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NASA Goddard Space Flight Center
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OPENING COMMENTS

Rear Adm. Henry D. Arnold
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CALL TO SESSION

Dr. Arthur McCoubrey
National Bureau of Standards

DR. MCCOUBREY: I am Art McCoubrey. I am the Chairman of the Technical Program Committee of PTTI, this year. It is my duty to call to session this meeting of PTTI. So it is my pleasure to call to order this meeting of the 11th Annual PTTI. And having done that, I am going to introduce to you the General Chairman of PTTI. He is head of the Space Applications Branch of NRL, Roger Easton.

DR. EASTON: Thank you Arthur. Now for welcoming remarks, we will hear from the Acting Director of the Goddard Space Flight Center, Mr. Robert Smylie.

WELCOME ADDRESS

Mr. Robert Smylie
Acting Director of the
Goddard Space Flight Center

On behalf of the Goddard Space Flight Center, I would like to welcome all of the delegates here and the people coming to this conference to the Center. I understand that this is the 11th such conference that has been held on this subject, although the name has changed a little bit over the years for various reasons. It is a very important activity to the Goddard Space Flight Center because of the work that we are engaged in and the need for increased capability in the area of precise time and time interval. I was glad to see that the speaker called it "PTTI" because it is really a mouthful to say that whole acronym out all at once.

One of the things that happens when you come here and invite me to speak is that you get a few words about the Goddard Space Flight Center because it has been my view that people coming from around the world and around the country get stuck in an auditorium or a conference room somewhere for several days and go away and say that they have been to the Goddard Space Flight Center but they really don't know anything about the place except what they saw as they walked across the campus and into the auditorium. So I would like to spend just a couple of minutes telling you what Goddard is and what we do and why it is that the kinds of things you consider here over the next three days are important to us. And I think that if you can find the time and want to get around the Center and see some of the things going on here that there may be ways that we could arrange to do that.

OPENING COMMENTS

Rear Admiral Henry D. Arnold
Vice Commander
Naval Electronic Systems Command

INTRODUCTION BY DR. EASTON

Admiral Arnold is a native of Tulsa, Oklahoma. He graduated from the Naval Academy in June, 1950, which put him just beyond where he would not have been in the academy when President Carter was there. He has served in numerous Naval assignments. He is a Naval aviator. He saw service in Korea. He was Commander of Air Wing 11, Executive Assistant to the Assistant Secretary of the Navy for R&D, Commanding Officer of the Naval Air Station at Whidbey Island, Commander, 13th Naval District, and Director, Tactical Air Surface and Electronic Warfare Development. He was Commander, Medium Attack Tactical Electronic Warfare Wing.

His decorations include the Silver Star, the Legion of Merit, Distinguished Flying Cross, Bronze Star, Air Medals, Presidential Unit Citation, Navy Unit Commendation, and the Navy Commendation Medal.

It is a great pleasure to introduce Rear Admiral Duff Arnold.

ADMIRAL ARNOLD:

Well I don't know about that introduction where being in the class of '50 relative to Jimmy Carter stands in my repertoire there, but I would like to welcome you to this PTTI Conference and let you know that we in NAVELEX are very happy to be co-sponsors of this kind of a gathering. Certainly my recent experience goes a long way in heartily endorsing the theme of this conference. That is, let's think about the user when we start putting these devices together. I know in this very exotic age of electronic capability, digital computations and measurements devices that we are able to very precisely come up with what is going on and keep track of things. Based upon my experience as an A-4 driver, I used to believe that you knew what time it was and you knew where you were and everything was in order - you were going to be able to get to the target in good shape. If either one of those things were getting out of synch though, the probability of hitting your CEP was very poor. We have come a long way since the old seat of the pants flying by map in those days, but this morning, I toured most of this part of Maryland trying to find the Goddard Space Lab based upon the map that I had. I

I am still not a very good navigator, I guess. I did know what time it was though and I arranged to be here on time. That was a positive result.

I would like to re-echo though that the user is the important person on the military side. We have got to think about the user when we put black boxes together. When they get out in the fleet and have to go through the rigors of the operational environment, they must stand up, be maintainable and be available when time and time interval are needed.

