

**PANEL DISCUSSION:  
Joint Defense Laboratories (JDL)  
Timing Research Status**

**MODERATOR**

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**EDWARD D. POWERS (NRL):** Good morning, everyone. We're going to start this morning off with a panel discussion on the Joint Defense Laboratory (JDL) Timing Research Status. We're going to talk a lot about what is Reliance and what does "Reliance" mean.

Our panel today is going to be Fred Betz from the Naval Research Laboratory (NRL), Ron Beard from the NRL and John Vig from the U.S. Army Research Laboratory (ARL). Dr. Ken Johnson was unable to attend today. We're also going to leave the floor more or less open for questioning throughout the whole panel discussion.

Let me turn it over to Fred Betz to start the discussion on his experience with what is Reliance. He's been on many panels for Reliance over the last few years, and he has quite a bit of knowledge about that. Fred.

**FREDERICK E. BETZ (NRL):** I don't have a prepared speech. I did get involved in the Reliance Program when my manager volunteered me a couple years ago, in 1990, to pick up when the Navy finally decided to get aboard Reliance. I understand the Army and the Air Force had gone through a Reliance type of activity. Finally, the Navy decided that maybe this was going to happen, and they had better join with the Army and Air Force.

In reality, it kind of all started when the Office of the Secretary of Defense, back in 1990, prepared a draft memorandum that said that they would take over all Science and Technology (S&T) funding activities for the three services. Perhaps for the first and only time in history the three-service principal S&T flag officers stood up and screamed in unison "No, let us do

it. Give us the rope and let us form our own noose that we may hang ourselves.”

So they formed a Joint Directors of Laboratories, which is composed of the three principal S&T flag officers for the three-services panel to investigate how they could meet the Department of Defense (DoD) objectives, which were to eliminate redundancy, promote joint activity, and, of course, I guess the redundancy and the perception that everybody was going their own way in doing what they would like in research, science and technology, without any guidance. A taxonomy was established – I’m not exactly sure how that came about. I got to be on the Space Panel, being a representative from the Naval Center of Space Technology.

At that time, there was also an astrometry panel. That was seeded, at that point in time, as a result of the determinations by the Reliance groups to the Navy, and basically with the U.S. Naval Observatory (USNO) being the principal actor in astrometry. The NRL had retained space clocks, and Dr. Vig retained frequency control technology. He’ll talk about that.

That is kind of the history. We went on for about three years, as I remained on the Space Panel, and not doing any real planning (to a very large extent), but more or less documenting the execution of the funding of science and technology. There were not a large number of true joint programs developed, although there were a number of small programs; and there were a number of good relationships that developed between the three representatives of the three services, in their technical areas. Instead of an environment like this in conferences, it was actually going to the residences of the laboratories of three services; and meeting, and working together, and looking at what each other were doing.

**JOHN VIG (ARL):** When this Reliance was initially created, my lab director came back and told us what had happened. And basically, the pie supposedly got carved up in a way that the three services each had a significant activity and area, like solid state technology, for example. Then it became, I believe it was, the Category I Program, where each service will continue doing research in a certain area; and there will be very close collaboration; and “jointness” was the key word; everything would be done jointly; that there would no Army solid state program or Air Force solid state program or Navy solid state program. All the programs shall be planned jointly and executed jointly, even though the funding might come from only one of the three services. So we were to be one big happy family, without the actual combination of the three services laboratories.

In frequency control technology, the Army was given what was called “Category III” responsibility, which meant that the Army had lead laboratory status within DoD for frequency control technology. When we first heard that, we thought that it was great news for us, we’re golden, we’re going to be the lead laboratory. Unfortunately, it didn’t turn out that way. Because of that, the Air Force, about that time, completely got out of frequency control; the Navy’s funding, I guess, was cut to zero in frequency control; and the Army’s funding was cut also. So instead of it helping the technology, I think it actually hurt us quite badly.

We were given frequency control; the Navy, for example, was given vacuum electronics; technology was a Navy Category III program. The Air Force was given antenna technology as an Air Force Category III program. But each of the three services continued to do service specific research in those areas.

This summer at the annual reviews, all the different electrotonic devices programs presented an annual review before a high-level DoD person, Dr. Susan Turnbach. I gave the presentation for frequency control technology. I pointed out that the technology has declined substantially since Reliance was created. I mentioned that, for example, ten years ago there were somewhere between 50 and 100 researchers in this area, because all three services had a significant program. The Air Force had a large program in frequency control technology; they were growing quartz sponsoring research and rubidium standards and various other technologies. The Navy had a significant program and the Army had a significant program. Today, the Army is the only one with an in-house 6.1, 6.2 activity in frequency control technology. The Navy and the Air Force have no 6.1, 6.2 programs. 6.1 is basic research, 6.2 means exploratory development, applied research, basically.

