OPENING REMARKS

Captain Dave Gillard
Superintendent
U.S. Naval Observatory
Washington, DC 20392, USA

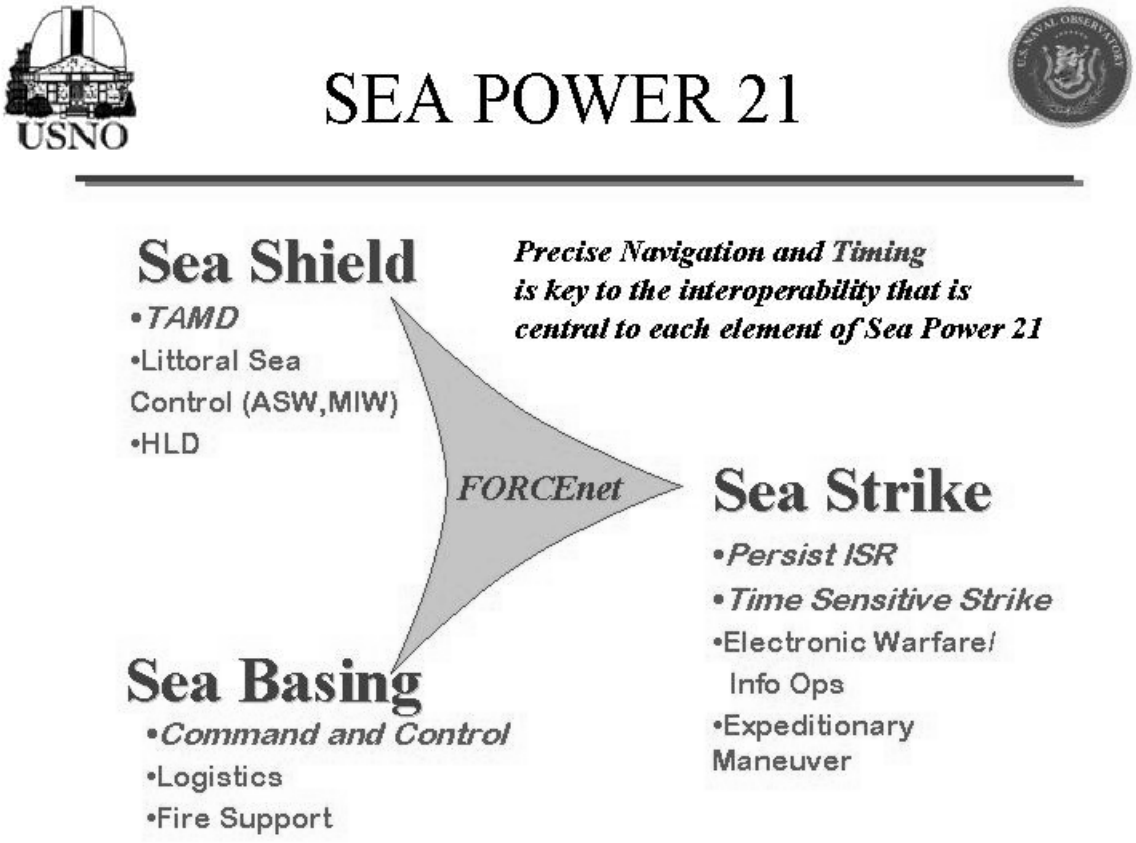
It is a pleasure to be here, and good morning ladies and gentlemen. It is a pleasure to open this 34th Annual Precise Time and Time Interval (PTTI) meeting. The objectives of this meeting are to bring all of you together to coordinate activities, review present and future requirements, and bring the newest developments to the attention of all of our colleagues here that have remained the same since the first meeting (many of them).

Decreasing budgets, smaller staffs and, most importantly, at least for the U.S. Department of Defense (DoD), increasing reliance on timing systems through naval-advanced, assured, and interoperable war-fighting capabilities make this meeting more important now than ever before.

