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## IHU-3 Meeting

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*A Critical Design Review took place in Marburg (Germany) from January 26 to January 30, at which time all of the technical details of the new IHU-3 on-board computer for P3E and P5A were examined critically.*

The participants were: Bob McGwier, N4HY, Chuck Green, N0ADI, Lyle Johnson, KK7P, Stephen Moraco, KC0FTQ, Bdale Garbee, KB0G, Gerhard Metz, DG2CV, Hartmut Paesler, DL1YDD, Peter Gülzow, DB2OS, and Heike Straube. In addition the new AMSAT President Rick Hambly, W2GPS and Art Sepin, (ex-K6IWS) were present as guests on the 28<sup>th</sup> and 29<sup>th</sup> of January, to get an idea of the progress made on P3E. The opportunity was used for extensive discussions about further cooperative expansion. Frank Sperber, DL6DBN, who was able to attend the meeting for a day, answered Chuck Green's questions about the two AzSTAR cameras.



Figure 1: Team discussion during the IHU3 meeting, in addition to clarifications of the hardware the further software development was on the agenda. In addition to the implementation of IPS32 also belong the DSP-codes.

A first operational capable IHU3 prototype was demonstrated and several measurements were

made on the LF section. Instead of hardware modems, the modulation and demodulation is completely performed by software relative to the coding of the command signals and the telemetry beacon, and results in the so-called "Software define Radio" (SDR).

The tasks of the IHU3 team are clearly distributed. While Chuck Green and Lyle Johnson are concerned with the hardware and the construction, Karl Meinzer has already developed a new 32-bit IPS structure. The first version ran on an Acorn RiscPC and was ported to the IHU3 via an on-hand cross development hardware tool on the ARM processor. Based on the IPS-D, which was used on the IHU-1, this version is called Version IPS-E.

Next we have to develop several test software programs and additional software modules, especially the receiver software to run the Turbo codes at full speed.

Meanwhile, Bob McGwier has received an IHU3 prototype and is working on implementing further software modules, so that IPS-E can be loaded into the new IHU3

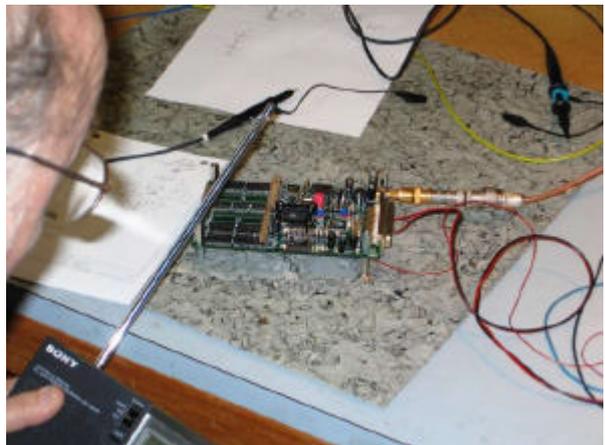


Figure 2: The IHU3 prototype on the workbench. Here the locking ability of the PLL oscillator is tested while applying a highly stable standard frequency.

hardware. This will happen using a software loader via the serial UART. Thereafter the software modems will be realized, which is a specialty of Bob's, at which he has been seriously engaged, having developed Software Defined Radios for amateur radios. Stefan Eckert, DL2MDL, who unfortunately could

not participate at the meeting, has already completed important preparation of the Turbo codes for the IPS.

Bdale Garbee will concern himself with the integration of the CAN functions in IPS-E, so that the CAN-DO can be adapted to the satellite. Stephen Moraco, who has written the software for the CAN-DO, will support him.

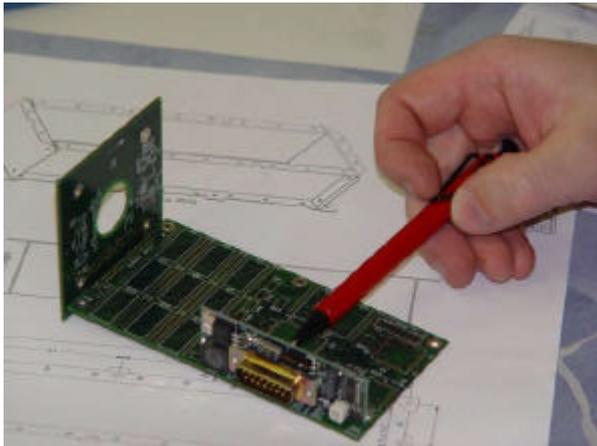


Figure 3: The unpopulated boards of the AzSTAR camera, edgewise the board for the image sensor, the large board is for the image memory and the processor, plugged into a CAN-do interface module.

Beyond these activities, important progress is also planned for the ground installation, since currently the cross development hardware is available only for the Acorn RiscPS. PC's based on 80x86 architecture naturally are dominant in the IHU3 team and therefore the IPS development environment has to be available on this hardware platform in the future. The subject has come up that Bdale Garbee was project leader at the Linux Debian Project for several years and closely tied to Linux, both professionally and privately. The aim is to integrate IPS into the Linux system, that can also be used in real time and all development tools be available. Karl Meinzer and Bdale Garbee will intensively tackle this integration of IPS into Linux in May. Bob McGwier will further concern himself with the implementation of the Turbo codes for the uplink and downlink based on soundcards, so that the ground segment is covered especially for the command station.

A rigorous time schedule was put into place and the "mass production" of the IHU3 should start beginning in the middle of May, because, in addition to the flight units including backup,

several engineering units will be required for software development and ground stations.

In addition to the IHU3, similar hardware will fly along for a RUDAK unit on P3E. Normally the IHU3A will perform the house keeping chores in the satellite. The similar IHU3B can likewise and theoretically undertake these chores, since all the I/O chores on the satellite flow through the CAN-Bus and the number of external crossover areas are minimal. Both IHU's have their own independent paths for command uplink and telemetry downlink, so that non-redundant switching will be generally avoided. If the primary IHU3A should fail, then the IHU3B could at any time take its place. The IHU's could either mutually monitor each other, or the switchover could, following suitable ground commands. As long as both IHU's perform without problems, the secondary IHU3B can readily take over the RUDAK chores. These new opportunities of the Turbo codes will make amateur radio more accessible and palatable. The reception of extremely weak RUDAK signals is imaginable, and finally radio technology will reach as far as Mars and will be set up by P5A. However, the data rate thereby is then accordingly low. Currently under discussion is still which modem operation method for the uplink to RUDAK will be installed.

One thing is certain, that with the implementation of the IHU3, satellite radio is being revolutionized and new paths are being covered.