

This is the public page for our part of the "[ALMA Phasing Project](#)" (APP) at MPIfR.

If you are looking for the "official" APP management pages go [here](#).

The APP project was presented By W. Alef at the "[11th European VLBI Network Symposium & Users Meeting](#)"

The presentation can be found [here](#), the proceedings will soon become available [here](#).

## Summary of the APP project

By phasing all ALMA dishes together into a single effective aperture, ALMA can operate as both an exceptionally sensitive mm/sub-mm VLBI element and a beamformed array suitable for high frequency pulsar work. A detailed design for implementing a system to phase up the array has been completed and funding to build and integrate this capability into ALMA has been secured. With this system in place, ALMA will become a key element in Global mm/sub-mm VLBI arrays that target a broad range of high sensitivity and high angular resolution science.

The ALMA Phasing Project is being realised by an international consortium consisting of [MIT Haystack](#), [NRAO](#), [MPIfR](#), [NAOJ](#), [ASIAA](#), and [U. Conception](#). MPIfR manages the European part which is supported by [OSO](#), [ESO](#) and others. The project duration is planned to be 4 years, with a total workload of more than 25 work years and a total budget of more than 4 \$M. Expected completion of the phasing system is in 2015. The funding for the project comes from a combination of pooled resources from international funding agencies.

ALMA was de-scoped in the development phase, but hooks for phasing were built into the correlator to make it relatively easy to implement VLBI at a later date. The parts that have to be added are:

- a Hydrogen-Maser
- a phasing system and software
- VLBI formatting, data transport and recording

The software VLBI correlator [DiFX](#) which will be used for correlating the phased ALMA signal against the recorded signals from other telescopes participating in an observation has to be enhanced to cope with non-matching frequency sub-bands (62.5 MHz vs. 64 MHz) and to be able to reconstruct ALMA's linear polarisation to the standard circular polarisation which is standard in VLBI.

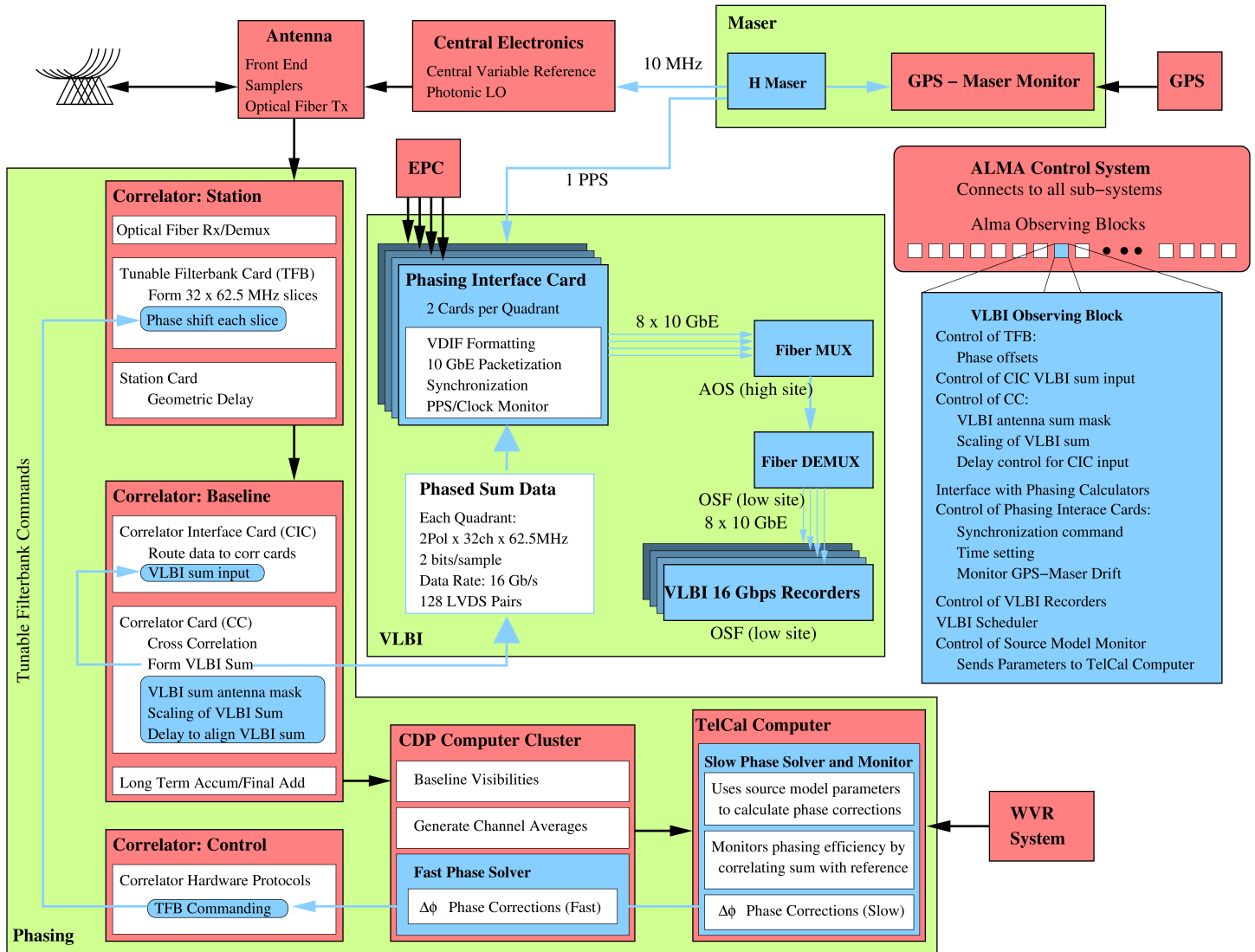
## APP status

The APP has passed both the preliminary design review and the critical design review and is being implemented.

