S. Naval Research Laboratory

SESSION X: Optical Time and Frequency Transfer

JAMES HANSSEN

U.S. Naval Observatory

SESSION XI: Clock Performance

STEFANIA ROMISCH

National Institute of Standards and Technology

SESSION XII: Algorithms and Calibration

PATRIZIA TAVELLA

Istituto Nazionale di Ricerca Metrologica

**PTTI 2010
FORTY-SECOND ANNUAL
PRECISE TIME AND TIME INTERVAL (PTTI)
SYSTEMS AND APPLICATIONS MEETING**

TUESDAY, NOVEMBER 16, 2010

- 0800 – 0805 **OPENING**
Leo A. Mallette, *The Aerospace Corporation*
- 0805 – 0810 **IN MEMORIAM – HARRY PETERS**
Paul Koppang, *U.S. Naval Observatory*; Clark Wardrip,
GSGNA, Inc.
- 0810 – 0815 **DISTINGUISHED PTTI AWARD PRESENTATION**
- 0815 – 0830 **OPENING REMARKS**
CAPT R. Scott Steadley, Superintendent, *U.S. Naval
Observatory*
- 0830 – 0835 **CALL TO SESSION**
Rachel Binfield, *Johns Hopkins University/Applied Physics
Laboratory*
- SESSION I NATIONAL LABORATORY UPDATES**
Chairman: Greg Weaver, *Johns Hopkins University/Applied
Physics Laboratory*
- 0835 – 0850 **Paper 1: TIME AND FREQUENCY ACTIVITIES AT THE U.S.
NAVAL OBSERVATORY**
D. Matsakis, *U.S. Naval Observatory*
- 0850 – 0905 **Paper 2: TIME AND FREQUENCY ACTIVITIES AT THE JHU
APPLIED PHYSICS LABORATORY**
M. Miranian, G. Weaver, M. Reinhart and R. Dragonette, *Johns
Hopkins University/Applied Physics Laboratory*
- 0905 – 0920 **Paper 3: TIME AND FREQUENCY ACTIVITIES AT THE
NAVAL RESEARCH LABORATORY**
R. Beard, *U.S. Naval Research Laboratory*
- 0920 – 0935 **Paper 4: ACTIVITIES AT THE STATE TIME AND
FREQUENCY STANDARD OF RUSSIA**
N. Koshelyaevsky, V. Kostromin, O. Sokolova, Zagirova, *Department
of Metrology for Time and Space FGUP "VNIIFTRI," Russia*
- 0935 – 0950 **Paper 5: TIMEKEEPING OF NTSC IN RECENT YEARS**
H. Yuan and L. Qu, *Chinese Academy of Sciences, China*
- 0950 – 1010 **INTERMISSION**
- SESSION II VENDOR PRESENTATIONS**
1010 – 1140 **Chairman:** Ryan Dupuis, *PerkinElmer Inc.*

TUESDAY, NOVEMBER 16, 2010

1140 – 1300 **LUNCH**

SESSION III ATOMIC STANDARDS

Chairman: Steven Jefferts, *National Institute of Standards and Technology*

1300 – 1320 **Paper 6:** MCAFS – A MINIATURE COLD ATOM FREQUENCY STANDARD

V. Shah, A. Martins and R. Lutwak, *Symmetricom*

1320 – 1340 **Paper 7:** PERFORMANCE OF FEI SPACE-CLASS RUBIDIUM ATOMIC STANDARDS

M. Bloch, O. Mancini and T. McClelland, *Frequency Electronics, Inc.*

1340 – 1400 **Paper 8:** 10^{-10} LEVEL SIMPLE SINGLE OVEN OCXO

M. Ito, H. Mitome, T. Oita and N. Dempa, *Kogyo Co., Ltd., Japan*

1400 – 1420 **Paper 9:** A RUBIDIUM PORTABLE ATOMIC FOUNTAIN FREQUENCY STANDARD

P. Kunz, T.P. Heavner and S.R. Jefferts, *National Institute of Standards and Technology*

1420 – 1440 **INTERMISSION**

SESSION IV SPACE CLOCKS AND GNSS

Chairman: Dennis Manning, *National Geospatial-Intelligence Agency*

1440 – 1500 **Paper 10:** ACTUAL OPERATION SIMULATION OF RESOX GROUND EXPERIMENTS

T. Iwata, K. Saito, K. Machita and T. Matsuzawa, *National Institute of Advanced Industrial Science and Technology, Japan*