Apparently my briefing caught Dr. Susan Turnbach's and AGED'S attention; and as a result, I learned recently – well, let me backtrack a second. Every year there are one or two technology areas selected for a special study, to determine what the DoD's investment strategy should be in those technologies. This year the AGED selected frequency control technology as one of two technologies. So there will be a very high-level study done on what the DoD's investment strategy should be for frequency control technology. I was asked to draft a statement of work for that study and to recommend people who should be participants in that study. I recommended some of you as participants. Potentially, this could be very helpful to us if we do a good job.

**RONALD L. BEARD (NRL):** I think the real significance in this overall effort is that the direction within DoD seems to be towards focused programs like this and joint operation, such that DoD isn't spending a lot of money in duplicative efforts, and things like that, which is one of the words that was used when this was initially formed. I think it is significant to point out that when it was initially formed, too, what they looked at was work that was actually being done in-house within the government, rather than contracted efforts. It was through that mechanism whether to assign the lead laboratories and the focus centers for this technology.

But in this role of combining and doing joint DoD-type procurement and development, where does the role of time and frequency fall? Well, it's almost slipped through the margins, I think, as John was pointing out. This technology is viewed by many authorities within DoD as just kind of a black-box thing that you buy off the shelf. Come to a conference like this and get a catalog from the vendor, and you just buy one. The care and feeding of the technology and development isn't really appreciated, I think, very much beyond this community. How this community can affect the long-range planning by DoD and other agencies can bear an important part on how well this technology flourishes.

I think that is one of the significant things that we need to discuss this morning, is where is this technology going; how does it contribute to the long-range plan; and should it be a significant thing to be pointed out in some of these high-level technology development areas? Otherwise, within DoD, it will get submerged behind the new extra smart sensor, the new weapon system that blows up asteroids, or things like that.

I personally think that it's a very significant technology that transcends the individual systems. It's an intersystem technology, if you will. Too many system developers and technology developers

look at individual systems and specific devices to do that mission, a new sensor, something where they can see trees from the other side of the world, or something like that. Time and frequency goes across all systems, and it's difficult to get people to appreciate that. Many of them simply take it for granted. And, as I think we all know, it's not something you can really take for granted; it needs to be nurtured and developed. Significant developments have been made in this area.

**FREDERICK BETZ (NRL):** Ron, one of the problems with the funding for science and technology that have been incorporated under the JDL Reliance is that it only addressed the service S&T funds, which were probably about one-third of the total defense research technology budget. The vast majority, the other two-thirds, went to both the Strategic Defense Initiatives Office (SDIO) at the time, and later, Ballistic Missile Defense Office (BMDO), and also, Advanced Research Projects Office (ARPA). There is a move afoot, at this point in time, towards getting more involvement of Director Defense Research & Engineering (DDR&E) ; it's largely in turmoil at this point in time. There was a meeting of the JDL in August where Mr. Brachkosky from DDR&E was there, and essentially agreed to be a major participant in not the JDL Reliance, but in Defense Science and Technology Reliance. So it may even have a new name before very long. That would, again, tend to centralize the control and centralize the funding, if, indeed, as proposed, ARPA and SDIO funds were swept into this area.

As was mentioned, the Navy funding of Science and Technology went away for the GPS area. Fortunately, we're a reimbursable laboratory, and Ron went out and found "customers," Space Command (SPACECOM), I guess, and some others to provide funds to keep the organization growing. His science and technology staff in precision timing are still quite robust.

I might also mention that Ron mentioned that the in-house staff was the basis for the formation of the establishment of the Reliance strengths. That was true to the extent that scientists and engineers in house included those involved running outside contracts, technical managers of outside contracts. The R&D funding that went to outside contracts through that channel was also included in the accounting of who had the lead laboratory status. It wasn't just how many true in-house S&T scientists were available, but also how much funding they could leverage through contracts.

**JOHN VIG (ARL):** Any questions from the audience?

**HAROLD CHADSEY (USNO):** You're talking about having a joint thing where one lab knows what another lab is doing. The Naval Observatory is not that large a lab in comparison to many others and to the entire DoD community. We have problems enough figuring out what the person in the other building is doing. If they have a program that they had already written and everything set up for, and we could use that program, sometimes it's quite by accident that we find out about it. How do you propose and implement at what time a communication between one lab and another lab happens, and prevent the idea of "empire building" and somebody saying "Well I'm not going to give you that information because it will tear away from my empire?"