First tests are planned for early 2014, the project will end with the commissioning of the phasing system early 2015.

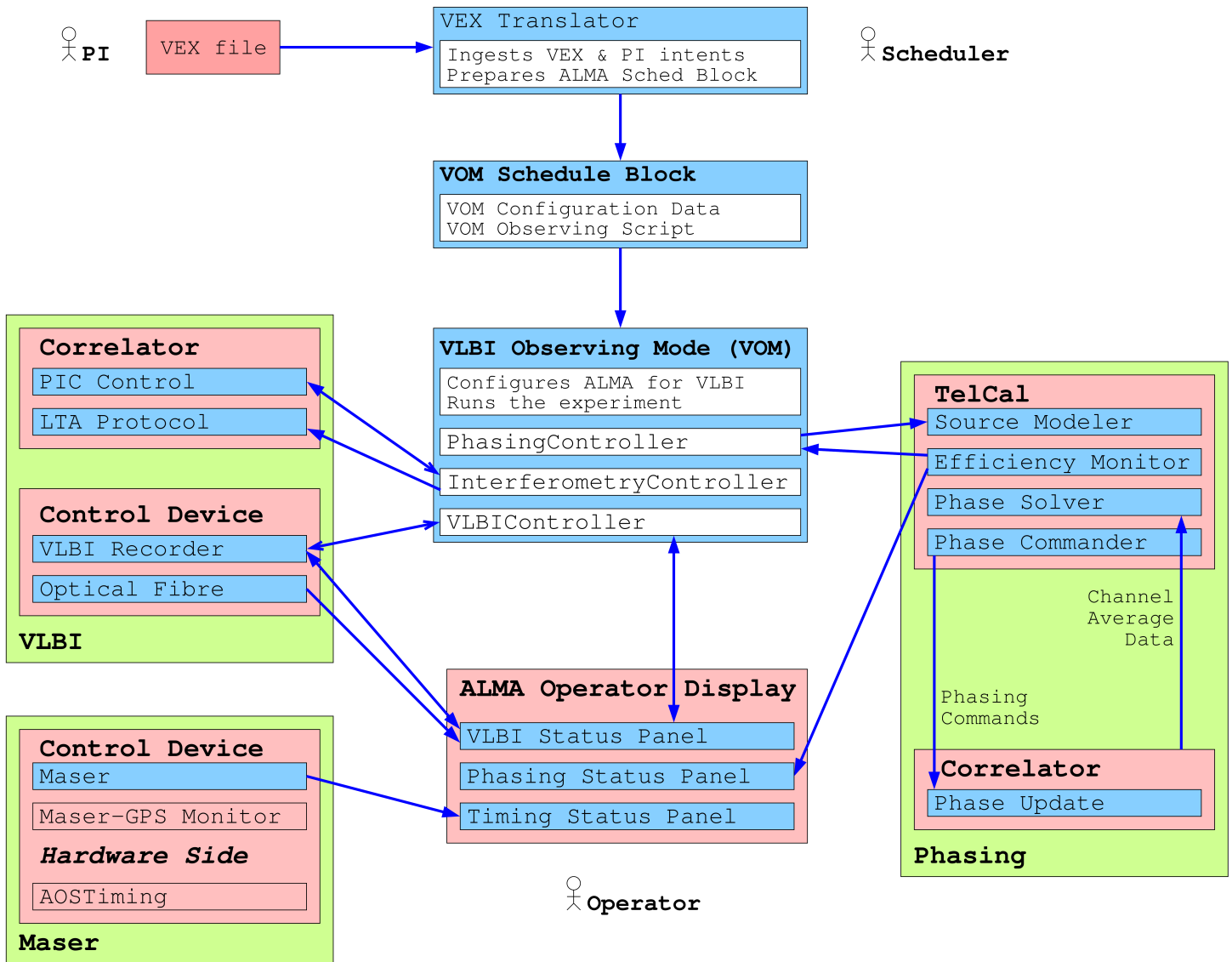
## Overview

Hardware blockdiagram:



ALMA phasing block diagram. The red boxes exist, the blue boxes have to be added for phasing ALMA, and the green colour groups boxes into larger units. (for details see attached paper)

Software blockdiagram:



Modifications needed for ALMA software. The red boxes exist, the blue boxes have to be added for phasing ALMA, and the green colour groups boxes into larger units. (for details see attached paper)

**MPIfR tasks**

MPIfR has a representative in the APP management team who takes care of managing the European contributions to APP which are software, VLBI data correlation, scientific contributions.

**Telcal Phase Solver**

The TelCal software will be enhanced to solve for antenna phases which will be used to correct the antenna signals of the incoming data, which can then be added coherently in the existing adder unit of the correlator.

**Polarization phase & delay calibration**

Under the lead of MPIfR personnel ways to combine the linear polarisation of ALMA with the circular polarisation of other antennas was investigated. The best method identified - correction of the polarisation after the VLBI correlation with [DiFX](#) - will be implemented in a joint effort with OSO.

**Scheduler**

VLBI observations are driven via so-called [VEX](#) schedule files. A typical VEX schedule file has to be enhanced for additional ALMA related control information. In addition this enhanced VEX file has to be translated into an ALMA specific XML file. MPIfR works on this together with MIT Haystack.

**Implementation and verification**

MPIfR will contribute the [APEX](#) telescope situated close to ALMA for first VLBI test observations.