M2 OBSEA'S SEISMIC STATION JOINS THE IGC NETWORK

Joaquin del Rio[25], Daniel Mihai Toma[42], Javier Cadena[22],Jordi Segalas[43], Joana d'Arc Prat[44], Jose Antonio Jara[45], Tànit Frontera[46], Carme Olivera[47], Xavier Goula[48]

Abstract

A cabled system for collecting real-time seismic data has been developed and was deployed in spring of 2011. Nowadays (2013) this seismic station is being part of the Catalan Seismic Network managed by the IGC (Institut Geològic de Catalunya). The seismic system is part of Western Mediterranean Cabled Observatory, OBSEA (www.obsea.es). A key component in this cabled system is the use of IEEE 1588 standard that serves as a clock synchronization mechanism for the seismometer with Universal Time Coordinates (UTC) clock. This paper presents the seismic measurements results of the broadband seismometer. The seismic data are time stamped using a UTC clock, which is traceable to within the desired level of precision of sub milliseconds through IEEE 1588 protocol.

Keywords-IEEE 1588, seismometer, time synchronization, cable observatory

I. INTRODUCTION

An important requirement to have an accurate location of the earthquake is to provide one-microsecond timing to all seismographs with GPS reference. In underwater seismic stations known as Ocean Bottom Seismometers, the instrument has no access to a GPS signal for time synchronization. Cabled ocean observatories as OBSEA (Expandable Seafloor Observatory) are widely used to monitor many ocean parameters as seismic activity. Furthermore, Tsunami warning systems that are based on seismic stations need a precise time base in order to generate a precise and reliable alarm.

II. SEISMOMETERS USED

An ocean bottom seismometer (OBS) has been used for the OBSEA network. One is the Trillium 120P/PA Broadband seismometer together with Taurus data logger [6]. This is a commercial seismometer used for land seismography, which is adapted to be synchronized through IEEE 1588. An external LM3S9B96 module which implements the IEEE 1588 protocol with the master clock on land is in charge of providing the precise timing and PPS (Pulse per Second) synchronization trigger to the seismometer through serial communication using Trimble Standard Interface Protocol (TSIP).

The IEEE 1588 Grand Master Clock (GMC) is synchronized with GPS on the land station. The real time clock of the LM3S9B96 board is synchronization through Ethernet network of the OBSEA with GMC using IEEE 1588 protocol. The real time clock of the LM3S9B96 is used as the time reference for the TSIP protocol that synchronizes the Taurus Data logger. Also the LM3S9B96 board provides a PPS signal to the logger to adjust the internal clock deviation.

III. SYNCHRONIZATION RESULTS

To test the IEEE 1588 time synchronization in the OBSEA network a demonstration test was performed. The test was done using the same communication hardware, which is installed in the OBSEA network. The test setup included the shore station, node Ethernet switches and ocean bottom seismometer running PTPd stack. An oscilloscope was used to measure the offset between pulse per second (PPS) from the master clock and slave clock.

VI. CONCLUSIONS

The SARTI research group has successfully designed and tested an underwater cabled seismometer implementing the PTP protocol over Ethernet to synchronize with UTC time to a high degree precision. The results of different tests carried out show that a precision of sub microseconds is achievable but requires VLAN setup of switches in the OBSEA network.

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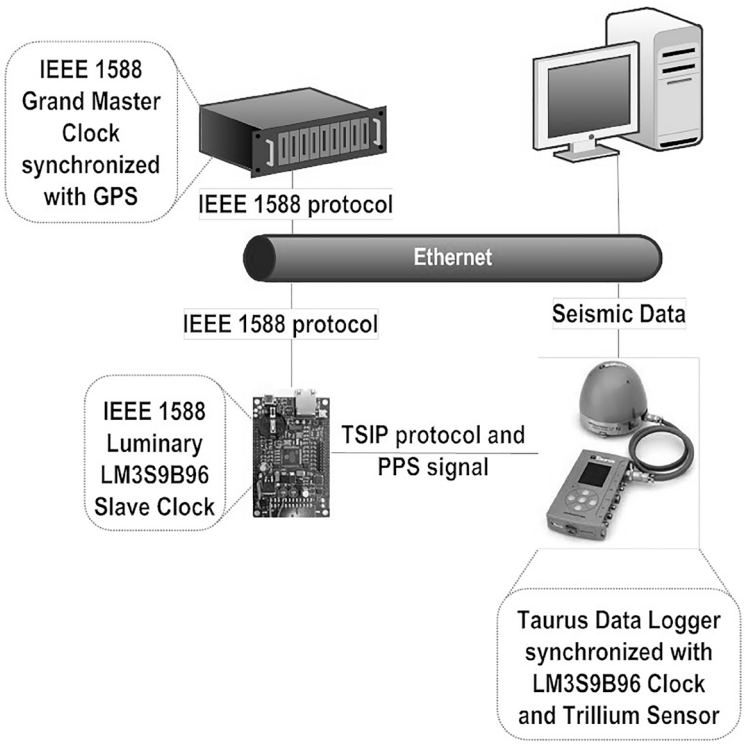

Figure 1 Taurus Broadband Seismometer synchronized with GPS through IEEE 1588 protocol