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A NEW SYSTEM FOR FOR AUTOMATIC STD DATA ACQUISITION FROM RANDOMLY POSITIONED OBSERVERS

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ABSTRACT

The Inst. of Marine Researche in Bergen has since 1935 on a regulary basis acquired data from fixed hydrographic stations on the Norwegian coast. The data are collected by local residents via water samplers and reversing thermometers, and the material is mailed to the Institute appr. twice per month.
In order to reduce costs and also to make possible automatic acquisition of data in real or close to real time, a new data communication system for hydrographic data has been developed.
In the new system the local observers will measure STD-data with a portable, recording STD instrument.
After having finished a STD profile, the observer connects his instrument to a communication system based on a mobile telephone, a modem and a communication interface. At programmable intervals a central PC at the Inst. of Marine Research will sequentially dial the telephone number for each operative communication unit. If an STD instrument has been connected, its recorded data will be loaded to a file in the PC.
If no STD has been is connected, the system will continue to the next telephone number.
The paper explains the instrumentation, the communication system and the software which has been developed for the system. Results from a field test are also presented. The system is sheduled to be operative from autumn 1991

INTRODUCTION.
During 1935-1942 stationary oceanographic stations were established along the Norwegian coastline at Ingøy, Eggum, Skrova, Sognesjøen, Utsira and Lista.
In 1971a new station was added at BUD.
The map on fig 1 shows the positioning of these stations.

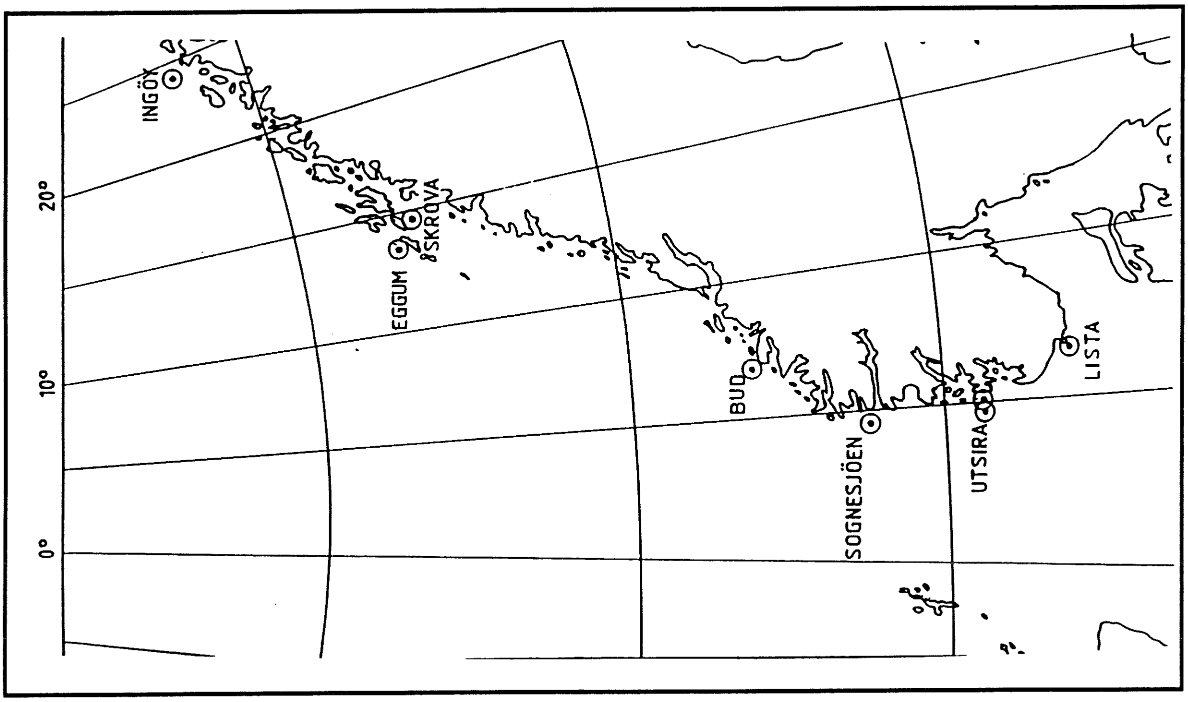

Fig. 1 Positions for Norwegian long term hydrographic stations.