You may recall Gordon Smith being here last year kicking this thing off and I would like to bring you the latest chapter in the saga of Mr. Clock, who you all know and remember was the cesium clock that we had to get first-class transportation for on the airlines because that was the only place that adequate power was available for this long, around the world junket he was making to calibrate our VERDIN System.

Well, the latest is, that one year later Mr. Clock has had a very healthy trip. He has made it all the way around, drinking electrons all the way while his partner has been having martinis for two.

Again, I hope you have a very fruitful meeting. I noticed some very interesting subjects on the agenda. I am sorry that I can't spend the time out here to be with you for the entire meeting, but again let me say that NAVELEX is happy to be able to sponsor this kind of a get-together. It is at this kind of a get-together where coordination and cooperation can occur that we discover a multiplying effect which is far-reaching and will enhance our posture as time goes on.

Thank you very much. Have a very good meeting.

OPENING COMMENTS

Captain Raymond A. Vohden

Superintendent, U. S. Naval Observatory

CAPT VOHDEN: Mr. Chairman, Ladies and Gentlemen: Although time is fabricated at the U. S. Naval Observatory, I have not yet been provided with enough of it in my first two months as Superintendent. As a result, I stand here before you knowing very little about the subject you are about to discuss. But one thing I have learned already: Dr. Winkler has told me that because our time is precise time, there are precisely 5,529,600 precise seconds in 64 days, and he just cannot provide any more for me. If it had been January now, he would have given me one extra second on December 31-- the leap second. Now 5 1/2 million seconds seem a lot to any layman like me. Imagine my consternation when I found that Dr. Winkler counts time in nanoseconds, and that I have already used up 5 1/2 times 10^{15} or 5 1/2 kilo-tera-nanoseconds. A frightening thought!

A famous astronomer, Ejnar Hertzsprung, once said: "We don't know what data astronomers want in the next twenty years, but we are sure that they want it with much greater accuracy." While this quote addressed astronomers' needs, it could equally well refer to the DoD. Requirements for precise time in some current applications or in systems now in the definition stage quote precision of 5 to 10 nanoseconds. The best portable clock trips occasionally reach that precision, but the platform clock that was synchronized with the Naval Observatory Master Clock this way will not retain its synchronization very long. Consequently, as DoD manager of PTI, the Observatory is continuously looking for means to improve time transfer and make the U. S. Master Clock more accurate and conveniently available. The GPS time will be directly traceable to the Naval Observatory, so that in another five years we might expect 10 nanosecond precision anywhere around the globe-- provided timing capability is available in the GPS receivers or special time receivers, such as the one now undergoing acceptance testing by the Naval Observatory.

But with the famous astronomer, "we are sure that DoD-- and others-- will want time with much greater accuracy" in the future. Perhaps we don't know why they might want it, but time transfer capability of 1 nanosecond or better is a requirement we can be almost sure will be with us in the late eighties or early nineties-- and perhaps earlier. This is a challenge for the Naval Observatory. On the one hand, there is no platform requirement now, while on the other hand it will take many years to develop such a capability. Moreover, as we have found all too often, the user simply assumes that the Naval Observatory can provide whatever accuracy is needed. And although I came to the observatory with an exalted view of the capabilities of the staff, I have come to realize that Dr. Winkler is actually a

human being just like you and me, who needs lead-time in order to be there when he is needed.

It is for these reasons that the U. S. Naval Observatory is attempting to obtain funding for experiments in Laser time transfer via satellite (the highest precision technology in existence and in principle), for very-long-baseline interferometry, and for highest precision time-keeping in general.

Upgrading of the master clock is in progress. We hope in five years to be able to guarantee 1 nanosecond real-time precision, a first step toward the sub-nanosecond master clock we expect will be required in the nineties.

But enough about plans. The Annual PTTI Applications and Planning Meeting, has, I understand, become an important forum for the PTTI community to look at the state of the art, to elaborate needs, and to look into the future. I have noted many papers on time transfer in this meeting starting today. Navigation is rapidly becoming again a time-ordered discipline, requiring a world-wide synchronized time distribution system.

In wishing you a successful meeting, may I express confidence that out of meetings such as this one may grow a collaboration which avoids, after initial experimentation, the danger of a multitude of competing systems, to the detriment both of the user and the taxpayer.

May the next 58 tera-nanoseconds (= 16 hours of talks) be a success!

Thank you.