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April 20, 2004

TO: Distribution
FROM : David Lapsley
SUBJECT: 12 April 2004 e-VLBI telecon summary

Attendees:

Lee Foster, Pat Gary, Kevin Kranacs, Mary Shugrue, Bill Wildes – GSFC
Jerry Sobieski – University of Maryland Mid-Atlantic Cross-roads
Terry Gibbons – Lincoln Laboratory
Dennis Baron – MIT
Charles Yun – Internet2
Kevin Dudevoir, Hans Hinteregger, David Lapsley, Arthur Neil, Alan Whitney – Haystack

This telecon is one of an ongoing series of telecons to prepare for 10 gigabit/sec e-VLBI demonstrations between NASA GSFC and MIT Haystack Observatory using a combination of network facilities including all or part of GlowNet, Bossnet, ISI-E, SuperNet, Max and GSFC/HECN.

ACTION ITEMS ARE HIGHLIGHTED IN RED.

Bossnet

Alan Whitney: Did everyone get a copy of the updated network map that I had sent around this morning? This is relevant to our efforts to get an OC48 connection to Haystack. It is downloadable from the Haystack website. Let's start with the status and then move into the proposal for getting OC48 onto Bossnet. More complex than we had initially thought due to restrictions on wavelength allocations on the path. Start with Terry.

Terry Gibbons: Continuing to try to solve GlowNet - Bossnet compatibility issues.

Alan: Jerry anything to report?

Jerry Sobieski: Last week we said that 192.9 THz is the wavelength that we would use down Bossnet and across MAX. Issues at GlowNet. Those issues at GlowNet are because there is no Quad mux (on Cisco 1500).

Terry: No Quad mux or standard mux/demux. They have series A mux/demux.

Alan: Put discussion on hold for a minute and ask status at Goddard, Pat?

Pat Gary: No changes. From MRTG, can see that Goddard is still there, online and ready as needed.

Alan: Discuss more about Bossnet path. Terry?

Terry: Currently Haystack to Lincoln is across Cisco 1500 metro optical switches. No longer produced by Cisco and only limited support. Ciscos currently only have gigabit rate devices from 810/1310nm to ITU Grid wavelength. Mux/Demux wavelengths on these are on wavelengths that are not compatible with Bossnet: below my amplifier range on Bossnet. How did we do it before? Previously, came on as gigabit ethernet from Haystack to Lincoln Labs. Gigabit wavelength peeled off and pass through my router, electrically, and then put back as gigabit ethernet signal on ITU wavelength across Bossnet to DC. Many issues: since Cisco 1500 is no longer produced, getting an OC48 card for this is no longer a trivial matter. Even getting this card, still might not be in a wavelength that could be transparently mapped to Bossnet. At this point, trying to preserve all optical path between Haystack and DC is challenging. Might have to look at home brew splitters things of this nature to try to move data optically. Not sure how Glownet folks are going to be doing this when its not on their production network.

Alan: we do have a strawman design to work around the problem. David?

David: One thing we had been thinking about, because we could not get hold of the Cisco 1500 OC48 transponders, we thought we could use a pair of JDSU Waveshifters maybe even just a single chassis that has transponders in it to do a wavelength conversion from the ITU wavelength on the Glownet side to an ITU wavelength on the Bossnet side. That's one way we thought we could do it. What do you think about that?

Terry: So the idea is come in to a JDSU Waveshifter, get on to Glownet, come into a MUX, go out the DEMUX on the 1500 at LL, out a JDSU Waveshifter at 1310 nm in to another JDSU Waveshifter at 1310 nm out a Bossnet compatible wavelength to DC. Then repeat in the other direction.

Jerry: So basically, we would need two pairs of JDSU Waveshifters: one to cover the Glownet segment and one to cover the Bossnet/ATDNET segment?

David: Yes, that's right.

Lee Foster: Does that include the Juniper at Eckington or will we put stuff there as well.