The stations are run by observers who live in the actual regions. Each observer has been trained and instructed to measure the temperature and to collect water samples from the same position at specified standard depths appr. twice per month. The material collected is regularily mailed to the Inst. of Marine Research in Bergen where the data are analyzed, controlled and processed.
Due to their regularity and long term character the data from the Norwegian fixed hydrographic stations are extremely valuable for research on climatic dependent physical and biological processes.
Increasing costs involved with manual collection of data from stationary stations have actualized a more automatic way to acquire them. An increased demand for early warning of possible disasters due to poisonous algae or due to pollution from production and transport of oil has also generated a significant need for hydrographic data in real time.

A system which both automates the delivery of data from a station and also makes possible acquisition of close to real time data from observers in random positions is now under testing at the Inst. of Marine Research. The project is carried out in cooperation with HOV (Norwegian Marine Surveillance and Forecasting Centre) which is also situated in Bergen.

SYSTEM DESCRIPTION
The system is based on a miniaturized, portable STD instrument, a communication system using mobile or stationary telephone and a PC software packet which effectuates an automated data readout and processing.

INSTRUMENTATION

The sensor part in the system is is the "intelligent" miniaturized STD - instrument described by Gytre (1989)

Fig 2 shows a simplified block diagram for the instrument.

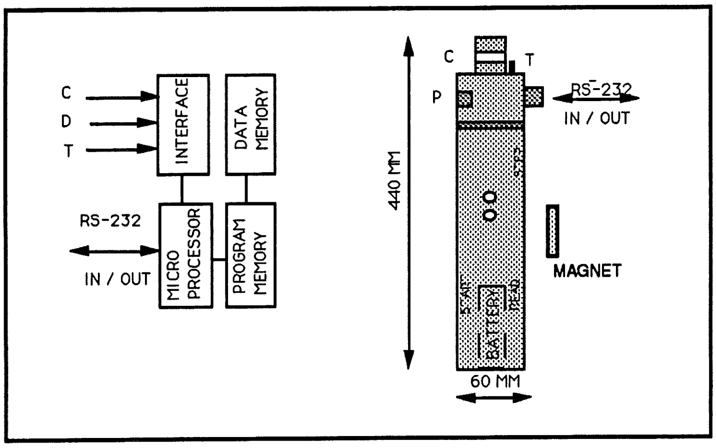

Fig. 2 Mini STD block diagram

The instrument has been designed physically small and compact in order to simplify transport and use from small boats. Total weight is 2.2 kg. It has sensors for conductivity, temperature and depth and built in processing power to compute salinity and sound velocity from the primary CTD variables. The STD can be programmed to measure and record data at a repetition rate from each 5. second to each 3 hour. For profiling T = 5 s is used.To start and stop it in the field, the instrument may be be activated and deactivated by holding a magnet outside marked START - READ and STEP- positions on the instrument surface.

To take a station the observer starts the instrument with a magnet Then he lowers it at a specified rate of 1 m/s. to the given maximum depth.

The data from each measurement series (each station) are recorded in the instrument memory. The memory can store up to 12.000 individual CTD data sets.

Fig 3 shows a typical measuring situation. The observer brings his boat to the defined position, starts the instrument with a magnet, takes it down to a given depth at a specified lowering rate of 1 m/s and brings it up. Then he stops theinstrument with a magnet.

Finally the observer finishes his job by connecting his STD to the communication system.