**JOHN VIG (ARL):** You have no choice. Even long before Reliance was created, there was another panel called the AGED, the Advisory Group Electron Devices. Before we could initiate

any contractual programs, if not in-house, we had to do was called an "AGED write-up;" we had to describe in just two or three pages as to what the program goals were; what the rationale was for the program; what the projected funding levels are; and who's going to be in charge of running the program; and who are the probable contractors who will bid on the program. This went to the AGED panel, which consisted of outside DoD, high-level executives, like vice-presidents of corporations, senior professors at universities and such. The AGED panel would look at these programs and look at the programs submitted by the Air Force and the Navy, and made sure that there was no duplication of effort; and also it was distributed to all the laboratories to make sure everybody knew what the other guy was planning.

So there was a formal mechanism to make sure that at least contractual programs were pretty well coordinated. Now this Reliance was to take the next step, and that is to make sure that all programs, whether they are contractual or in-house, were well coordinated; and not only coordinated, but actually performed jointly. So whereas before, if I decide I wanted to do a program on a very low power compensated oscillator, we would create a program; and write up a work statement; and then do an AGED write-up; and then it would get coordinated; and then it would be sent to the Navy and the Air Force to make sure they knew what the Army was doing.

Now, even before we do anything, we are supposed to contact our counterparts in the Navy and Air Force and jointly decide what should be done, jointly write the work statement, jointly do everything in the process of creating this contractual program. That's the theory anyway. Has it happened that way in reality? Not really. In large part, because we just simply don't have much money for contracts. So since the Reliance was created, we haven't had many contracts.

**RONALD BEARD (NRL):** I think communication is a problem, though, even in these joint efforts. Certainly in large efforts like this, it's very difficult — as he pointed out, it's difficult to communicate across the lab. It's even more difficult to communicate from laboratory to laboratory, especially on a programmatic level. That is a significant problem.

**FREDERICK BETZ (NRL):** Yet, that was one of the fundamental purposes of forming the Reliance panel in the area of astrometry. In astrometry, there was a single service identified, and perhaps it's time to readdress the technology centers of excellence across all the services if there's going to be a reevaluation and the realignment of the technology panels, so that USNO could participate with the Army and the Air Force personnel who are doing work in frequency.

**JOHN VIG (ARL):** In our technology area, there is an additional coordination mechanism, and that's the PTTI coordination meetings that we have every year at the USNO. Under Dr. Winkler's leadership, all the government organizations that are involved in PTTI technology get together and share information.

**GERNOT M. WINKLER (USNO):** I just want to correct one impression that exists persistently, and that is that the USNO is not a laboratory. The distinction is very important. We are part of an operational part of the Navy. This is not under the research and development organization which, for instance, is, of course, the case with NRL, which is under the Chief of Naval Research. Similarly in the other services.

Therefore, we are not a competitor in any way. We are a user of results of research and

development. That is the function of the USNO. Independently and separately from that, of course, is our role as the PTTI managers for DoD. In that regard, we have a coordination function, as you just mentioned, Dr. Vig.

I just wanted to keep that separate as much as we can, because otherwise, if things are that way, you always get into wrong conclusions. So we are not a laboratory, and that distinction is very important.

**FREDERICK BETZ (NRL):** I just had an opportunity to look at the document that came out in September of this year called "The Defense Technology Plan." I couldn't find anything in here, at least in the major headings, that dealt with precision timing or frequency. It may be buried deep down somewhere in one of the panels or subpanels, but it certainly isn't addressed as part of the a technology S&T effort at the Director of Defense Research and Engineering level.

**JOHN VIG (ARL):** That is because that document doesn't go down to the sub-subpanel level. That's where frequency control sits. There is an electronic devices panel under which there are a number of subpanels, one of which is RF components. Frequency control is a sub-subpanel in RF components technology. I think that only goes down to RF components and not to the sub-subpanel level.

We are a very small part of the total DoD electronic devices effort. In solid-state technology, when you look at the funding charts, we are a little blip; solid-state technology is probably 50 times as large in funding levels.

**RONALD BEARD (NRL):** Well, I'm not so sure that we should be a major heading under "Science and Technology" per se. But on the other hand, we could be part of the sub-sub-sub-sub-subpanel that's absolutely totally forgotten.

That's something I think we shouldn't allow to happen; because, this technology is taken so much for granted that people just assume you know time; I mean, people are familiar with time, they look at their watches everyday so that they can be at work on time. But it's not *really viewed as a technology*; and from that perspective, it just can be "subbed" into oblivion. I think that's the issue that I would like to bring forth, so that people can be aware of this when they're communicating with developers and people who are doing contracts and developing systems and those sorts of things.

You just can't take time for granted. It has to be generated, it has to be nurtured, and it has to be taken care of.

**JOHN VIG (ARL):** We also have an image problem. I have heard frequency control and clock technology it referred to as "that old technology."

