Minutes of the 26-Apr-96 EMU Meeting

Ari Mujunen, `Ari.Mujunen@hut.fi` v1.1, 11 July 1996

Minutes of the EMU meeting held on Friday, the 26th of April 1996 at MPIfR, Bonn.

Contents

1 Participants

The first item in parenthesis indicates an email address and the second item is an abbreviation used to identify a given person in the rest of this document, i.e. (`email`, *Abbrev*). Action items are later indicated with a boldfaced word "**Action:**".

- EMU group:
  - Jan Buiter, NFRA (`buiter@nfra.nl`, *Buiter*)
  - Arno Freiholt, MPIfR (`p416arf@mpifr-bonn.mpg.de`, *Freiholt*)
  - David Graham, MPIfR (`p062gra@mpifr-bonn-mpg.de`, *Graham*)

  - Ari Mujunen, Metsähovi (`Ari.Mujunen@hut.fi`, *Mujunen)*
  - Klaus Ruf, MPIfR (`kruf@mpifr-bonn.mpg.de`, *Ruf)*
  - Ralph Spencer, Jodrell (`res@jb.man.ac.uk`, *Spencer)*
- NASA and Haystack representatives:
  - Ed Himwich, NASA GSFC/NVI (`weh@vega.gsfc.nasa.gov`, *Himwich)*
  - Dan Smythe, MIT Haystack (`dls@newton.haystack.edu`, *Smythe)*
- TWG and station representatives:
  - Walter Alef, MPIfR (`walef@mpifr-bonn.mpg.de`, *Alef)*
  - Richard Porcas, MPIfR (`porcas@mpifr-bonn.mpg.de`, *Porcas)*
  - Michael Wunderlich, MPIfR (`p655miw@mpifr-bonn-mpg.de`, *Wunderlich)*
- Regrets from:
  - John Conway, Onsala (`jconway@oso.chalmers.se`)

The meeting was chaired by *Spencer* and *Mujunen* took notes for minutes.

1.1 Getting this document in various different formats

To get another version of this document:

- PostScript version of the DVI file (`ftp://kurp-ftp.hut.fi/pub/emu/emumin9.ps`)
- "gzip" compressed PostScript version of the DVI file (`ftp://kurp-ftp.hut.fi/pub/emu/emumin9.ps.gz`)
- ASCII only version (`ftp://kurp-ftp.hut.fi/pub/emu/emumin9.txt`)
- SGML version (`ftp://kurp-ftp.hut.fi/pub/emu/emumin9.sgml`). You will need the `linuxdoc-sgml` package to transform this file into other formats. See section 2.10.2.
- A "tar" archive of all the previous files, including HTML files for WWW (`ftp://kurp-ftp.hut.fi/pub/emu/emumin9.tar`)

2 On Friday, 26.04.1996 09:30

Spencer welcomed all present and opened the meeting.

2.1 Approval of agenda

The following was approved as the agenda of this meeting:

1. Minutes of last meeting and matters arising.
2. Thin tape upgrade—problems at Onsala and consequences.
3. Baseband converters—sideband rejection.
4. Phase-cal—quote from Onsala and the decoder.
5. Read/write electronics installation.
6. Formatters:
   - Status
   - Testing at Haystack
   - Testing at Bonn
   - Installation
   - Fringe tests
7. Software:
   - Canned modes
   - VEX
   - VLBA modes
   - Etc
8. Future development: VLBA to MkIV (VIV) and China.
9. AOB

2.2 Minutes of the previous meeting and matters arising

The actions arising from 12-Sep-1996 EMU meeting were enumerated.

All:

There is space for the extra NIM bin in the recorder, but the power connectors and pinouts have not been checked.

All with upgraded VCs:

TPI offset voltages have been measured and found to be positive, but less than 30mV. A discussion between *Graham*, *Himwich*, *Spencer*, and *Smythe* emerged about the recommendable offset voltage level. This is described in more detail in section 2.4.