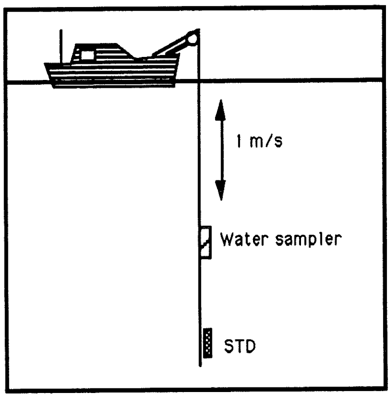

Fig. 3 STD- profiling. The observer starts the instrument with a magnet and brings it down to specified depth at 1 m/s. When the instrument is up again he stops the recordingwith a magnet. He ends his job by connecting the STD to the data communication system

THE COMMUNICATION SYSTEM

The communication system is based on public telephone. In order to be able to read data from remote observers in random positions, the system has been specially designed to work with a mobile telephone .

Norway has one mobile telephone network operating at 450 Mhz ("450 system") and one net-

work at 900 Mhz. The 450 system ,which has been selected, covers the entire country and the signals reach far into the sea outside Norway.
Data from the instrument are fed to to a modem which is connected to a mobile telephone.
A modem is basically a device which converts digital signals to frequency modulated signals suitable for the telephone. It can also convert frequency modulated signals back to digital signals suitable for computers.
Fig. 3 shows the communication unit used by the observer.

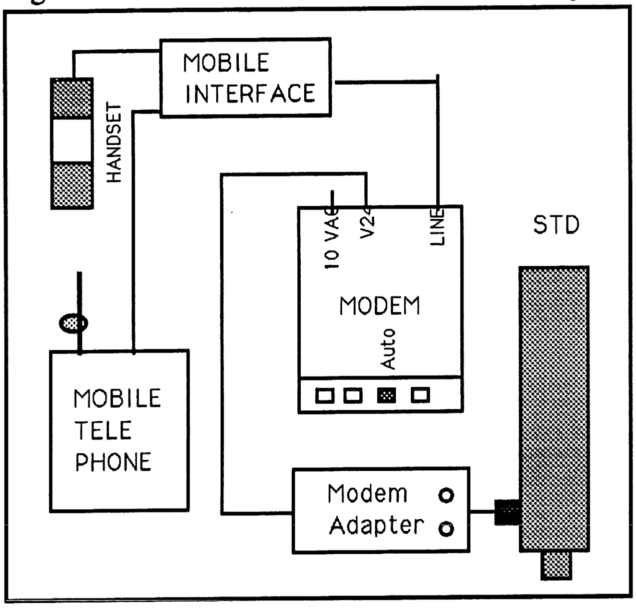

Fig. 3 Communication equipment needed by the observer.
The observer connects his STD unit with data to a communication system based on a mobile telephone.
At any time after this the data can be remotely read by a PC via standard telephone network from practically anywhere in the world.

The communication system is made from a standard mobile telephone, a standard modem and a specialiy designed interface - the modem adapter.
Fig. 4 shows the priciple for the modem adapter. The adapter reacts on special control characters in the data stream from the readout PC and passes control orders to the STD. It also monitors the technical quality of the data transmission. It will break the transmission and ask for a new try if the transmission noise level becomes unacceptable. The modem adapter has also mailboxes for optional written communication between user and observer.

