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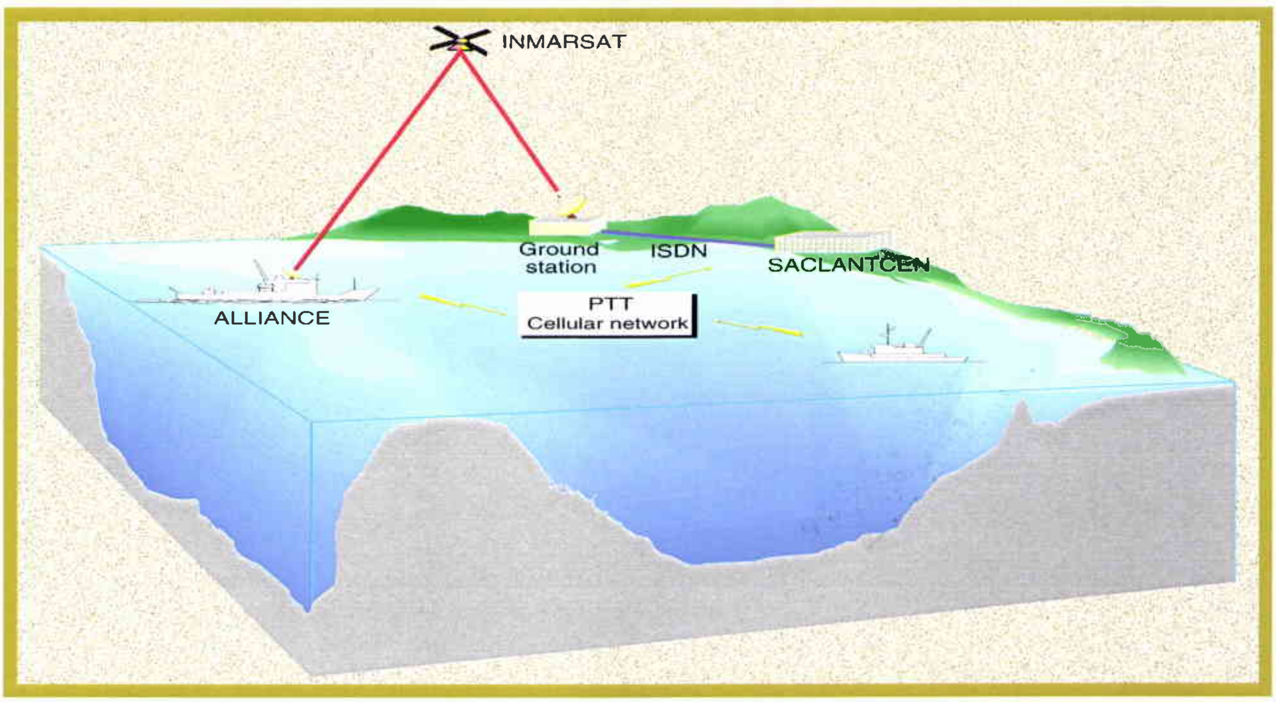
SACLANT UNDERSEA RESEARCH CENTRE REPORT

Improvements to data networks in support of REA during Generic Oceanographic Array Technology (GOATS) 98



Alessandro Berni, Laura Madrignani and Alex Trangeled

May 2000

NORTH ATLANTIC TREATY ORGANIZATION ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

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Jan L. Spoelstra
Director

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Improvements to Data Networks in support of REA during Generic Oceanographic Array Technology (GOATS) 98

Berni, A., Madrignani, L., Trangeled, A.

Executive Summary: Communication technologies play a vital role in supporting and making Rapid Environmental Assessment activities more effective. This paper presents the advances that were introduced during the Generic Oceanographic Array Technology experiment **(GOATS) 98**, conducted in the Tyrrhenian Sea in May 1998. R/V *Alliance* was connected to SACLANTCEN and the Internet *via* radio link to a shore control *via* an ISDN link. Preliminary experimental data were made available using www servers installed onboard R/V *Alliance* and at the shore laboratory. Videoconferencing experiments were conducted from R/V *Alliance* to SACLANTCEN and *vice versa*.