Peter Bolis (reported by Smythe):

There is nothing new about the obsolete parts used in MkIV formatter, but the temporary problem with formatter drawing readme file at `(ftp://card.haystack.edu:/pub/mark4)` has been resolved. The question about implementing canned modes in formatter firmware has lost its relevance to standard observing, since standard modes will be canned in FS procedures and schedules.

Buiter:

Tape path upgrade has been arranged.

Paul Burgess (reported by Spencer):

Determined that DAT racks have sufficient space for new formatter power supplies.

John Conway (reported by Himwich and Mujunen):

Information about the required software for the analog phase cal detector nor astronomical requirements for NASA SKED program has not been provided.

Tony Foley (reported by Spencer):

Minutes of 12-Sep-1995 meeting have been prepared.

Freiholt:

Arno has been in contact with Jim Levine (Haystack) about the MkIV formatter; current firmware does not support barrel rolling, test modes, fan-in, nor pseudorandom modulation of data bits. Jim recommends two new 15 Amp power supplies, +5V and -5V, for the formatter. A discussion emerged *(Buiter, Freiholt, Spencer, Smythe)* where it was decided that observatories will buy their own power supplies and that switched mode supplies can be used. **Action:** *Freiholt* will provide a drawing for adding the new +/-5V supplies into the rack and wiring them properly to formatter NIM block connectors.

Himwich:

The Japanese have decided to use Craig Walker's SCHED for scheduling VSOP experiments, and therefore (instead of putting VSOP requirements in NASA's SKED) the current focus is to add VEX output to SCHED (Walker, van Langevelde) and VEX input to FS `drudg` SNAP schedule generator (Himwich). Geodetic VLBA rack sampler cables vs. mixed VSOP and MkIII observing have been discussed, see actions of *Mujunen* below.

Dave Holland (reported by Spencer):

See section 2.4.

Huib van Langevelde:

The question whether it is possible to read old Haystack Mark IV test tapes at NRAO Socorro was not resolved. An email description of most popular VLBA/MkIV modes has been circulated.

Mujunen:

Time has not permitted further work on MkIII decoder based multitone phase cal extraction software.

An operational problem plagues stations with geodetic (14 BBC) VLBA racks if they need to frequently change from MkIII observing to VLBA/VSOP-style modes with 2-bit sampling. This needs:

1. Changing the ribbon cables at rear panel of two sampler modules from one connector (VLBA) to another (MkIII) or vice versa.
2. Updating one control file (`equip.ctl`) and restarting the FS.

It is not straightforward for FS to detect if the rack type in (`equip.ctl`) matches the real connections. (One way could be to use phase cal signal detection in bypass mode with formatter DQA with BBCs adjusted so that the signal should be visible only in one bit stream.) **Action:** *Mujunen* to document such geodetic VLBA sampler wirings which would allow recording the VSOP mode in both VLBA and MkIII positions of the cables. A discussion emerged *(Graham, Himwich, Mujunen, Smythe)* in which the feasibility of an automatic switch was discussed; **Action:** *Smythe* to list the requirements for such a device. Another thread of discussion *(Alef, Himwich, Mujunen, Spencer, Smythe)* pointed out that the manual patch panel problem of MkIII remains in MkIV. *Spencer, Smythe* pointed out that JPL/DSN has solved the patch problem with a remotely-controllable set of IF switches—the field system `PATCH=` command actually performs patching instead of being a no-op. A similar patching problem plagues IF inputs of geodetic VLBA terminals, since not all four IF inputs reach all BBCs: A and C goes to BBC01–08, B and D to BBC09–14 (BBC01–02 get all four inputs).

Richard Schilizzi (reported by Spencer):

Has discussed the VSOP scheduling problem with JPL and Japanese.