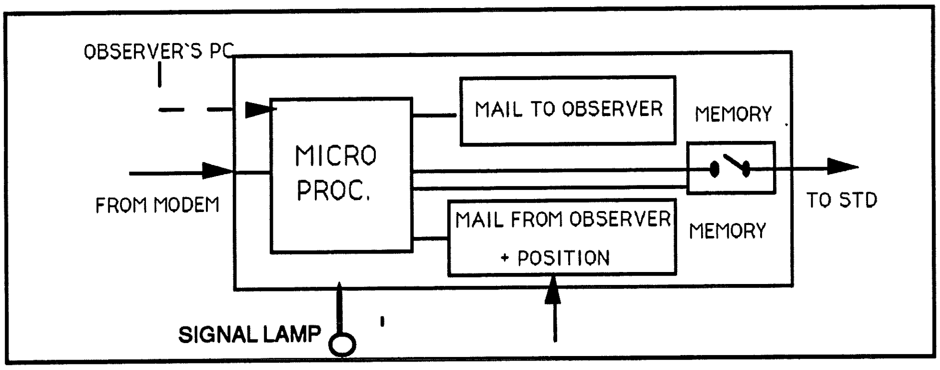

Fig. 4 Interface unit between Mini STD and modem. The unit controls data quality and translates operating commands from modem to STD. If the observer posesses and can use a PC, he may write and receive up to one page of text in the "mailboxes".
Station positioning data can be entered without PC
When all data have been successfully read, the unit informs the user by flashing a lamp.

Fig . 5 illustrates how the complete communication system works.
The Inst. of Marine Research has installed a dedicated PC to read data via telephone.
When station data are wanted, the PC dials the observer`s telephone number. The modems in both ends will first select a common baud rate.

Via commands "VG" and"F" the PC then instructs the STD to deliver all recorded data. When the data have been loaded to a file in the central PC, the communication ends.