Jerry: the only Juniper at Eckington is the MAX M160. We haven't used that one in the past. The M160 where it was getting on is at ISI-E. That's over another section of fiber. Another piece of information for you all is that we finally got our additional fiber from Qwest. That should be turned up in the next few weeks as well. From Eckington over to MAX/CLPK and ISI-E. What we had planned on doing was to have one JDSU Waveshifter where the wave was handed off at MAX at Eckington, that would jump on to another wave that would bring us over to ISI-E and the rest of the path would remain the same. That is still a viable option. The issue is that if we choose channel 4 on the Bossnet wave was

192.9 THz. Bossnet does not have muxes that would allow us to mux some outside wave into the 8 that they currently have doing right now. Terry, can you validate that?

Terry: In terms of amplification, I can't go above 194.2 THz. But we could do 194 THz. That puts us below the current bypass. The bypass channel, which is what they were running on before is at 193.8 THz.

Jerry: If we ran a 194 THz it wouldn't interfere with anything on Bossnet?

Terry: No. The only thing running on Bossnet are ATD wavelengths.

Jerry: That was the problem. Firstwave switches don't have muxes for anything but the 8 waves that are on Bossnet. So in order to put it on or take it off via a Firstwave switch, it has to be one of those 8 channels.

Terry: That is correct. Doesn't present a problem necessarily, but does require us to do things with home build splitters and filters.

Jerry: How are the metro 1500's configured now? Must be multiplexer. Two waves currently lit?

Terry: Correct. Might be three.

Jerry: Must be a mux/demux card on 1500's. From what David Lapsley and I looked at on the technical docs for the 1500, they use a hierarchical mux/demux? 8 channels per mux/demux which feed into 4 banded multiplexers/ demultiplexers.

Terry: Yes. Not strictly necessary with only a single set of cards.

Jerry: Right. 4 band mux/demux not required if all you have is waves in one of the 4 bands. Existing waves should be plugged into a mux card with 8 ports on it associated with 8 different wavelengths.

Terry: That's correct. None of those wavelengths overlap with the Bossnet wavelengths. That was by design. Because at one point, I believe they were riding the same fiber. Primary chassis that comes with the 1500 almost completely reproduces the ATDnet/Monet(?) wavelengths. There is only 1 channel that's not on one of the ATDnet/Monet wavelengths. The extension A chassis is in the range of 194.5 THz and up.

Jerry: So, what David was suggesting to use one pair to hop across Glownet and then converting them at Lincoln to 192.9 THz to take it down to Washington that is a viable means of getting it down. That would not require us to insert anything in to the middle of Glownet.

Terry: Correct, but still have the issue of the Firstwave switch at Eckington.

Jerry: At Eckington, they would be pulled off at 192.9 THz. 192.9 THz would start at Lincoln and come

South to Eckington with a pair of Waveshifters serving that link. And then across Glownet, we would select a wave on one of the 8 port muxes that does not interfere with the existing wavelengths. David, how much were those Waveshifters?

David: They are about \$9K each. We could probably get away with buying a larger chassis and putting it at Lincoln labs and putting a pair of transponders in that. That might save us a bit of money.

Jerry: I'm just thinking if there is any way that we could invoke some assistance from our partner Movaz. Let me talk to Henry tonight or tomorrow morning and let me broach the issue with him. How much money do you have? We might be able to get it for less than it would cost from JDSU Waveshifter, but it might still cost us some money.

Alan: The JDSU solution is 4x\$10K is about \$40K.

Jerry: Let me see what Henry can do for us? You guys could throw in some money if he couldn't do it for free. Let me see if he can help us with that. As this is one of the primary demos for the DRAGON project, this might be a useful thing to do.

Alan: We'll sit tight on this until we hear from you.

Jerry: If you don't hear back from me in the next day or two, ping me.

Terry: Using 192.9 THz is also going to take some co-ordination from Linden.

Jerry: I've already sent him an email, he says that would be as good as any other wave.

Terry: Let me chat with him a bit. Jerry: He said that should be alright. If there's some other issue check him and let me know. Do you have the 192.9 THz transponders as part of Bossnet?

Terry: I still have not received the Firstwave from NRL yet, so currently I am putting the waves on Bossnet via our own home grown devices.

Jerry: Are those OC48 capable?

Terry: In theory. One of them is running OC48 now and seems to be good. I haven't put the other one up to OC48 yet.