Spencer:

- Contact *Graham* re VC band passes before and after VC upgrade at Westerbork?
- Status of Ny Ålesund is clear, they are upgrading (R/W, formatter, tape path). *Smythe* noted that Tom Buretta (Haystack) is going to Ny Ålesund with a spare capstan to perform the thin tape upgrade.
- Phase cal system ordered from Onsala (see section 2.5).
- Contact Craig Walker (NRAO) re need for continuous sampler statistics (2-bit sampling)? *Smythe* noted that all bit streams are available at a MkIV formatter connector which makes it possible to implement a DQA with sample statistic counters.
- Questions to formatter tenderers have been faxed.
- Report to directors done.

2.3 Thin tape upgrade — problems at Onsala and consequences

An email report from John Conway and Biörn Nilsson (Onsala) about problems exposed by their thin tape upgrade was distributed. In this report, Hans Hinteregger (Haystack) attributes permanent inner tape edge damages to “gross wear (up to .007" diameter reduction)” of the capstan. Older urethane-covered aluminium capstans are apparently more susceptible to wear than later urethane-impregnated porous ceramic rollers.

Smythe stressed the importance of making sure that a given recorder satisfies key specifications before attempting to do the upgrade:

1. Forward-reverse offset must not exceed 50μm.

2. Playback eye pattern in oscilloscope must not change when the transport door is opened.
3. There must be a 10mil gap between tape and tape deck plate. This can be verified by checking if light can pass this gap.

Smythe also noted that there had been problems with the Onsala tape drive a year ago, and that their forward-reverse offset indeed exceeded 50μm. Thin path upgrade assumes that the recorder to be upgraded is in working condition i.e. that it meets the specifications. *Buiter* noted that when they performed the upgrade they had to move the lower reel motor over 1mm towards the deck plate.

Smythe told that Hans Hinteregger has compiled a book about recorder issues. It contains all the memos plus some new material. **Action:** *Ruf* checks for availability of this book and makes sure all EVN observatories can order and get a copy if they wish.

Alef and Buiter asked about running both thin and thick tape with changing the vacuum level. *Smythe* described that he has been able to reproduce thin tapes at high density with 5 inches of water and thick tapes at low density with 15 inches of water. Three times more vacuum for thick tapes is necessary to maintain similar head contour in both cases. *Smythe* does not recommend this as standard practice for stations. It is very easy to destroy head contour by accidentally running (even the so-called "non-abrasive") thick tapes at low vacuum, a few hours is sufficient. *Mujunen* asked if the combination "thick at low" is the only dangerous one, i.e. what happens if you run "thin at high"? *Smythe* expected the contour to improve because it will get more pointed but that thin tape may not tolerate increased tension.

Smythe continued to remind that at recording stations using wrong vacuum will produce unreadable tapes in addition to damaging the head contour. VLBA recorders have software-controllable vacuum motors, so if the field system can know the tape type, it can adjust the vacuum accordingly.[1] A switch or relay can be designed for Mark IV recorders which would enable two "low/high" pretunable vacuum levels. Software remote control depends on the availability of extra bits at recorder I/O board—*Smythe* expected that unused bits are available. *Smythe* also reminded us that not all Mark III recorders can reach 15 inches of water, and that a hardware shut-off switch which operates at 6 inches of water must be disabled.

2.4 Baseband converters — sideband rejection

Upgraded MkIV VCs have difficulties in reaching acceptable sideband image rejection at the widest 16MHz bandwidth. Figures less than 20dB, 15–14–even 11dB occur. Alan E. E. Rogers (Haystack) has recommended changing C5 and C6 on the SSB mixer boards from 15pF to 12pF. *(Graham* noted that the nominal calculated value in AEER original memo was 14pF.)

This change has been applied in a few Jodrell Bank VCs and the results are somewhat mixed. Overall it seems to balance cases where USB and LSB exhibit dramatically different ratios. In some cases this change makes image rejection worse.

Smythe recommended selecting the best two VCs for VSOP recordings and the best eight for VLBA-compatible recordings. *Buiter* noted that Westerbork cannot find eight VCs which would perform at the 20dB range after upgrade. *Spencer* noted that the modification can be attempted in the worst-performing

[1] NRAO VLBA correlator apparently uses simple rules and deduces tape type from tape id labels.

upgraded VCs and that regular leaded capacitors can be used instead of SMD caps. **Action:** Les *Parry* (Jodrell) orders extra 12pF capacitors for all upgraded stations.