1500 – 1520 **Paper 11:** GALILEO COMMON VIEW: FORMAT, PROCESSING AND TESTS WITH GIOVE

P. Defraigne, *Royal Observatory of Belgium*; and A. Mudrak, S. Binda, *Galileo Project Office, European Space Agency*

1520 – 1540 **Paper 12:** LONG-TERM PERFORMANCE ANALYSIS OF GIOVE CLOCKS

P. Waller, F. Gonzalez, S. Binda, *European Space Agency, ESA-ESTEC, The Netherlands*; D. Rodriguez and G. Tobias, *GMV S.A., Spain*; and A. Cernigliaro, P. Tavella, *Istituto Nazionale di Ricerca Metrologica, Italy*

1540 – 1600 **Paper 13:** GPS BLOCK IIF ATOMIC FREQUENCY STANDARDS ANALYSIS

F. Vannicola, R. Beard, J. White, K. Senior, *U.S. Naval Research Laboratory*; M. Largay, *Global Defense Technology & Systems Inc.*; and J. Buisson, *Antoine Enterprises Inc.*

TUESDAY, NOVEMBER 16, 2010

1600 – 1620

INTRODUCTION OF STUDENT PAPERS

James Camparo, *The Aerospace Corporation*

SESSION V

1620 – 1740

POSTER SESSION

Chairman: James Camparo, *The Aerospace Corporation*

Poster 1: STUDIES ON IMPROVED COMPACT PHYSICS PACKAGE FOR RB CELL STANDARDS

T. Bandi, C. Affolderbach and G. Mileti, *Laboratoire Temps-Fréquence, University of Neuchâtel, Switzerland*

Poster 2: SPUR CORRELATION IN AN ARRAY OF DIRECT DIGITAL SYNTHESIZERS

T.M. Comberiate, K.C. Lauritzen, L.B. Ruppalt, C.A. Lugo and S.H. Talisa, *Johns Hopkins University/Applied Physics Laboratory*

Poster 3: EVALUATION OF A GPS RECEIVER FOR CODE AND CARRIER-PHASE TIME AND FREQUENCY TRANSFER

V. Zhang and M. Lombardi, *National Institute of Standards and Technology*

Poster 4: HOW TO HANDLE A SATELLITE CHANGE IN AN OPERATIONAL TWTSFT NETWORK?

K. Liang, *National Institute of Metrology, China*; and T. Feldmann, D. Piester, A. Bauch, *Physikalisch-Technische Bundesanstalt, Germany*

Poster 5: CHARACTERIZATION OF PHASE NOISE EFFECTS IN THE PHOTODETECTION OF ULTRASHORT OPTICAL PULSES

J.A. Taylor, *Department of Physics, University of Colorado*; F. Quinlan, A. Hati, C. Nelson, S.A. Diddams, *National Institute of Standards and Technology*; and S. Datta, A. Joshi, *Discovery Semiconductors, Inc.*

Poster 6: INRIM TIME AND FREQUENCY LABORATORY: A NEW DATA MANAGEMENT SYSTEM (DMS)

V. Pettiti, R. Costa, G. Cerretto, F. Cordara, P. Tavella, D. Orgiazzi and G. Reffo, *Istituto Nazionale di Ricerca Metrologica, Italy*

Poster 7: THE STABILITY OF CARRIER-PHASE GPS RECEIVERS

L.A. Breakiron, *U.S. Naval Observatory*

Poster 8: PTTI 2030 – SYSTEM APPLICATIONS OF ADVANCED CLOCKS

R. Dupuis, *PerkinElmer Inc.*; and B. Owings, *Symmetricom*

Poster 9: PTTI 2030 – TIME TRANSFER AND APPLICATIONS IN 2030

J. Wright, *L-3 Communications*; and S. Mitchell, *U.S. Naval Observatory*

TUESDAY, NOVEMBER 16, 2010

SESSION V POSTER SESSION *(cont.)*

Poster 10: PTTI 2030 – THINKING OUTSIDE THE BOX
P. Kunz and S. Römisch, *National Institute of Standards and
Technology*