**JOE WHITE (NRL):** Let me encourage a little bit of speculation for a minute. You all have talked about, number one, that within the time and frequency community we have done a fair amount of coordination; there's a mechanism to it. I think there has always been kind of a division of labor, particularly between our group and John's group, in terms of who did what. You generally work in the crystal and the portable technology, we tend to do work in the space area.

I think also, as Fred has pointed out, a lot of these meetings at a higher level don't really reflect that kind of a coordination going on, not necessarily in our area, but in general. Do you think we're in some danger, either at the DoD level or even at the service level, of somebody deciding to merge functions and solve our problems for us? Even though we may not have any problems, are we going to be swept into laboratory mergers or whatever? Anybody have a feeling about that?

**JOHN VIG (ARL):** Some of the cynics think that the whole idea of JDL Reliance was to prevent what is called the "purple-ization of DoD laboratories." "Purple" means forming a single — you know, the Army is green, the Air Force is blue and the Navy is, I guess, white. So, "purple" is a term that people have been using as a merging of the three services' efforts.

I believe that even now there are serious proposals being considered for merging the three organizations and creating a single DoD laboratory structure. Perhaps Helmut Hellwig is in a position to address that question.

**HELMUT HELLWIG (AF OFFICE OF SCIENTIFIC RESEARCH):** Let me comment on a couple of these questions.

The issue of the old Reliance and the incubating defense investment strategy, which I think is the current best word and the official word — I think it's on your document too — the issue is not whether or not you work with the other lab; the issue is that you don't have enough money to do what you used to do. So you are questioning where do you put the money; several dimensions, where do you put it and topics. So the question for time and frequency is not USNO versus NRL versus whatever goes on in the Air Force. By the way, something still goes on in the Air Force, in the extramural program; we're on a very solid 6.1 program.

The issue is: Should there be time and frequency in any DoD activity? Should Ron Beard go out of existence? That is the issue. Why could he go out of existence? Don't get me wrong here, there's no proposal, to the best of my knowledge, of that nature on the table. So I'm just giving you a fictitious view of the world. But it is the kind of thinking I want to project. Why couldn't he go out of the existence in the thinking of defense managers? Because of NIST and Hewlett Packard? That's why.

I think the challenge for the time and frequency DoD community is to prove that they add something significant to defense, in view of the ongoing academic and commercial activities. The issue has graduated very much from being an issue of "Are you working together?", yes, no, to "Why do you exist in view of other efforts?" "Should we use the money you are earning for things where it is more needed?" That is the issue, and it will be with us for the rest of the century.

**PHILLIP E. TALLEY (RETIRED FROM AEROSPACE CORPORATION):** Along the line of this discussion, I think that one shortcoming is that potential contractors for various large systems don't really know where within the government to go for advice for time and frequency. I've been inclined to recommend going to see Dr. Winkler as a source of what's available, and possibly recommendations of how to approach the time and frequency problems. But people don't seem to appreciate that there is help out there. I think the integration of labs, or whatever happens, needs to address this and make it known to the various industrial

contractors that service is available; and we need to know this in order to direct the efforts in whatever laboratory activities are going on, but will satisfy the needs for the future contractors.

**JOHN VIG (ARL):** We spend a considerable portion of our time answering questions over the telephone and having visitors come to us and ask us about oscillators. That is an important function that we perform. But that's not what sells programs when we go for our annual reviews. To say that we have advised a corporation or have answered questions from industry does not buy us much. If we have developed a new gizmo that we can demonstrate increases battery life in a tactical radio, because the power consumption of this oscillator is ten times lower than before, that's the kind of thing that sells programs. Or, if you can make tiny little atomic clocks versus the 19 inch rack atomic clocks, and you can explain what the significance is in future military systems, that can sell programs.

But you are right. That's an important function that government laboratories can and do serve. But that's sort of a side issue.

**EDWARD POWERS (NRL):** One final question here. Speaking of the Aerospace Corporation, other government laboratories, are they following this anywhere?

**JOHN VIG (ARL):** Not that I know of, no.

**RONALD BEARD (NRL):** One final quick comment. I think Helmut made some very good points, specifically that my group wasn't targeted for extinction. But I think that is the key issue. Since the resources and funding is going to be much more limited than it has been in the past, what are the technologies doing for you, compared to what is available? And, does additional research need to be done? In the additional research, where can you get the best available? That is the key issue.

**JOHN VIG (ARL):** We have an image problem. I think when there are annual reviews, and people get up and talk about these micro-electromechanical devices, tiny, tiny microscopic motors and actuators and pumps and various other devices, those are considered to be the sexy technologies. It's hard to compete with that when you are talking about a new generation of clocks, for example.

**RONALD BEARD (NRL):** The "glitzy" technologies.

**Ed Powers (NSR):** I would to thank the panel and the audience for their participation in this discussion.