Spencer asked what is the effect of poor image rejection at 16MHz bandwidth. *Graham* expected more closure errors due to non-matching bandpasses. *Porcas* asked what is the VLBA BBC specification of image rejection at 16MHz and *Smythe* answered 20–21dB.

Porcas showed a bandpass plot of an experiment with Effelsberg (not upgraded) and Westerbork (upgraded MkIV VCs). 4MHz filters were supposed to have been used, but the plot shows very distinct 2MHz filter bandpass. Eventually this phenomenon got its explanation from Westerbork special IF processing which was accidentally set for 2MHz operation. Nevertheless, it was recommended that **Action:** *All* check with a spectrum analyzer all upgraded VCs select the correct filters under FS control. *Smythe* recommended stickers near to the front panel filter LEDs, covering 1MHz with 8MHz and 0.25MHz with 16MHz. These stickers will indicate an upgraded MkIV VC which has also been checked to produce correct bandwidths under FS control.

Graham reminded us about total power integrator (TPI) offset voltages. He suggested that the offset voltage is too low when TPIs read out as zero. In Feb96 session logs he could not find any zero readouts, but this can also happen if stations do not measure `TPZERO` properly. He also asked if it is possible for the TPI return zero counts although the offset voltage is positive.

Spencer described that offset voltages were adjusted to be in the range of 10–30mV. *Smythe* feared less than 30mV can be too low and could possibly lead to negative values. *Spencer* noted that changing resistors will get the offset back to the range of 30–100mV, or (as suggested by *Graham)* 100 or (as suggested by *Himwich)* 200 counts minimum.

Smythe has composed the following two useful email messages concerning TPIs:

```
Date: Mon, 29 Apr 1996 14:26:22 -0400 (EDT)
From: Dan Smythe <dls@newton.haystack.edu>
Subject: Adjusting TPI Zero Levels
To: emu@jb.man.ac.uk

A procedure for setting the zero level can be found on p. ANTENNA-39 in
Volume 2 of the Mark IV Fiels System Manual, in the Antenna Performance
section, and also in the manual for earlier versions of this manual.  A
similar procedure for the I.F. Distributor is on p. 41.  These
procedures suggest a zero level of 200-600 counts on the TPI, which
corresponds to 6-18 mV.  But the Perfromance Specifications for the
Video Converter say that the Square law detector linearity is better
than 2% from 5% full scale to full scale (Mark III Documentation, p.
VC-8 (1982 Jan 1)), which implies a minimum level of 100 mV, or 6000
counts.
... Dan
```

```
Date: Tue, 30 Apr 1996 08:48:35 -0400 (EDT)
From: Dan Smythe <dls@newton.haystack.edu>
Subject: tsys measurements
To: emu@jb.man.ac.uk (EMU)
```

```
I just talked to Alan Rogers about the linearity of the TPI.
It's dynamic range is limited to about 13 dB by nonlinearities in the
square-law detector, and if a reading is less than 5% of full scale, the
10-dB attenuator should be switched out to increase the signal level.

The zero offset is a completely independent issue:  the V-to-f is
perfectly linear, provided the input is positive.

My own interpretation of his comments is that you can not increase the
dynamic range of the TPI beyond this 13 DB by reducing the zero offset
voltage.  Reducing the offset voltage from 100 mV to 10 mV would
increase the dynamic range from 10*log(1.9/.1)=12.8 dB to
10*log(1.99/.1)=13.0 dB, assuming that the square-law detector is not
used outside its linear range (below 100 mv).

Cheers,
Dan
```

Action: *All* measure `TPZERO` read-outs of all VCs/BBCs and verify that they are in the range of 200–600–6000 counts.