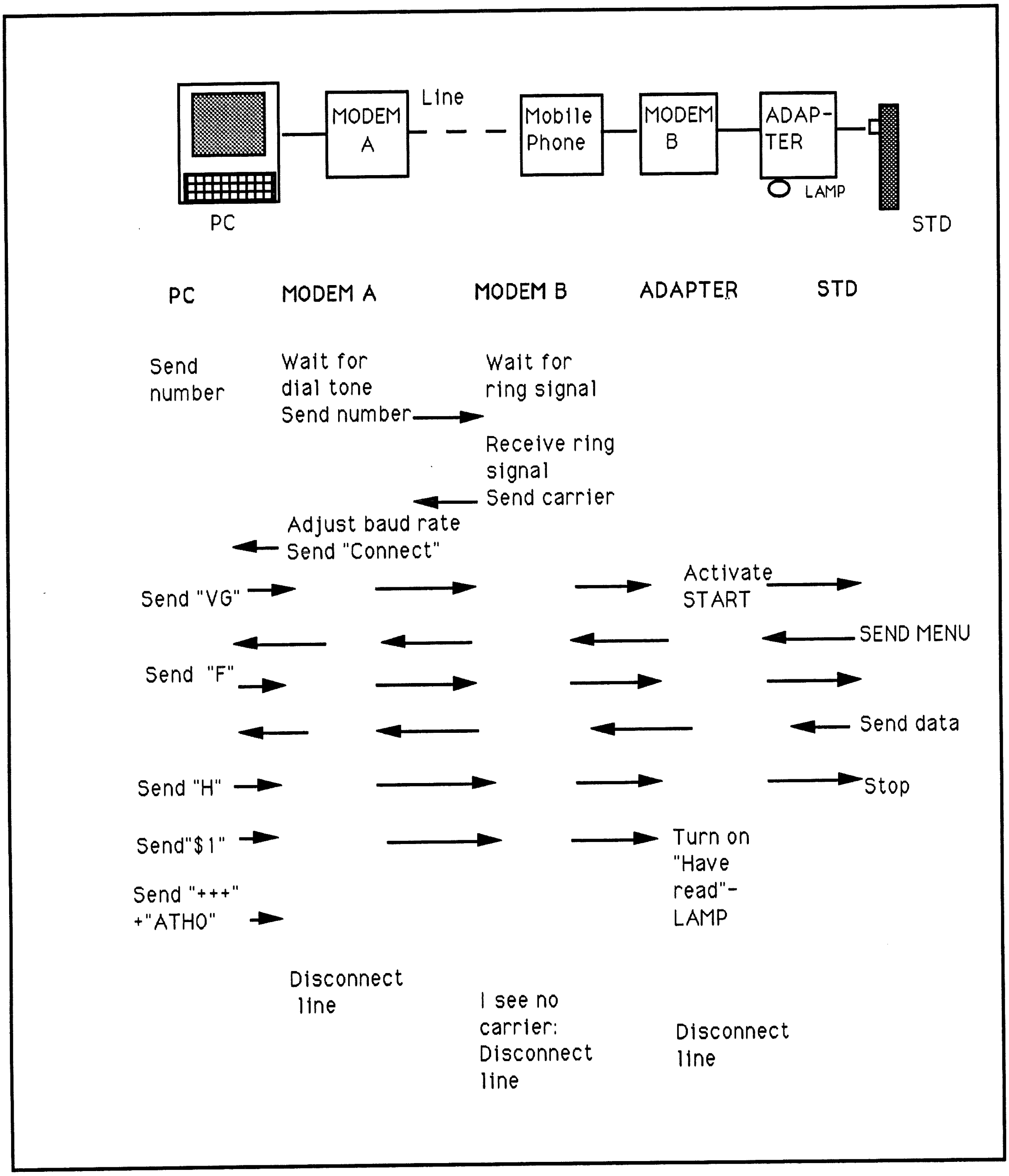

Fig. 5 Sequence diagram for data and instructions between Mini STD and PC via telephone.
When using a mobile telephone data can be sent from the STD immediately after they were measured to virtually any telephone in the world

Fig. 6 shows the PC screen during readout. The STD has sent its menu. The PC has selected command F (Dump data) and data have started to flow to its disk. Measurement no. 916 is just being transferred.

```
COMMUNICATION MODE
Strike any key to get menu
Strike any key to get menu
Menu:
Select ctd/std/ox/sound velocity      <B>
Set real-time clock                   <S>
Dump data.DC1=start DC3=stop G=menu<F>
Erase storage memory                  <E>
Sensor calibration                    <C>
List cal.coefficients                 <L>
Reset battery life counter            <P>
Select master/standard mode           <I>
Self-test                             <T>
Set coefficients                      <M>
Select baud rate for communication <A>
Stop instrument                       <H>

Receiving file number 0 from station: Observatør på
Waiting for start of measurement series.        Lista
Receiving measurement no.: 916
```

Fig. 6 PC screen picture during remote readout of station LSTA via mobile telephone. The PC has sent an "F" in order to receive all recorded data
By sending one or several of the other command characters listed in the menu, the user may also set the internsl clock, erase all data, change calibration co-efficients etc.

Software description.

Fig. 7 shows a block schematics for the software .