Jerry: you have a set of those that are at 192.9 THz. In theory, if the Haystack guys put the Waveshifters on Glownet and handed you an OC48, you could put it on Bossnet as it is.

Terry: Yes. I don't have the Firstwave yet, so that is the only way I could do it.

Jerry: Even if you do have the Firstwave, they are still expecting to use the same transponders to put it on?

Terry: No. I thought the JDSU Waveshifter was going to take the 1310 coming off Glownet and then put it on to 192.9 THz and then I would use a MUX/Splitter and put it on.

Jerry: Do you have a transponder right now on 192.9 THz?

Terry: It has not been tested at OC48. It is not a commercial transponder, it is one that was probably built 3-4 years ago.

Jerry: So the question is whether it would work and then if it would be available to use. We could take the 1310 from Glownet and hand it to the transponder which would send it at 192.9 THz on Bossnet heading South.

Terry: Yes. This would bypass the JDSU Waveshifter.

Jerry: Yes. There is one set that would cover the Glownet hop. So if there is already a transponder that runs at 192.9 THz, then it may be that we don't need to buy the second set of transponders? We could do the same thing at the South end of Bossnet?

Terry: At the South end you would be at 192.9 THz and go into the Firstwave. Coming out of the Firstwave, still at 192.9 THz because they do not have 1310 drops.

Jerry: do they have a 192.9 THz transponder down there?

Terry: I believe the Firstwave's are setup to handle all 8 Monet wavelengths.

Jerry: with the transponders, not just the muxes.

Terry: That's a Linden/NRL question.

Jerry: What did you guys do before? Didn't both ends have transponders? Maybe the other end was at ISI at the time?

Terry: Yes, but that was at 193.8 THz.

Jerry: So we may not have a transponder on the south end for that wavelength.

Terry: You certainly don't.

Jerry: OK. Best thing to do is to get another set of transponders in. Let me check with the folks at Movaz. Maybe they would be willing to put something up for less than \$40k.

Alan: That would serve both the Glownet and Bossnet parts of it?

Jerry: It would provide the wavelengths to get across Glownet. I'm not certain we would replace

Glownet with those components. We could Ray Expresses that would go across Glownet on the appropriate frequency. It is like the Waveshifters, only we wouldn't have to pay for them.

Terry: A quick question for David. On the output power of those JDSU Waveshifters is that tunable?

David: It's fixed. I check with them, it's fixed power. The other thing I wanted to check with you guys is the wavelengths. I'm not sure how customizable they are. If you look at the sales brochure, they have the part numbers for the various wavelengths. They don't have the full list of wavelengths. So, I don't know if that is firm or if they will customize that for you. There are two matching wavelengths that will fit into that Cisco 1500 band: one is 1539.77 nm which is channel 11 and the other is channel 12 1538.19 nm.

Jerry: either one of those should work, provided it is not on a channel that Glownet already has lit.

David: I believe those are both spare channels.

Jerry: Yes, I believe when we looked at David it they had channels 15/16 left. I don't remember what those frequencies were. Terry/David can one of you guys validate with the Glownet guys to see that channels 11 or 12 would work?

Terry: My notes indicate that those channels are currently not occupied.

Jerry: That would get you from Haystack down to Lincoln.

David: Right.

Terry: With appropriate pads. If we can't adjust the output power, we will have to put appropriate pads.

Jerry: The only thing left to identify on that link is whether Movaz can do it for less than \$20K. What I'm thinking is that Movaz may be willing to put a chassis up at Lincoln that would have transponders facing Haystack and facing Bossnet. And also maybe a chassis up at Haystack that would have a transponder facing Lincoln.

Alan: OK Jerry, well we will sit tight and wait to hear something from you.

Jerry: It may take them a little longer than two days to run it up the ladder to see if they can do anything. I'll talk with them within the next 24 hours to get them off the mark.

Alan: You said Jerry that the fiber from Eckington to ISI-E is still not in place?

Jerry: Still not in place. We have the contract signed for the DRAGON fiber ring down here. That will give us a pair of fibers from Eckington to ISI. Along one segment. That will also give us a pair from Eckington up to College Park. There's some other stuff that I have to work to bring those up and get

them in to service. I thought you would be interested to hear that the contracts finally got signed with Qwest and the University of Maryland.