Over the next three days, there will be nearly 50 papers scheduled for presentation during the various sessions. Current and future means for time transfer dominate most of the topics this year. There are papers that discuss GPS system performance and the use of GPS for time transfer, and a good number of papers that discuss Galileo timing and the space-based clock development. Several papers address the issues faced by two-way time transfer and frequency transfer and new data processing methods that will allow us to look at old data with a completely new perspective.

The DoD regards PTTI as a very important element in maintaining interoperability among its systems and war fighters. And, by way of illustration, I would like to show you just one example of how this becomes important. This will illustrate the Navy's strategic vision called *Sea Power 21*. This is unique to the Navy, but in terms of its use of timing, it is not unique to the Navy. All of the military forces are looking at network centric warfare, by whatever name they call it, as the way to go. It is part of the Information Age. This is a vision which, as I will describe to you, depends very critically upon precise timing to make it work. Sea Power 21 envisions using revolutionary information superiority and dispersed network force capabilities to deliver unprecedented offensive power, defensive assurance, and operational independence to joint-force commanders. This is based upon developing traditional, but transformational, capabilities such as persistent intelligent surveillance, reconnaissance, and time-sensitive strike.

In the figure, you can see those listed under Sea Strike to your right. Theater air missile defense, which is a key capability of Sea Shield at the top and enhanced offensive and defensive power projection and command and control from a sea-based posture, which we call Sea Basing, is in the lower left. The truly transformational part of this vision is in the center. That is the development of Force Net, the operational construct and architectural framework that will enable network centric warfare. Precise timing is critical to each of these advanced capabilities. With it, U.S. and allied military forces may be able to preclude effective action from an adversary, and therefore avoid the conflict. Without it, we simply cannot compete and win wars in the Information Age.



Sea Power 21 is a vision put forth by the Chief of Naval Operations. Precise timing is the key to the communications that will take place throughout the network. Allowing for coordinated dispersed action to take place between people that are shooting and people that are targeting, and so forth. It also enables allied and U.S. forces to be jointly working together in a very time-critical way.

Modern civilian timing applications also recognize the need for precise timekeeping and time transfer operational standards. Standards for time and time interval play an increasingly important role in ensuring that the nation's infrastructure systems can function effectively. The infrastructure interoperability issues range from telecommunications and computer communications to using a mix of navigation systems and coordination of events.

Coordinated management of PTTI resources and requirements has a significant payoff through the elimination of needless duplication of efforts. I would like to encourage everyone here to use this opportunity to exchange ideas and to discuss the possibilities for improving system interoperability through standardized PTTI dissemination. The Naval Observatory is prepared to assist anyone in your efforts to take advantage of improving PTTI resources, to improve current operations, and to develop new processes and systems. I am sure that we will all learn something from the presentations, and I hope in the days to come we can all work together to reap the rewards of new technology and more effective management of PTTI.

Thank you.

PTTI DISTINGUISHED PTTI SERVICE AWARD

Presented to
Mr. Harry E. Peters
Datum, Incorporated (Ret.)

by
Dr. Paul A. Koppang
U.S. Naval Observatory

I will be presenting the award this morning. This year's Distinguished PTTI Service Award is being presented to Harry Peters. Harry was born in 1922 in St. Paul, Minnesota. In 1941, he joined the Navy, and received an Honorable Discharge in 1953 with last rating as a Chief Petty Officer.

In 1957, he graduated *magna cum laude* from the University of Washington with a B.S. in Engineering Physics. After working three years at the Applied Physics Lab of Johns Hopkins, he accepted a position with Womack, later Varian, in Beverly, Massachusetts. While there, he participated in the design, construction, and operation of the first field-operable hydrogen masers under the leadership of Bob Vessot and with the consultation of Norman Ramsey and Dan Kleppner.