1830 – 2000 **RECEPTION**

WEDNESDAY, NOVEMBER 17, 2010

SESSION VI TIME TRANSFER

Chairman: Christine Hackman, *U.S. Naval Observatory*

- 0800 – 0820 **Paper 14:** ACCURACY AND PRECISION OF USNO GPS CARRIER PHASE TIME TRANSFER
C. Hackman and D. Matsakis, *U.S. Naval Observatory*
- 0820 – 0840 **Paper 15:** SIMPLE METHODS FOR THE ESTIMATION OF THE SHORT TERM STABILITY OF GNSS ON BOARD CLOCKS
J. Delporte, C. Boulanger and F. Mercier, *CNES – French Space Agency, France*
- 0840 – 0900 **Paper 16:** NEAR REAL-TIME MONITORING OF FREQUENCY STANDARDS AND TIME SCALES USING PPP
G. Cerretto, P. Tavella, *Istituto Nazionale di Ricerca Metrologica, Italy*; F. Lahaye, Y. Mireault, *Natural Resources Canada*; and D. Rovera, *LNE-SYRTE, OP, France*
- 0900 – 0920 **Paper 17:** AOS STUDIES ON USE OF GNSS FOR TIME TRANSFER
J. Nawrocki, P. Nogaś and P. Lejba, *Astrogeodynamical Observatory, Poland*
- 0920 – 0940 **Paper 18:** INTEGRATED DOPPLER CORRECTION TO TWSTFT USING ROUND-TRIP MEASUREMENT
Y. Huang, W. Tseng and S. Lin, *Telecommunication Laboratories, Chunghwa Telecom, Taiwan*
- 0940 – 1000 **INTERMISSION**
- SESSION VII IEEE-1588 AND NTP**
- Chairman:** George Shaton, *Northrup Grumman*
- 1000 – 1020 **Paper 19:** PERFORMANCE OF IEEE 1588 IN LARGE-SCALE NETWORKS
G. Gaderer, N. Simanic, P. Loschmidt and B. Coric, *Institute for Integrated Sensor Systems, Austrian Academy of Sciences, Austria*
- 1020 – 1040 **Paper 20:** LAYER 1 ETHERNET CLOCK SYNCHRONIZATION
R. Exel, G. Gaderer, *Institute for Integrated Sensor Systems, Austrian Academy of Sciences*; and N. Kerö, *Oregano Systems*
- 1040 – 1100 **Paper 21:** IEEE 1588 FREQUENCY AND TIME TRANSFER MEASUREMENT AND ANALYSIS
L. Cosart, *Symmetricom, Inc.*
- 1100 – 1120 **Paper 22:** A NETWORK TIME PROTOCOL STRATUM-1 SERVER FED BY IEEE-1588
R. Schmidt, *U.S. Naval Observatory*

WEDNESDAY, NOVEMBER 17, 2010

SESSION VII IEEE-1588 AND NTP (cont.)

1120 – 1140 **Paper 23:** TIME SYNCHRONIZING USING IEEE-1588 + SYNCHRONOUS ETHERNET IN A TIME-SETTING MODE OF OPERATION

P. S. Bedrosian, *LSI Corporation*

1140 – 1150 **ANNOUNCEMENT OF STUDENT PAPER WINNERS**

Leo Mallette, *The Aerospace Corporation*

1150 – 1320 **LUNCH**

SESSION VIII PTTI AND NETWORK APPLICATIONS

Chairman: James Wright, *L-3 Communications*

1320 – 1340 **Paper 24:** IEEE-1588 DEPLOYED ON THE EASTERN RANGE

W. Rendla and J. Wright, *L-3 Communications, SpaceLift Range Systems Contract*

1340 – 1400 **Paper 25:** A REVIEW AND ANALYSIS OF IEEE 1588 SECURITY MEASURES

A. Treytl, B. Hirschler and G. Gaderer, *Austrian Academy of Sciences, Institute for Integrated Sensor Systems, Austria*

1400 – 1420 **Paper 26:** UTC TIME TRANSFER FOR HIGH FREQUENCY TRADING (HFT) USING IS-95 CDMA BASE STATION TRANSMISSIONS AND PTP

