

Date: Wed, 02 Feb 2000 13:50:33 +0100
From: "Albert Bos" <bos@nfra.nl>
To: <jwebber@NRAO.EDU>
Subject: Re: Correlator PDR report

Dear John,

Thanks for the PDR report. Just a brief comment on the NRAO Correlator = Architecture subject:

The last sentence contains a misunderstanding (it may be that I have not = explained it correctly). The last part should read:

....there are two tied array adder outputs, that are used for VLBI or for = high (spectral) resolution tied array interferometry.

Regards,

Albert

From: "Larry D'Addario" <ldaddari@tuc.nrao.edu>
Date: Thu, 3 Feb 2000 10:53:52 -0700 (MST)
To: John Webber <jwebber@NRAO.EDU>
Subject: Re: Correlator PDR report

John,

You've done a superb job on the Correlator PDR minutes. I have only a few comments:

1. Under "Fiber Optics" I am quoted as saying we must keep all bits from one digitizer on one fiber. I don't think I said that, but if I did then I should not have. The true statement is that all bits from one digitizer must be delivered to the correlator in the correct order, and with constant delay. Even if they are all on one fiber, there will be substantial timing skew if they are not on the same optical carrier, due to dispersion. If only 2b/sample are transmitted, then under the present design it is possible to have a 1:1 correspondence between digitizers and optical carriers. This is not true at >2b/sample, and we should not count on it being true in the long term, even if 2b/samp becomes the baseline. Therefore, I consider it essential that the data transmission system include the ability to de-skew data among optical carriers. Once this is incorporated, it will handle a reasonable amount of de-skewing among separate fibers. Dan's comment (correctly quoted, I believe) that WDM makes this "a lot easier" is arguable. A related point, not mentioned

in the minutes, is that substantial skew among separate baseband channels (== separate digitizers) is not a concern, since it is easily absorbed in the correlator's bulk delays, which are also separate by channel.

2. Under "Open Discussion" a differential cost for 3b/sample transmission is quoted. To put this in perspective, consider the following costs for transmitting 16 GHz of signal bandwidth:

	per ant 64 ants	
Digital, 2b/samp, 64 Gb/s total, 8 opt channels:	100k\$	6.4M\$
Digital, 3b/samp, 96 Gb/s total, 12 opt chan:	150k\$	9.6M\$
Analog, 2 optical channels of 8 GHz each:	24k\$	1.5M\$.

This is based on \$12.5k/chan for 10Gb/s digital (Dan/Jim's figure), and \$12k/chan for 8 GHz analog (GBT actual costs via Steve White). The "waste" due to the fact that the present digital design has 20% overhead is then 1.28M\$ at 2b/sa and 1.92M\$ at 3b/sa, which is comparable to the cost of a complete analog system!

We decided to go digital with the full knowledge that it would be more expensive, but only now do we have enough data to estimate the extra cost reliably. The decision was based partly on the assumption that the cost of digital transmission would drop much more rapidly than that of analog transmission, and that by the time of our release to production the difference will be small or reversed. If this assumption remains valid, then the extra cost of transmitting 3b/samp (or 4b/samp) will eventually seem low. If the assumption is not valid, we should re-consider analog transmission rather than minimizing the digital bandwidth.

3. Under "Committee session," the final paragraph includes the comment, "Correlators present perhaps the greatest single intellectual challenge in the ALMA project." This was said by Whitney, and (IMHO) it gets the prize for the most stupid statement of the meeting. It is quite insulting to those who work in other areas. If I were writing this report, I would leave it out. But Alan really did say it, so you may wish to leave it in. In that case, more care is needed to make it clear that this is Alan's personal comment. As written, only the first sentence of this paragraph is attributed to him, and the last sentence to Rafal and Woody; the other sentences might be taken to be devised by the report's author, expressing some sort of consensus of the group, which they certainly are not.