Alan: We will keep the options open until we hear back from you.

Jerry: The reason that might be important is that that would allow us to take the 192.9 THz right off the Firstwave switch at Eckington and dump it via fiber to where we already have a Movaz chassis. So we don't need to get another chassis just get the transponder to the south end.

Pat: Jerry, this is Pat Gary. We've ordered a fiber from College Park to Maryland another fiber pair. That will go from College Park to our building 28, which is where we are expecting to put your Ray express. The issue that remains from Building 28 out to the GGAO site is that could be part of what you want to do in the future testing with VLBI and special codes/higher speeds.

Jerry: Where's the Mark5?

Lee: GGAO.

Pat: Yes, they are out at the GGAO site. What may yet be required is another Movaz Ray express be placed out at the GGAO site.

Jerry: What's the distance between there and GGAO?

Lee: Less than 8 km.

Jerry: That's not 4 miles. That may be short enough so that if you have the fiber access with the right interfaces, you wouldn't need to put another set of muxes out there, just the right NIC on the Mark5. Does that make sense? Mark5's have gigabit ethernet right now is that correct?

Alan: yes.

Jerry: To get them above that, what would we do? Put 10 G NICs in them? Put multiple NICs in the Mark5? Or a switch?

Alan: either that or a pair of GigEs?

Hans Hinteregger: If we put a switch in there, you could put a number of CWDM/DWDM wavelengths. If you put a 5224/5212 in here, you can do just about anything you want.

Jerry: Pat, do they have fiber from 28 out to GGAO?

Pat: There's one fiber pair.

Bill Wildes: Actually, I think there is two fiber pair.

Jerry: Are they available that we can use them? That would give us two gigabit ethernet links.

Kevin Dudevoir: We are currently running LX gigabit ethernet over that link.

Jerry: That's a matter of getting a couple of LX GBICs over that link. So we could send two gigabit ethernets from GGAO to Building 28. Mux them up there and send them across DRAGON to wherever we need it. This is an ideal application for the Movaz service aggregation transponders/ transceivers. These take 2 gigabit ethernets and put them into an OC48. Let me think about this. We still have some time also. Wee might ask Movaz to put a couple of these service aggregators in. This would also help in Massachusetts. We could put a couple of gigs up there and feed them right down over Bossnet. Look just like an OC48 to Bossnet.

Alan: We do have the Juniper M10 up here which will effectively do that.

Jerry: Yes. That's even simpler. Let me talk to Movaz. I'll chase that down in the next day or so. As far as the Goddard end, do you guys have a router over there you can put these links in to?

Pat: Right now there's an Extreme 5i gigabit ethernet switch at the GGAO site and a mirror image of it at Building 28. That allows them at GGAO to plug in either our G4 macs or our 5is. But we were only sending one output from the 5i onto bldg 28 and onto the reset of the network via GigEs.

Jerry: We can leave that as is for the moment. We'll keep thinking about how we can engineer this to get the bandwidth up to 2 x 1 gigabit ethernets or an OC48. We have the OC48 blade in at ISI. That will remain in service as we get the Bossnet/MAX/Glownet thing all worked out. Our target at this end is to get things back to where they were several weeks ago before things got torn down. But that may give us OC48 rather than just gigabit ethernet.

Alan: That sounds good. We'll sit tight until we hear from you. Very good. Anything else on this? Sounds like there are a few things that the dust has to settle on. People can work that out offline over the next week to 10 days. We are anxious to get this link up as soon as practical so we can resume some of this high bandwidth testing. We also want to do it right, so if it takes a bit more time, then we'll do that. Let's change gears and talk about some of the experiments. We did another e-VLBI experiment that we can talk about. Do you want to talk about it David ?

e-VLBI Experiments

David: We had another real-time experiment between Onsala and Westford. The first one between these two. We had a single baseline between the two of these. We used some special software to get our bandwidth up. The TCP performance on that link was still pretty bad, so we basically used UDP with rate-limiting to make sure we didn't impact other users too badly. We had 32 Mbps coming from Onsala and the same from Westford. Fed this into the correlator and got a real-time correlation.