M. Korreng, *EndRun Technologies*

1420 – 1440 **Paper 27:** THE PERFORMANCE OF ULTRA-STABLE OSCILLATORS FOR THE GRAVITY RECOVERY AND INTERIOR LABORATORY (GRAIL)

G. Weaver, J. Garstecki and S. Reynolds, *Johns Hopkins University/ Applied Physics Laboratory*

1440 – 1500 **Paper 28:** VERY PRECISE SYNCHRONIZATION OF A GROUP OF PSEUDOLITES

W. Lange, *Lange-Electronic GmbH, Germany*

1500 – 1520 **INTERMISSION**

SESSION IX PANEL DISCUSSION: GPS MITIGATION IN CHALLENGED ENVIRONMENTS

1520 - 1620 **Chairman:** Dennis McCarthy, *U.S. Naval Observatory*;
Ronald Beard, *U.S. Naval Research Laboratory*

1700 – 1800 **JOINT EXECUTIVE AND ADVISORY BOARD MEETING**

1830 – 2030 **SPECIAL EVENT – “Time and Navigation,”** a new exhibit opening in late 2012 at the Smithsonian’s National Air and Space Museum, will be presented by Mrs. Carlene E. Stephens, Curator, Division of Work and Industry from the Smithsonian’s National Museum of American History.

THURSDAY, NOVEMBER 18, 2010

SESSION X OPTICAL TIME AND FREQUENCY TRANSFER
Chairman: James Hanssen, *U.S. Naval Observatory*

0800 – 0820 **Paper 29:** STABILIZATION OF THE PROPOGATION DELAY IN THE FIBER OPTIC FREQUENCY DISTRIBUTION USING ELECTRONIC DELAY LINES
A. Czubla, *Central Office of Measures*; Ł. Śliwczyński, P. Krehlik, Ł. Buczek, M. Lipiński, *AGH University of Science and Technology*; and Jerzy Nawrocki, *Polish Academy of Sciences, Poland*

0820 – 0840 **Paper 30:** TIME TRANSFER BY LASER LINK – T2L2: FIRST RESULTS OF THE 2010 CAMPAIGN
Ph. Guillemot, S. Leon, *CNES –French Space Agency*; P. Exertier, E. Samain, F. Pierron, *OCA – Observatoire de la Côte d'Azur*; and Ph. Laurent, M. Abgrall J. Achkar, D. Rovera, K. Djerroud, *SYRTE – Observatoire de Paris, France*

0840 – 0900 **Paper 31:** SINGLE WAY FIBER-BASED TIME TRANSFER WITH ACTIVE DETECTION OF TRANSFER TIME VARIATIONS
S. Ebenhag and P. Hedekvist, *SP Technical Research Institute of Sweden*

0900 – 0920 **Paper 32:** TIME TRANSFER IN OPTICAL NETWORK
V. Smotlacha, *CESNET, Czech Republic*; A. Kuna, *Institute of Photonics and Electronics, AS CR, Czech Republic*; and W. Mache, *Bundesamt für Eich - und Vermessungswesen, Austira*

0920 – 0940 **Paper 33:** COMPENSATED FIBER OPTIC FREQUENCY DISTRIBUTION EQUIPMENT
J. MacDonald and G. Conway, *Linear Photonics, LLC*

0940 – 1000 **INTERMISSION**

SESSION XI CLOCK PERFORMANCE
Chairman: Stefania Romisch, *National Institute of Standards and Technology*

1000 – 1020 **Paper 34:** PRIMARY FREQUENCY STANDARDS AT NIST
T.P. Heavner, T.E. Parker, P. Kunz, J.H. Shirley and S.R. Jefferts, *National Institute of Standards and Technology*

