Interim Progress Report of Phase vs. Elevation tests 22 Jan to 22 Feb 2007.

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Tests are ongoing. A detailed EVLA memo with all data, diagrams and final results of any hardware modifications will be written at the conclusion of the effort.

Week of 22-25 Jan 2007

Test #0: X-Band 'Baseline' type observations on sky, all elevations.

Result: +/- 20 to +/- 60 degrees of phase change with elevation, seen after best fit antenna offsets, fiber drifts removed. Antenna dependent; not very IF dependent.

Test #1: disconnect front end, inject X-band harmonics of 512MHz generated by second L300 to input of T304a-d. Second L300 fed from L304 512MHz output to isolate effects of L305 PLL & oscillator.

Antennas 18, 24, and 26 used.

Included antenna modules: L304, L305, L300, L302, T304, DTS, LO and IF fiber.

Procedure: Tip antennas (24, 26) while correlating the injected tones with ant 18 (not tipped) and measuring other signals with additional modules and external test equipment. Three simultaneous measurements were made:

<u>Correlation between antennas:</u>
(Includes the transition system and full signal path of astronomical observation)

Result: Still see about 20 deg variation on ea26; ~0 on ea24 (known good antenna) in correlated data.

Conclusion: Front end, first freq. conversion components exonerated. (partial cancellation of effects from several modules still possible)

<u>Measurement of LO signals:</u>
During this test two L352 round-trip phase meters were used on antenna 26. The first was used in its intended configuration to monitor the round trip phase on the LO fiber. The L305 512MHz Phase Locked Oscillator was monitored with a second L352 round-trip meter.

Result: Neither outbound nor return LO showed significant phase change with elevation.

Conclusion: This eliminates L304 and L305.

Measurement of DTS phase:
During this test, the 'recovered' clock from the 10Gbps IF data stream was measured using a DDS configured in the D351 FPGA and a Fluke synthesizer locked to the maser.

Result: This clock (divided down to 50MHz) showed +_0.1deg phase change with elevation, or 20deg if scaled to 10GHz.

Conclusion: The effect of this on sky data occurs, not at 10GHz, but at some lower frequency (e.g. sampler clock?) and should be independent of sky frequency. Not clear if this is the culprit.

Test #1 was rerun, with the recovered clock replaced by a clean, separately generated clock on the IF A D351 deformatter. It did not eliminate the phase change with elevation. Still see 20deg on ea26, IFA, (clean clock); same as on IF C and D, regular recovered clock. (IF B was bad – D351-b deformatter was incorrectly configured – no effect on conclusion)

Conclusion: The recovered clock in the DTS is not the main culprit.

Week of 13-16 Jan 2007

Test #2: 857 MHz CW signal sent out on spare LO fiber, and injected directly into the digitizers. This bypasses the L302 and T304 and is meant to test the DTS.

857 MHz was chosen since it aliases to 1191MHz, the same frequency presented to the digitizers by the T304's in Test 1. 1191MHz is beyond the spec of the fiber transmitter/receiver pairs used in our LO modules.

Antennas 18 and 26 were used. Ran same script as Test #1. First attempt failed. After we discovered phase switching needed to be turned off since the L302 was bypassed, the test was run successfully.

Result: No phase change with elevation (ea26 tipped, ea18 steady)

Conclusion: L302 or T304 cause phase change with el. DTS is exonerated.

Test #3: 12967MHz L302 signal mixed down by L300 comb to 1191 MHZ and injected directly into the digitizers. This bypasses only the T304 and is intended to test the L302.

Procedure: same as Test #2 but with command sent to set L302 to correct frequency.

Result: No phase change with elevation. Test setup was a little flaky, multiple comb lines were probably present and their relative phases were changing. Will repeat the test using an L301 in place of the L300 comb line on a maintenance day to be very sure. (Duration: 1hr setup, 2-3hrs test, 1 hours reset).

Conclusion: L302 possibly exonerated; T304 left as main suspect.

To be done/ongoing, next 2 weeks:

Test #4: Bench test with tip-frame on L302 and T304 modules. This will involve considerable thermal testing as well. Close examination of the data still indicates that thermal behavior inside one or more of the modules is the most likely culprit.

Test #5: Bench and field test of modifications to suspect module(s)

Possible modifications include

- -mini-bend cables replaced by semi-rigid.
- -better thermal management inside modules
- -replaced components
- -modified PCB's