--Larry

From baudry@observ.u-bordeaux.fr Thu Feb 3 14:33 EST 2000
Date: Thu, 3 Feb 2000 20:32:39 +0100 (MET)
To: John Webber <jwebber@NRAO.EDU>
Subject: Corelator PDR report

Dear John,

Thank you for the report of the Correlator PDR committee. It reflects well or very well the spirit and details of our discussions.

I have only a few corrections to propose; some are important in my view.

European Digitizer Plans

second sentence: ...there would be about 40% increase...
(this is because the exact value depends on the exact number of levels in the 2- and 3-bit quantizations)

third sentence, and addition: ...of which one goes as high as 4 Gsamp/s and several up to 1 to 2 Gsamp/s. The group is looking for engineering contacts within one of the companies which make these devices. The European group has made a survey of fast digitizers fabricated or planned in various radio observatories. Dewdney noted...etc.

after [see further discussion on January 21]: ...first to get an operational unit...specifications with 2-bit 4-level quantization ...etc.; Baudry replied that he thought the 3-bit operational case would be very difficult.

later: ..even thinking about other aspects such as system-related or packaging aspects.

bottom of page: ...D'Addario discussed why bandwidth sampling would be better..etc.
(rather than needed)

Discussion of European...

fourth sentence: ...several interested organizations in Europe, several of them are getting close ..etc.

Committee session and recommendations

John I cannot approve the sentence under item 2: Emerson and

D'Addario both said that the US development had been dropped when the European side agreed to do the digitizer etc..

Once again we never agreed on that and I have not found any mail or letter stating this. We rather exchanged comments/criticisms on top level specs. for the ALMA project with Larry. Thus you have to modify the phrasing here.

For all other things I have no major comments. And my approval also contains discussions with Torres and Bos (who sent you separate remarks).

You have made a nice job, Alain

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From awhitney@haystack.mit.edu Fri Feb 4 13:15 EST 2000
Date: Fri, 04 Feb 2000 13:14:06 -0500
To: John Webber <jwebber@NRAO.EDU>
Subject: Re: Correlator PDR report

Hi John,

Thanks for such a complete summary of the meeting. I really just have one comment: In the Open Discussion section, I am quoted as suggesting considering 0.25 um development. I did say that at the time but by the end of the meeting was convinced otherwise, so don't want that to stand alone (or just perhaps remove). I fully support initial development at 0.18 um.

On another matter, we have finished the proposal to re-direct the existing NRAO thin-film money to development of a new COTS-based VLBI data system. We should have it out to you shortly.

Regards, Alan

From dwoody@caltech.edu Fri Feb 4 14:25 EST 2000
From: "David Woody" <dwoody@caltech.edu>
To: "John Webber" <jwebber@NRAO.EDU>
Subject: Re: Correlator PDR report

Hi John



The report looks good and is quite thorough. There are a couple minor corrections that can be made.

1) on "European digitizer plans", I don't remember saying anything about "clock slew rate" and feedback.

2) on "correlator card and custom chip", I believe I said ~"about half of OVRO time would be used in the widest band mode when our new correlator is implemented." I wasn't referring to our current use of the array for "searches for narrow extragalactic spectral lines."

There are some general system design issues related to phase switching, binning, DSB receivers and future upgrades that I will discuss in an E-mail later today hopefully. This are system issues that heavily impact the correlator but which need to be discussed in the wider context of the system design. Do you have a recommended distribution list for such comments.

Cheers

Date: Wed, 09 Feb 2000 08:53:39 -0700

To: "Larry D'Addario" <ldaddari@tuc.nrao.edu>, John Webber <jwebber@NRAO.EDU>

From: Dan Edmans <dedmans@aoc.nrao.edu>

Subject: Re: Correlator PDR report

At the PDR, Digital was expected to be 2x analog, but I have made conservative estimates of the component costs and we see that it is ~4x for year 2002 purchases.

(With FIR filters at the antenna we don't need to send 3 bits)

It is quite possible that many component prices will drop radically before we begin purchasing in 2003 and as we will not purchase all of the components in 2003 we can expect the prices to continue dropping.