It was then discussed if the proper way to do `TPZERO` was to use a dummy load at rack IF input, use 50dB attenuator in MkIII/MkIV IF distributor, and/or use 20dB attenuators in VLBA IF distributors. *Graham* noted that NRAO VLBA stations do not apparently measure `TPZERO` at all while they get 80Hz continuous-switching noise diode TPI readouts integrated by the BBCs. *Spencer* and *Porcas* reminded us to check the effect of noise diode used across the band.

2.5 Phase-cal — quote from Onsala and the decoder

Spencer described the quote from John Conway (Onsala) of an analog 10kHz phase cal extractor promoted by Lars Bååth. It can detect the phase and amplitude of 10kHz in 16 input channels (8 simultaneously), i.e. 14 VC/BBC USBs. It connects to the VC/BBC front panel USB monitor output BNC connectors. It was decided to order the system at 22kSkr/each.

Himwich and *Mujunen* reminded that they had not received programming information of the CTM-10 PC counter card used in the extractor and thus they could not say for sure if this card can be supported in FS PC.

Mujunen reminded that the document about upgrading the MkIII serial port transfer speed from 9600 baud to 115200 baud has been available at `(http://kurp-www.hut.fi/mk4-docs/databuff2.html)` (or `(ftp://kurp-ftp.hut.fi/pub/mk4/docs/databuff2.ps)` for a printable PostScript version) for a while and that *Buiter* has already sent the required upgrade parts to stations. *Spencer* urged all stations implement the upgrade. **Action:** *All* upgrade the data buffer.

2.6 Read/write electronics installation

Spencer noted that the formatters will be going to Haystack for testing after 29-Jul-1996, and this affects

R/W plans if R/W has to be installed in conjunction with formatters.

Smythe suggested that there are basically two ways to proceed:

1. Install R/W early, before the formatters, and use special cable adapters and FS procedure files to check and calibrate the recorder. Mark III modes A and B can be recorded, but not mode E, nor any mode which would require finer control over enabled recorder tracks than all/even/odd/none.
2. Install R/W together with the formatter, realistically taken after Oct-1996.

Installing R/W before formatters would naturally be a more gradual approach, allowing for testing R/W independently of the formatter. However, this would introduce a transitory period during which only Mark III modes A and B could be recorded using special FS procedure files.

Himwich noted that there is a possibility that Onsala and Medicina could receive prototype Mark IV formatters for a geodesy session later this year. *Mujunen* described that Metsähovi has been using MkIV R/W electronics in their VLBA recorder for over a year without any complaints from the correlators.

VSOP test have been planned in mid-June and mid-October 1996, and *Graham* suspected CMVA may have a session in October 1996. *Smythe* stressed that a zero-baseline test in which half of the samplers are correlated against the other half would be highly desirable for each completed R/W + formatter upgrade before actually doing real observations.

Ruf and *Buiter* noted that when they initially unpacked R/W upgrade module shipment they could not easily find the head assembly module (HAM). *Mujunen* ensured that it haas been included in the shipments. It is most probably located inside the NIM subrack, between the installed PWM and RDM modules, in the empty two-module wide space, wrapped in bubble plastic.

Smythe informed the meeting that installing the HAM requires dismounting the head stack, followed by a complete head stack alignment procedure. (Previously it was thought that only the preamplifier boards will be changed and the head stack will not be touched.) This is due to the following (this also actually completes the **Action:** *Buiter* looks for the documents of the head stack support change):

```
Date: Tue, 30 Apr 1996 11:58:09 -0400 (EDT)
From: Dan Smythe <dls@newton.haystack.edu>
Subject: Mark IV Head Block Pair
To: emu@jb.man.ac.uk (EMU)

Dear All,

VLBA Drawing D54330M007 Rev. A (2/92) documents the change to the head
block pair.  It replaces Dwg. No. D-6310-30 Rev. C on pp.21-25 of the
Tape Density Upgrade Manual by Horst Blaschke.  The only change is the
10-degree slope on the top; old parts can be modified to the new
specification by machining the top surface as shown in that drawing.

I will try to get a copy of this drawing added to the Mark 4 ftp area.

This modification is required to prevent flying at high speed.
It may be necessary at speeds as low as 160 ips with a low tape tension
```

```
of 5 inches of water, which is necessary with thin tape to allow mixing
tape thicknesses.

Cheers,
Dan
```

The revised drawing (D54330M007A) was published in Mark IV Memo #185.