From 1965 to 1975, he was responsible for the hydrogen maser research and development at NASA/Goddard Space Flight Center. He received the 1971 John C. Lindsey Memorial Award for individual contribution to the advancement of hydrogen maser frequency standards. From 1975 to 1977, he did consulting work on hydrogen masers. In 1977, with wife Aileen Peters, who is with him today, he incorporated Sigma Tau Standards Corporation where he undertook research to develop a small hydrogen maser for the Air Force. This research led to the development of the cavity-frequency switching method of cavity tuning that did not require an external frequency reference: an auto-turning maser. Also developed at Sigma Tau was an improved focusing magnet and beam trajectory design that improved hydrogen consumption by more than an order of magnitude. In 1985, the first three Sigma Tau prototype masers that implemented these new designs were delivered.

Harry received the INM Society Award for contributions in the advanced design and development of hydrogen maser frequency standards for precise earth physical measurements. In 1977, he received the I. I. Rabi for development and manufacture of the hydrogen maser for precise timekeeping applications. In 1997, he sold Sigma Tau to Datum, which is now Symmetricom, and then retired.

At that time, Sigma Tau had delivered about 40 masers worldwide and, with possibly one or two exceptions, all the masers built to date are still operating.

Harry, if you could join me up here, I have a presentation for you.

HARRY PETERS: Thank you. This is wonderful. I must say that I am a bit surprised to be here. I am speechless as a matter of fact. I wish to thank the Selection Committee for putting me in this position and all my colleagues of the past, the organizations that have supported my research, and that of my friends and colleagues in hydrogen maser work. Particularly, the people who worked with me at Sigma Tau, some of whom are here. Thank you very much. This is wonderful.

Mr. Harry E. Peters

CALL TO SESSION

JAY OAKS (U.S. Naval Research Laboratory): As Technical Program Chairman, I have the privilege of kicking off the session this year. But before we do that, we have a special opportunity from U.S. Air Force Space Command to provide input into the future of GPS. We have Ron Lee from Space Command who will give you the details.

RON LEE (Air Force Space Command): Thank you. I appreciate the opportunity to talk before this group. My purpose for being here is to solicit timing community input into new requirements to be provided by GPS.

By way of background, the Air Force is the executive agent for GPS modernization, and we are in the process of defining requirements to be provided by the next generation GPS satellites. Air Force Space Command is responsible for documenting those requirements. In particular, we are looking for the capabilities to be provided by GPS in the 2010 to 2030 time frame. Because of the time it takes to develop and launch satellites, your input is needed now for this time frame. The way we want to do this: I have a questionnaire at the registration desk. I also have an electronic version (*http://pcisys.net/~ronlee/PTTI.doc* below). It is in three sections: one is to define the current uses of GPS timing; the next is also to define if you improve a particular parameter such as 10 nanoseconds to 5, what benefit do you gain from that; finally, there is visionary aspect as to what you would like to see in the 2010 to 2030 time frame.

Contact Info

Name
Phone
Email

CURRENT PTTI APPLICATIONS

Document applications and associated requirements supported by current PTTI systems

Application (Telecom, power distribution, etc)	
PTTI Source (Clock, LORAN, GPS, etc.)	
Timing accuracy needed	
Timing availability needed	
Integrity requirement	
Continuity requirement	
Backup source and accuracy	
Other requirement	
Other requirement	
Other requirement	
Benefit of supported application (e.g., economic)	

INCREMENTAL BENEFITS

Describe the benefit to your application of improving a specific capability (such as timing accuracy).

VISIONARY REQUIREMENTS/CAPABILITIES (2020 TO 2030 TIMEFRAME)

Application (Telecom, power distribution, etc.)	
PTTI Source (Clock, LORAN, GPS, etc.)	
Timing accuracy needed	
Timing availability needed	
Integrity requirement	
Continuity requirement	
Other requirement	
Other requirement	
Other requirement	
Benefit of supported application (e.g., economic)	