Alan: Onsala came over our commodity 100 Mbps Internet connection. Westford was running 900 Mbps.

Jerry: where's Onsala? Is that in Sweden?

Alan: Yes. As far as we know, this was the first real-time Intercontinental e-VLBI that was done.

Jerry: Do you have the traceroute for that path?

David: I do, I can forward that if you like.

Jerry: Yes, why don't you. I would be interested in how you get there through the commodity link.

David: We come up through NOX to get up from Washington to Massachusetts. Then it goes through Lincoln Labs to get to us.

Alan: David did you isolate the problem part of that link?

David: Yes. So we have been doing quite a bit of testing on that link from Onsala to work out what the problem was. The conclusion we came to is that it looks like the rate is dominated by the packet loss at either end. The way we came to that conclusion was by comparing the measurements that we get from Washington to Haystack, about 51 Mbps TCP throughput at the moment coming from ISI-E. Coming from Onsala we get about 5 Mbps over the default path. So, if you have a look at the Mathis equation which compares the TCP throughput with the round trip time, MTU size, and the packet loss ratio, it works out that you would expect to get that sort of throughput from Onsala given the packet loss between Haystack and Washington. So basically, if you look at the throughput from Washington to Haystack, you can calculate the expected packet loss. If you compare the throughput from Onsala to Haystack, but this time with a round trip time of 120 ms compared to 10 or 15 ms, then the throughput drops in proportion to the round trips times. So it looks like it is the loss on the local links that is really dominating that.

Jerry: When you say local, you mean the local end up at Massachusetts?

David: Right, that is where I believe it is. I haven't isolated it yet. I have spoken with one of the guys at NOX and he has agreed to do some testing to see what the performance is like at 1/2 and 3 hops from the end system.

Arthur: Did you imply that there is the same type of loss at the other end as well?

David: That is possible. I haven't investigated this yet.

Kevin: We historically haven't looked at that loss because we have had Bossnet.

Alan: And in other news, Kevin is still working on Germany and Hawaii. Do you want to update on that?

Kevin: We have done a lot test transfers to Wetzell. That is a 34 Mbps channel capacity. We can

typically average anywhere from 23-28 Mbps over an hour or two hour transfer window.

Alan: This is near the limit of the link for the antenna.

Kevin: Performance is good with either single stream TCP. We usually run bbftp with 4 streams. That is a pretty stable and predictable link. Kokee, we would like to find out what Bill said to PMRF. We still have the same problem, very lossy link in the Haystack to Kokee direction that cripples us to a few Mbps. However, the PMRF people, Roger Hall in particular, have been doing a lot of testing, point to point, of the Kokee to PMRF links last week. We haven't seen the full results, still. Evidently they have found some problems, but I haven't heard back from them what the fix may be or a detailed description of the problem, but they seem to be doing a lot of active testing.

Alan: have you heard anything Bill?

Bill: Not since I was there.

Alan: Well, since you were there they seem to have had a bit of a fire lit under them. So we don't know what you did, but things have changed.

Bill: We promised them money.

Alan: So that's the secret. Anything else Kevin? Any other comments or questions?

Pat: Just a comment. Since Jerry asked for a traceroute to Onsala, I would ask David to capture that in the minutes, that way we could all review it.