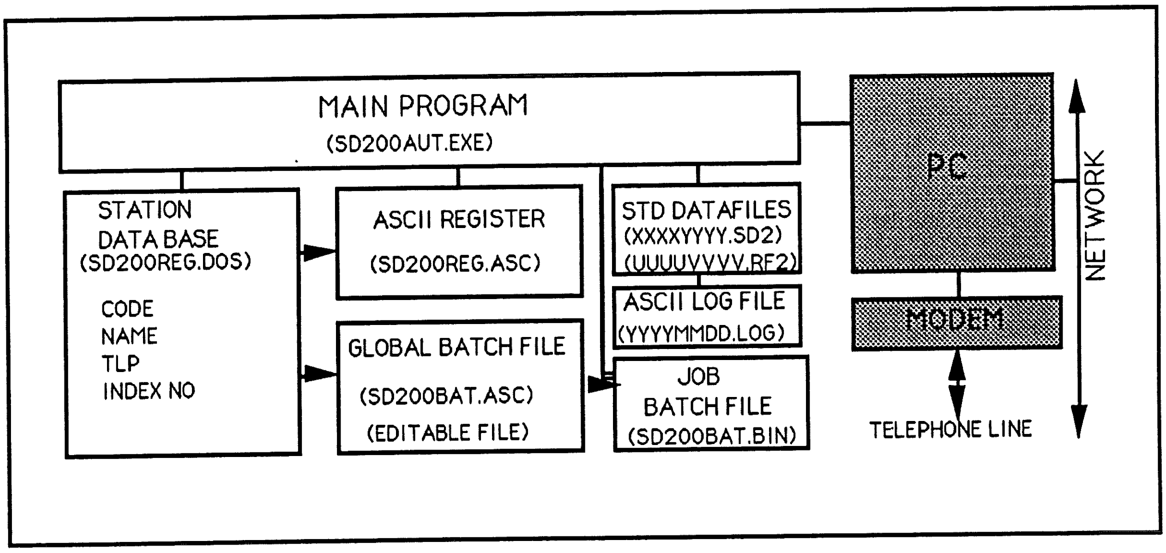

Fig.7 : File structure for the communication programme.

Each station is identified by a 4 character station code, a station name and a telephone number. The station database contains this information for all stations registered in the system It also knows how many times each station has delivered data. This information is used to assign all STD data files to individual index numbers from 0 - 9999 depending on how many files the station has ever delivered to the system. An ASCII register readable from the network contains a copy of the station data base.
The "global" batch file is basically a copy of the station data base. However- it can be edited to remove temporarily non active stations from the system. The "job"batch file is initially a copy of the "global" batch file. As the main program excecutes data readout from the stations listed in the global batch file, the calling instruxes for stations that have been read are removed.

job batch file one by one.
When the Job batch file is empty,the readout process comes to an end.
The final results of all this activity - new series with STD - data - are loaded into the .SD2 and .RF2 data files.
. SD2 data files, f. inst. LSTA ___ 0 .SD2 , contains STD data only. The index number ___0 shows that these are the first data ever received from station LISTA.
The RF2 files contain time and length of data series information for the . SD2 data.
The main program instructs the PC to dial all active observer stations oneby one at a given time or at an "Immediate readout"- command. If the observer has connected an unread STD, its data will be downloaded. If not, the station will be immediately bypassed. If the telephone line is busy or too noisy, up to five new calls will be made later.
The arrival of data will also generate an ASCII "log"file that contains all data files received since last midnight. To make the log- files easy to find from a network, they are named from the date they were generated.
Fig.8 shows the main program menu.

```
Program for automatic readout of SD200 meters.

F1  Modify dialing register

F2  Create ASCII batch file

F3  Create ASCII dialing register

F4

F5  Immediate readout

F6  Timed readout

F7  Daily readout

F8

F9

F10 Exit.
```

Fig. 8 Main program menu

```
C:ØSDAUTO>type 19910504.log
MOBI___6Mobiltelefon Gytre

199105042210

C:ØSDAUTO>
```

Fig. 9 LOG- file listout

Fig 9 shows the contents of the log file19910502. LOG. The file show s that during 2. may 1991 station MOBI has sent its data set no 4 . The data were received 22.17 o`clock.
The station MOBI was a test station situated onboard F/F Johan Hjort on a survey outside the Lofoten islands in North Norway.

RESULTS

A system prototype field test was made in May 1991 during a survey with F/F G.O.Sars. The position was close to SKROVA shown in fig. 1.
For 8 days one STD profile was taken with a mini STDper day. The STD was then connected to the transmission system shown in fig.3.
Each night a PC in Bergen dialed the mobile telephone and downloaded data.
During these test no problems were observed. A control of the received datafiles compared with the transmitted ones showed that all transmitted and received data files were identical.

FUTURE PLANS

From the autumn 1991 the described STD data acquisition system will gradually replace the manual system currently used and start to deliver data to both Inst. of Marine Research and to HOV. Within this year a minimum of 4 stations are sheduled to be operative.

Ref . Gytre T: "Automatic calibration of the sensors used in a miniature STD- instrument " (ICES C.M: 1988 / C24 Hydrography Committee.