

OPENING REMARKS

LARA SCHMIDT (RAND Corporation): Good morning, and welcome to the 36th Annual PTTI. We've got some great surroundings here on Capitol Hill this year, so I encourage you to get out on your free time and look around.

We have a fantastic program lined up this year, courtesy of the Program Committee and our Technical Program Chair, Dr. Ken Senior. We've got lots of good talks about timing, timekeeping, time transfer, etc. Last night, when I was watching Monday Night Football, even Al Michaels was talking about atomic clocks, so I knew this was going to be a great conference this year.

Right now, I would like to introduce the Superintendent of the Naval Observatory. He's going to make some opening remarks today. Captain Tettlebach is the 49th superintendent of the United States Naval Observatory. The USNO maintains the Master Clock for the United States and determines and provides precise time to the Department of Defense. The USNO also determines and promulgates the positions and motions of the earth and celestial bodies for precise navigation of DoD forces.

Captain Tettlebach served as an oceanographer aboard the U.S.S. Saipan, and made four deployments to McMerdo Station, Antarctica. Aboard the U.S.S. Theodore Roosevelt, he served as oceanographer and provided METOC support to Commander Carrier Group 8. He served as the Executive Officer for the Naval National Ice Center in Suitland, Maryland, followed by duty in the Office of the Assistant Secretary of the Navy for Research, Development and Acquisition. Captain Tettlebach holds a B.S. in Oceanography from the U.S. Naval Academy and an M.S. from the Naval Post-Graduate School in Meteorology and Physical Oceanography.

CAPT. TETTLEBACH (U.S. Naval Observatory): Good morning and welcome. It's a little wet out there, so hopefully the weather will improve, and for those who want to see DC, they will get a chance to get out and actually get a good look. But if you want to get out now, you will get pretty soggy.

First of all, it is a pleasure to open the 36th Annual Precise Time and Time Interval, or PTTI, Systems and Applications Meeting. Now this is my very first PTTI Meeting, but most of you, I am sure, are veterans of these meetings, and have far more experience and expertise in the field, and should be anxious for me to get out of the way so you can get onto the real business here. But, not so fast! I have a few things to say.

Okay, with my operational background on ships and fleet staffs (despite being a Navy meteorologist and oceanographer), I believe that I can relate, maybe to a small degree, to the Navy and Defense customer, consumer, or user of PTTI. And now, as Superintendent at the United States Naval Observatory for 6 months, I sit on the other side of the fence with many of you, and a little knowledge and education can make you a little dangerous. I think I speak for far too many Navy and DoD operators and probably a fair share of commercial users when I say, Wow! I never realized how very critical, important, and far reaching the need for PTTI is, especially in order to ensure that the war fighter can communicate, navigate, target, conduct surveillance, guide his weapons, etc. with the precision and accuracy necessitated by today's economics, politics, and asymmetric threats.

A challenge to the PTTI community here, because I believe most of you are PTTI providers and a minority of you are PTTI users, is to continuously and aggressively advocate and educate that user, that

war fighter, in my case, with regard to the importance of PTTI. This conference serves that purpose, but it is not nearly enough to get the job done. That knowledgeable user, that educated war fighter, is the one that will have to lay down the requirements that will drive the funding for PTTI programs, research, and development.

Ideally, these PTTI meetings also provide the timing community with an opportunity for those users of PTTI products to challenge PTTI providers with issues and requirements to meet the nation's developing needs in defense and commercial enterprises. Similarly, these conferences have allowed precise time and time interval providers to make system developers aware of the latest improvements in the field and to present users with the challenge of how to take advantage of these developments in order to provide improved services and products in the future. Continually decreasing resources and, most importantly for the U.S. Department of Defense, increasing reliance on timing systems to enable the critical interoperability in war-fighting capabilities, make this meeting even more important and relevant today.

At the beginning of a meeting of this type, it is worthwhile to remind ourselves of the "stated" objectives for this series of meetings: (1) to disseminate and coordinate PTTI information at the user level; (2) to review present and future PTTI requirements; (3) to inform Government engineers, technicians, and managers of precise time and frequency technology and its problems; and (4) to provide an opportunity for an active exchange of new technology associated with PTTI. The program should present us with a series of papers and posters that are clearly aimed at disseminating PTTI information at the user level to address this first objective.

The second objective, to review requirements, is more difficult to achieve. The combination of (1) the reluctance on the part of program managers to state or write formal requirements and (2) the fact that users may not even have the slightest idea of the presence of PTTI needs in some final product or system make it difficult to identify, recognize, or conceive PTTI requirements much beyond anecdotes – again, the need to advocate and educate. Nevertheless, this objective must be diligently pursued to ensure that future PTTI requirements will be met when they are needed.