David: Sure (See below traceroute from Onsala to ISI-E).

```
traceroute to 140.173.180.6 (140.173.180.6), 30 hops max, 40 byte packets
 1  oso-gw.oso.chalmers.se (129.16.208.1)  0.794 ms    0.764 ms    0.755 ms
 2  chalmers2-bb1-gw.chalmers.se (129.16.2.111)  0.745 ms    0.731 ms    0.939 ms
 3  goteborg2-srp2.sunet.se (130.242.85.2)  1.138 ms    1.040 ms    1.030 ms
 4  boras2-pos0.sunet.se (130.242.81.9)  2.436 ms    2.122 ms    2.110 ms
 5  jonkoping1-POS0.sunet.se (130.242.81.18)  3.909 ms    3.598 ms    3.496 ms
 6  stockholm1-pos3.sunet.se (130.242.81.102)  29.683 ms   26.330 ms   10.689 ms
 7  stockholm2-POS1.sunet.se (130.242.82.14)  8.147 ms    8.224 ms    7.878 ms
 8  se-kth.nordu.net (193.10.252.177)  8.080 ms    7.902 ms    7.933 ms
 9  nordunet.sel.se.geant.net (62.40.103.117)  8.199 ms    8.133 ms    8.163 ms
10  se.uk1.uk.geant.net (62.40.96.126)  43.239 ms   45.249 ms   43.090 ms
11  uk.ny1.ny.geant.net (62.40.96.169)  111.647 ms  111.856 ms  111.914 ms
12  198.32.11.61  111.697 ms  117.632 ms  116.483 ms
13  washng-nycmng.abilene.ucaid.edu (198.32.8.85)  119.679 ms  120.013 ms  119.679 ms
14  snet-abilene.ngi-supernet.org (140.173.1.237)  120.030 ms  120.184 ms  120.030 ms
15  fish6.ngi-supernet.org (140.173.180.6)  120.470 ms  119.900 ms  120.064 ms
```

Alan: It went quite smoothly to Onsala. We had a lot of trouble with the one a few weeks earlier to Westford. That was mostly getting software straightened out. But the Onsala one went quite smoothly.

Kevin: We've actually done a few tests. The correlator software and a lot of the latency issues we were worried about and buffering at the correlator, so far it has been fairly transparent and worked extremely well. But we've only done low data rates.

Alan: Right. OK. Any more on that? If not, let's go to performance and testing. David, do you have anything to say on that.

Performance and Testing

David: I guess I've mainly been testing to Onsala. One of the things we did arrange with the GEANT people was to have the path changed. Originally it was landing in New York and going across a switch there that has only gigabit ethernet interfaces. We thought that might have been a bottleneck, it is quite heavily utilized with 300-400 Mbps steady 5 minute averages on the MRTG charts. We had that path changed and did a couple of days of testing. We got up to 100 Mbps instead of the default 5 Mbps. And it seems that it has changed back now to the default path.

Jerry: David, can you say that again? Forgive me, I was trying not to wreck.

David: Our default path goes from Europe lands in New York. In New York it goes from the GEANT router across a 1 gigabit ethernet interface to a MANLAN switch, used to connect a few different networks within the New York metropolitan area. We thought that interface may have been one of the bottlenecks, so we asked the GEANT people to re-route that route, so they re-routed it. I believe it went through Germany and then into Washington. That was 2.5 Gbps, so we had a bit more headroom on that. So when they did that, the TCP throughput went up from 5 Mbps to 100 Mbps. It has gone back now to the original path and so the throughput has gone back down to about 5 or 6 Mbps. So we will see if we can have our route from Onsala to Haystack changed back again to the high performance path.

Jerry: So that trans-Atlantic GEANT link lands in Washington. Charles, do you know anything about that?

Charles: Not off the top of my head. I'm taking some notes trying to catch up with this. I wasn't aware of this.

Jerry: Does GEANT peer with Abilene in Washington?

David: Yes it does. The link here on the traceroute is washng-nycmng, that's the Abilene router.

Alan: Anyone have anything else to report on performance testing? Pat any more work that Bill Fink has been doing?

Miscellaneous

Pat: Not directly related, but part of future next generation stuff. I did email out to you all the testing we did between a pair of Force10 E100's where they had a pair of 10 GE blades back to back. We have access to a multi-head Beowulf cluster. A machine called Thunderhead. It's rated at 106th in the top 500. We have access to 32 heads (CPUs), these are all Xeons. We setup gigabit ethernet connections between 16 pairs. Bill tested with his nuttcp program. The first test he did was using their basic Myrnet connections. Each pair could get 1.6 Gbps in single, one directional flows. And he could get close to 2 Gbps in each pair with bi-directional flows. With the gigabit ethernet with standard Ethernet frames was getting 941 Mbps on each of the 16 pairs. That is close to the theoretic maximum. Close to 1.5 Gbps in a bi-directional sense. We now expect to hold on to 15 heads and go and look for another cluster in another building at Goddard which is building 33 and start doing tests between these clusters where we have these 10 GE switches in between. These are all in the category of pre-testing to get all the steps so that we can understand where the limits are. We're looking at those opportunities where we are able to be on a true 10 G network, either to Chicago to test with Tom Defanti's clusters there or to San Diego to Larry Smarr's with his opti-puter's or the Scripps institute of Oceanology. We are planning to have a meeting with the level 3 folks this coming Wednesday and they will tell us what connectivity they can give us before the National Lambda Rail comes up in the September time-frame.