Buiter mentioned that he has an updated procedure for head stack installation (the “Blaschke procedure”).

Spencer eventually recommended the following approach for the upgrade: if the prototype formatters will become available, Onsala and Medicina could be installed in June-July; Westerbork, Bonn, Jodrell (and if the formatters will not be available, Onsala and Medicina, too) in November/December. Later it was discovered that Medicina will be unavailable during summer due to repairs, and that the geodetic Mark IV experiment with loaned prototype formatters will be highly unlikely.

Mujunen reminded everybody about the prerequisites for R/W installation. **Action:** *All* please ensure that:

1. You can find a place for the new modules and the new NIM bin.
2. You can get suitable power connectors for connection to your version of Mark III power supply.
3. Check that your Mark III decoder works in playback mode (can show timecode, can count parity errors).
4. Check that the `PEAK` command of FS works.
5. Do a pre-installation `hdcal.snp` standard narrow-track head calibration routine and save the results.

2.7 Formatters

Spencer updated the latest estimates of when the new formatters will become available. Changes in one multiwire board have caused a delay of one month, and the first manufactured unit will go to Haystack for testing at the end of July, and it is expected to arrive in Bonn not before middle of September.

For a suitable testing procedure, *Smythe* recommended zero-baseline tests against a VLBA formatter, both VLBA and MkIV formatters running VLBA modes. **Action:** *Spencer* to contact *Freiholt, Smythe,* and Allied Signal and iterate the test plan.

Freiholt plans to use a function generator at formatter inputs and a logic analyzer at its outputs for tests at Bonn. *Spencer* asked about shipping requirements and *Smythe* stated that a MkIV formatter is not amy more fragile than a MkIII formatter and that Allied will most probably provide sufficient containers for them. **Action:** *Spencer* to arrange this with Allied.

Ruf and *Spencer* brought up the issue of import and re-export formalities and VAT. **Action:** *Buiter* and *Spencer* to check with their administration the proper procedures for handling import from US to Germany and from there to other EU countries with minimum VAT impact.

Porcas and *Smythe* reminded that all samplers of the MkIV formatter need to be checked. *Smythe* stated that all 32 sign bit sampler can be recorded and checked with the Bonn correlator. The MkIII decoder can be used to track signals going thru the crossbar switch by detecting the channel number embedded in the aux field. *Alef* suggested that one way to approach MkIV formatter testing could be to record in MkIII modes and verify with the Bonn correlator that at least them are working properly.

At this point of the meeting, *Himwich* received confirmation that the planned geodetic experiment in September using part of the VLBA plus Onsala and Medicina with borrowed prototype MkIV formatters will be very unlikely. As a consequence *Porcas* suggested that there will be no point in doing read/write electronics upgrade before installing the formatters.

2.8 Software: canned modes, VEX, VLBA modes

The issue of canning modes in the MkIV formatter has lost much of its importance since the key mode parameters will be set by the FS (and schedules/procedures) much in the same way as what is being done with VLBa formatters. The key mode parameters include sampling rate, fan-in/out, barrel roll, and assigning BBC USB/LSB channel 1/2-bit sampled bitstreams to recorder tracks.

Smythe described that the MkIV formatter single-board computer has EPROM and it is capable of canning complete setups. However, these will be mainly useful for testing. Also it may be practical to include the conventional MkIII modes A, B, C, and D. *Himwich* noted that a VLBA-style mode which would utilize all 64 tracks (8 BBCs and both USB and LSB used) could be useful. **Action:** *Smythe* and *Himwich* sort out useful test modes and make a proposal to *Freiholt.*

Alef asked about migrating to using 14 passes instead of 12. *Smythe, Himwich,* and *Mujunen* confirmed that this is just a matter of adjusting positions in `TAPEFORM*` procedures in FS. *Alef* asked if stations without a thin tape upgrade (and thus allegedly improved tracking) can safely use 14 passes. *Smythe* replied that if the tape drive is well maintained, there are no grooves in precision plates, and specifications (such as the three ones in section 2.3) are met, having 14 passes will work fine.

