

Advanced LIGO Engineering Change Request (ECR)

ECR Title: Long Term Upgrade to the Timing Diagnostics System

DCC No: E1500328-v1

Date: 7/31/2015

**Requester: Zsuzsa Marka Impacted Subsystem(s): CDS
Daniel Sigg**

Description of Proposed Change(s): We propose to install distributed GPS clocks to complement the aging commercial fiber based timing distribution system used in the timing diagnostics. Three new CNS II clocks would be installed—one in each building. Each clock would provide 1PPS, IRIG-B and diagnostics readback through serial port.

Plan: (1) evaluate a partial implementation at LHO during O1, (2) complete the system and also install it at LLO after O1, (3) run both the new and old system during O2 at both sites. The old commercial timing distribution system would then be redundant after O2—enabling seamless decommissioning in case of failure.

Reason for Change(s): The timing diagnostics system has been taken from initial LIGO essentially unchanged. It consists of an atomic clock in the corner station and a commercial fiber based timing distribution system. The atomic clock did reach end of life and was replaced. However, the commercial timing distribution system may have to be replaced when the product reaches end of life. In initial LIGO the main timing system was based on distributed GPS clocks, whereas the diagnostics system was based on fiber. Since the Advanced LIGO timing system is also fiber based, it is possible to complementally change the diagnostics system to distributed GPS—but still maintaining an atomic clock in the corner to monitor the master GPS. The distributed GPS clocks will also allow us to reintroduce the distributed system of IRIG-B signals which was lost with Advanced LIGO. We propose to run the old diagnostic system in parallel to the new GPS based system at least until the end of O2, or until the system's end-of-life is reached.

We will use O1 to assess the need of a true fly wheel for the master GPS. A rubidium based system has already been successfully investigated at Columbia, [T1500387](#). Alternatively, we can think of using the atomic clock as a fly wheel.

Estimated Cost: \$3000/GPS clock, 6 total; potentially \$5000/rubidium, 4 total.

Schedule Impact Estimate: can go on in parallel.

Nature of Change (check all that apply):

- Safety
- Correct Hardware
- Correct Documentation

- Improve Hardware
- Improve/Clarify Documentation
- Change Interface
- Change Requirement

Importance:

- Desirable for ease of use, maintenance, safety
- Desirable for improved performance, reliability
- Essential for performance, reliability
- Essential for function
- Essential for safety

Urgency:

- No urgency
- Desirable by date/event: _O2_
- Essential by date/event: _____
- Immediately (ASAP)

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Impacted Hardware (select all that apply):

- Repair/Modify. List part & SNs: _____
- Scrap & Replace. List part & SNs: _____
- Installed units? List IFO, part & SNs: _____
- Future units to be built

Impacted Documentation (list all dwgs, design reports, test reports, specifications, etc.):
CDS rack drawings, timing docs.

Disposition of the proposed change(s):

The disposition of this proposed engineering change request is to be completed by Systems Engineering and indicated in the “Notes and Changes” metadata field in the DCC entry for this ECR. The typical dispositions are as follows:

- **Additional Information Required**: in which case the additional information requested is defined. The ECR requester then re-submits the ECR with the new information using the same DCC number for the ECR but with the next version number.
- **Rejected**: in which case the reason(s) for the rejection are to be given
- **Approved**
- **Approved with Caveat(s)**: in which case the caveat(s) are listed
- **TRB**: the ECR is referred to an ad-hoc Technical Review Board for further evaluation and recommendation. It is the System Engineer’s (or designee’s) responsibility to organize the TRB. The System Engineer (or designee) then makes a technical decision based on the TRB’s recommendation. Links to the TRB’s documentation (charge, memos, final report, etc.) are to be added to the “Related Documents” field for this ECR.
- **CCB**: a change request for approval of additional funds or schedule impact is to be submitted to the Configuration Control Board. Links to the CCB’s documentation (CR, etc.) are to be added to the “Related Documents” field for this ECR.

Concurrence by Project Management:

Acknowledgement/acceptance/approval of the disposition is to be indicated by the electronic “signature” feature in the DCC entry for this ECR, by one the following personnel:

- Systems Scientist
- Systems Engineer
- Deputy Systems Engineer