The third objective, to inform Government personnel, again should be achieved in the vendor session this morning and throughout the program. I look forward to these sessions meeting the fourth objective by providing a lively forum to exchange PTTI information.

Since the first PTTI meetings, the precision with which time and time interval are measured and transferred has improved by three orders of magnitude – a factor of ten per decade. We have witnessed remarkable growth in the use of precise time and frequency. The Global Positioning System has become part of our everyday infrastructure, if not officially, at least unofficially. And PTTI is critical for improving communication throughput and providing improved national security in perilous times. Precise time and time interval make systems interoperable at unprecedented levels of sophistication.

I believe the program for this meeting includes topics that promise exciting, significant developments for the future. Sessions are devoted to issues related to time and frequency transfer, clock measurements, the latest developments at timing laboratories, global navigational satellite system interoperability issues, and a special session touching on a number of subjects ranging from clock statistics to Galileo timing. A panel of experts is slated to discuss interoperability issues in future navigational systems.

When we talk about precise time, we think immediately of the role it plays in precise navigation – the growing importance of GPS is evident. Sometimes lost in the description of the navigational capabilities of such systems is the fact that the time products may be equally or even more important to the users. The papers in the sessions of this meeting will, no doubt, demonstrate the latest numbers characterizing the precision and accuracy of the systems that take advantage of GPS for timing.

The growing use of GPS, however, is not without its own issues. The success of GPS continues to slow the development of improved clocks, and the development of possible alternative time transfer methods will definitely be a future concern to mitigate the possibility of a single point of failure.

Realize, too, that the rapid migration of the military to Network Centric Operations and the increasing use of interoperable systems will demand accurate, as well as precise, time and time interval, even though this is not well appreciated by too many users. However, it is not just precise time, but standard, common, absolute precise time that empowers the networks and enables every participant to interoperate with other participants. Not every node will contribute the same amount nor in the same way, but with absolute precise time, they can operate within the same reference frame and, thereby, maximize the strength of the network and truly exploit the power of information.

This also introduces issues of time transfer and timing system architecture. Thus, the PTTI community must continue to challenge today's system engineers to utilize the development of increasingly more accurate and precise time and time interval. In 10 years, we may have the capability to provide 10-picosecond timing to the user. Will our customers be in a position to exploit this? Imagine the numerous advantages of applying this level of precision: In Defense, we could make communications incredibly secure; make detection and targeting much more precise and efficient; make weapons with sufficient accuracy to significantly reduce collateral damage; and create savings by making smaller weapons. While we need to keep track of user requirements for PTTI, we also need to challenge users to take advantage of the possibility, no, the probability, of 10-picosecond timing or one part in 10^{16} frequency.

We often hear that precise time is a utility, and that we must recognize the need to manage this new utility to meet society's current and future requirements. Part of this management responsibility is to make sure that users are aware of current and projected PTTI capabilities. I would again challenge providers and the users of time to think creatively about new possibilities that take advantage of our ability to provide time and time interval with improving precision. This utility of precise time can and will provide improvements for us all, and we need to plan now to take advantage of this resource.

Thanks. You have a chance now to move on with the program. I am really looking forward to the presentations and discussions of this increasingly important field.

JOE WHITE (U.S. Naval Research Laboratory): You all remember last year when I was standing up here getting ready to make the award, and I reached down here under the podium and did not find anything. I am happy to tell you that that is not going to happen this year. However, I have got a better story for you.

This year not only do I not have the award laying here, I don't have the awardee here, either. What I have is an announcement.

The Awards Committee got together this year, and we decided that it was a time for a special award at PTTI. And we also decided it was time to do it at a special time. As most of you are aware, next year we will have a joint meeting with the IEEE Frequency Control Symposium in Vancouver; and what we have decided to do is make the announcement this year of who the awardee will be for next year, and make the formal award next year.

So I am very pleased to announce to you that the PTTI Award winner for 2004 and 2005 will be Professor Norman Ramsey of Harvard University. Most of you are aware that the work he has done in clocks has done an amazing thing for the timing community; it has allowed us to do things that probably would never have been possible otherwise. And we thought that was a very special award and one that needed a very special audience.

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So that is our intent. Next year, we will make the formal award.

DR. KEN SENIOR (U.S. Naval Research Laboratory): Good morning. And welcome now to the Call to Session for the 36th Annual PTTI. Let's begin this morning with the vendor presentations.