Spencer wanted to know who will do the EPROM, and *Smythe* stated that Haystack will put the test modes (A, B, C, D, a few VLBA modes) into it.

Spencer asked about the status of VEX scheduling file format. *Himwich* told that a VEX parser exists which can read VEX files into a memory-based data structure. This will be incorporated into the *drudg* SNAP converter of the FS, and the goal is to use VEX in June 1996 VSOP test observations. *Porcas* asked how this was done in February 1996 VSOP tests and *Himwich* replied that the SNAP procedures were created manually. *Porcas* informed us that Craig Walker is including VEX output in his SCHED scheduling program (with help from Huib van Langevelde), and SCHED will thus become the preferred solution for astronomical VLBI scheduling.

2.9 Future development, VLBA to MkIV (VIV) and China

After completing EMU, EVN will strive to upgrade its VLBA-equipped stations to MkIV. Haystack proposes to implement this by augmenting the MkIV formatter with a decoder/phase cal unit (connected to the sampler output connectors), and then replacing VLBA formatters with MkIV formatters. VLBA recorders need a second head stack and associated read/write electronics. *Smythe* reported that Ed Nesman is designing MkIV formatter to VLBA rack interface, and that Alan Whitney is hiring a new digital engineer which will be involved in this project and in MkIV formatter firmware development.

Spencer suggested forming a VIV group, similar to the EMU group.

Spencer and *Porcas* noted that in 1997–1998 the JIVE correlator and VLBI user demand will press for having MkIV available across the network. *Mujunen* suggested partitioning the upgrade into two:

1. Thin tape upgrade to VLBA recorders. This will be immediately beneficial as thin tape can be allocated and used at these stations in the same way as the VLBA is doing now.

2. Later we can proceed to acquire the expensive additional items: a second head stack, MkIV formatter etc. The VLBA formatter is already capable of recording many popular astronomical high-bandwidth modes (up to 256Mbits/s) in ways which offer large speedup factors at the Socorro correlator.

   Spencer told us that there is yet no decision of EU money for supporting Shanghai and Urumqi. [2] *Himwich* noted that NASA is interested in supporting Chinese stations for geo-VLBI and that NASA/EVN cooperation would be beneficial in this area.

2.10 AOB

Porcas wanted to know if NASA DSN stations are upgrading to MkIV. *Himwich* and *Mujunen* could tell that they are acquiring standard FS PCs and read/write electronics upgrades. *Smythe* indicated that Alan Whitney knows the current status, but *Smythe* assumed that DSN upgrade is progressing fine. He also noted that DSN may have S2 systems available at some stations.

2.10.1 Date of next meeting

The date of next meeting was left to *Spencer* to decide. It was noted that the TWG will be in September.

2.10.2 Production note

This document was written using the `linuxdoc-sgml` DTD. SGML stands for "Structured Generalized Markup Language" and I chose SGML for this document because SGML is made specifically for translation to other formats. SGML allows you to specify the *structure* of a document—that is, what kinds of things make up the document. You specify the structure of a document with a DTD (Document Type Definition). `linuxdoc-sgml` is one DTD that specifies the structure for Linux HOWTOs and other docs. QWERTZ is another DTD; the SGML standard provides DTD's for books, articles, and other generic document types.

For further information about software used to process this document, the `linuxdoc-sgml` package by Matt Welsh, please refer to the text file `(ftp://kurp-ftp.hut.fi/pub/emu/linuxdoc-guide.txt)`.

[2] On next day in EVN Director's meeting Richard Schilizzi informed us that the application had been turned down.