1020 – 1040 **Paper 35:** CORRELATIONS IN HYDROGEN MASER FREQUENCIES
T.E. Parker, S.R. Jefferts and T.P. Heavner, *National Institute of Standards and Technology*

1040 – 1100 **Paper 36:** AN AUTOMATIC SWITCHING MATRIX (ASM) FOR THE GALILEO PTF
E. Detoma and P. Griseri, *SEPA S.p.A., Italy*; A. Moudrak, M. S. Gestido, *ESA ESTEC, The Netherlands*; and M. Bianchi, R. Zanello, *Thales Alenia Space Italia, Italy*

THURSDAY, NOVEMBER 18, 2010

SESSION XI CLOCK PERFORMANCE (*cont.*)

- 1100 – 1120 **Paper 37:** ON-BOARD GPS CLOCK MONITORING
M. Weiss, *National Institute of Standards and Technology*; R. Beard, *U.S. Naval Research Laboratory*; P. Shome, *Federal Aviation Administration*
- 1120 – 1140 **Paper 38:** PERFORMANCE COMPARISON OF TWO COMPOSITE CLOCKS SIMULATING FUTURE GPS CLOCK SCENARIOS
M. Suess, *German Aerospace Center – DLR, Germany*; D. Matsakis, *U.S. Naval Observatory*; and C.A. Greenhall, *Jet Propulsion Laboratory*

1140 – 1310 LUNCH

SESSION XII ALGORITHMS AND CALIBRATION

Chairman: Patrizia Tavella, *Istituto Nazionale di Ricerca Metrologica*

- 1310 – 1330 **Paper 39:** AN ALGORITHM FOR THE DETECTION OF FREQUENCY JUMPS IN SPACE CLOCKS
L. Galleani, *Politecnico di Torino*; P. Tavella, *INRIM*
- 1330 – 1350 **Paper 40:** ADVANCED GPS BASED TIME LINK CALIBRATION WITH PTB'S NEW CALIBRATION SYSTEM
T. Feldmann, A. Bauch, D. Piester, M. Rost, *Physikalisch-Technische Bundesanstalt, Germany*; and E. Goldberg, S. Mitchell, B. Fonville, *U.S. Naval Observatory*
- 1350 – 1410 **Paper 41:** MULTI-SCALE CLOCK ENSEMBLING USING WAVELETS
K. Senior, *U.S. Naval Research Laboratory*; and D. Percival, *University of Washington*
- 1410 – 1430 **Paper 42:** PROGRESS REPORT OF THE CNES ACTIVITIES REGARDING THE ABSOLUTE CALIBRATION METHOD
A. Proia, *Centre National d'Etudes Spatiales, France*; and G. Cibiel, *Bureau International des Poids et Mesures, France*
- 1430 – 1450 **Paper 43:** EVALUATION OF GNSS TIMING RECEIVERS
J. Prillaman, S. Mitchell, B. Fonville, B. Goldberg and E. Powers, *U.S. Naval Observatory*
- 1450 – 1510 **Paper 44:** THE REALIZATION OF TA(NIM) AND UTC(NIM)
Y. Gao, X. Gao, A. Zhang, W. Wang, D. Ning, L. Nianfeng, P. Wang, M. Li, P. Lin, W. Chen, Y. Lin and T. Li, *National Institute of Metrology, China*

- 1510 – 1520 **GENERAL DISCUSSION**
Francine Vannicola, *U.S. Naval Research Laboratory*

1520 CLOSE OF MEETING

TYPE, PRINT AND FAX (see number below)

HOTEL RESERVATION CARD

The block of rooms for the PTTI 2010 rate will be released on **October 20**

Please mail or FAX to:

**Hyatt Regency Reston Town Center
(PTTI 2010 Room Block)
1800 Presidents Street
Reston, Virginia, USA 20190
703-709-1234, Fax 703-925-8295**

Name _____

Company _____

Address _____

City, State _____

Country _____

Postal (Zip) Code _____

Phone _____

Arrival Date _____

Departure Date _____

Smoking Non-Smoking Occupants in Room _____

Credit Card AMEX Diners Club Discover MC Visa

Name on Card _____

Number _____

Expiration Date _____

CCV _____