Alan: Thanks for that report Pat and thanks for sending out the email. Anything else anybody wants to report on that? Dave, do you want to report on the software work you have been doing?

David: Yes, I can talk about that. I've been working on some software for this Experiment Guided Adaptive Endpoint that we are working on, this is an intelligent system. One of the things that it will do is implement the new VSI-E protocol for transmitting VLBI data across the network in a standard format. It will also include some congestion control protocols and some higher level intelligence that will allow it to work out the best way for it to transmit VLBI data over the network. It's software that will run on a PC or a Mark5 that will be able to measure the performance of the network, and then based on its measurement of that performance, try to determine the best way for it to transfer the data: whether it is switching modes, going from non-real time to real-time, or whether its stopping altogether because there is not enough bandwidth in the network. It will also be able to choose what protocol to use, whether it's plain old TCP, if your network will support it and the bandwidth is sufficient, UDP is you are a dedicated network, or something in between. That's something I've been working on, and I've been making a fair bit of progress in the last couple of months, so I guess that will be available pretty soon.

Alan: David has been turning out reams and reams of software, tested software and instructions to use it. We're anxious to see how it does and I think David wants to distribute it to a few select people.

David: Sure, if anybody is interested in it, let me know and I would be more than happy to send it out to you and see what you think of it. I would be very interested in any feedback.

Pat: David I'm going to be very interested. During the summer, Goddard brings in a number of undergraduates or graduates to work with us in a 10 week program. That introduces them to a professional

atmosphere and some challenging problems. We have a couple of students coming on board and I would like that student to be involved in participating in testing alternate transport layer code, that is alternate TCP, whether it is modifications to TCP or replacements, UDP-based. And clearly what you have developed is the kind of things that I would like to have and be able to look at as well as some of the other things such as High Speed TCP and others.

David: That would be great. I would be more than happy to forward the code. And I should also thank you for sending out that link on the Binary Increase TCP. Kevin and I have both been looking at that and it looks very promising we've simulated using the Network Simulator 2 tool to try and see what the performance would be like over networks with similar characteristics to the ones we've been looking at and we've also got hold of the Linux patch from the authors. I think it is 2.4.20 of the Linux kernel that we can patch. So we are working on getting a kernel for that available.

Pat: Now that sounds great. The student I referred to, they typically show up around the first of June, so you'll have some time to finish some development, but if we could throw those guys into the mix in terms of participating in the testing, then maybe we could all get something out of that.

David: Sounds good!

Alan: Good, excellent. Any other subjects, comments or questions that anybody would like to bring up? I guess there are several action items.

ACTION ITEM: Jerry to check with Movaz people about possibility for getting equipment.

ACTION ITEM: Pat, call Jerry tomorrow morning.

ACTION ITEM: David to distribute prototype software that he is working on, to anyone who send him an email.

ACTION ITEM: Alan will update the network diagram.

Next telecon is scheduled for Wednesday, 5th May 2004 at 2 pm EST.

cc: Steve Bernstein, LL
Jim Calvin, LL
Rick Larkin, LL
Lorraine Prior, LL
Peter Schulz, LL
Leslie Weiner, LL
Herbert Durbeck, GSFC
Bill Fink, GSFC
Lee Foster, GSFC
Pat Gary, GSFC
Andy Germain, GSFC
Chuck Kodak, GSFC
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Tom Lehman, ISI-E
Jerry Sobieski, MAX
Guy Almes, Internet2
Charles Yun, Internet2
Richard Crowley, Haystack
Kevin Dudevoir, Haystack
Hans Hinteregger, Haystack
David Lapsley, Haystack
Arthur Niell, Haystack
Joe Salah, Haystack