Contents

1 Introduction

The immediate objective of the GOATS'98 experiment was to develop an improved understanding of the physics of 3-dimensional acoustic scattering from proud and buried objects and associated seabed reverberation in shallow, littoral environments. The long-term objective is to develop new sonar concepts and systems using a combination of fixed and moving sensor platforms to adequately measure the scattered field [1]. In this context, small sensor platforms such as the Generic Oceanographic Array Technology (GOAT), under development at MIT, will be evaluated not only with regard to the determination of their potential for MCM detection and classification, but also for Rapid Environmental Assessment (REA) in denied areas.

This document concentrates on the data network architecture in support of the experiment, which we believe, represents a significant improvement in comparison with previous experience and opens new opportunities for Rapid Environmental Assessment activities.

2
Network Infrastructure

2.1. Operational scenario

The experiment took place during May 1998 in the Northern Tyrrhenian Sea, off Island of Elba. The test area was located approximately 130 m North of the pier access in Marciana Marina, Elba. A combination of fixed and mobile sonar arrays was deployed for recording the 3-D scattering and reverberation from targets and seabed: all fixed equipment in the test area was controlled from the shore control centre established near the pier. Autonomous Underwater Vehicle (AUV) operations were performed primarily from R/V *Alliance*, either anchored or in motion off shore, at a distance varying from a few hundred metres to 2 km (Fig. 1).

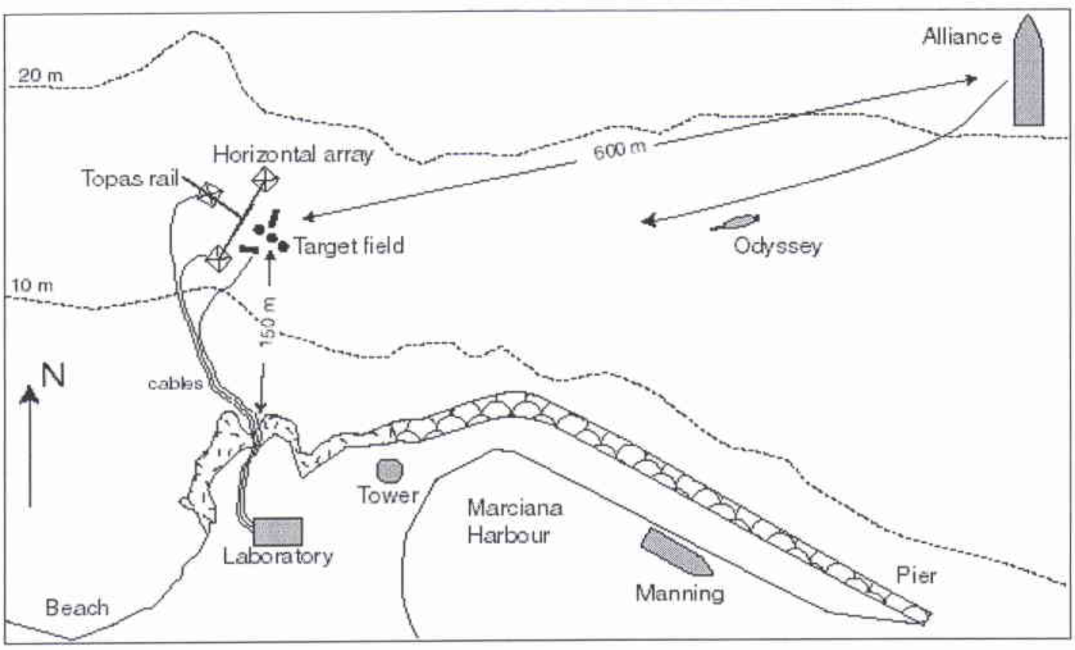


Figure 1 *GOATS'98 Operations scenario*

2.2. Ship-shore link

The coordination of shore facility operations with AUV operations onboard R/V *Alliance* was crucial to the objectives of the experiment: to help meet these requirements a high-speed wireless LAN connection was used to connect the shore acquisition systems with computers in the control centre on *Alliance*.

For the first time, scientists at SACLANTCEN were able to interact with their counterparts onboard *Alliance* and in Marciana Marina during the experiment.

An ISDN connection was used to connect the shore laboratory to SACLANTCEN: using both B channels it was possible to deliver a bandwidth of 128 Kbps.

The link between R/V *Alliance* and the shore laboratory was established using direct sequence spread spectrum radios, with PPP encapsulation, at a speed of 128 Kbps. In order to be able to maintain the connection even while the ship was maneuvering, we used omnidirectional antennas. This approach limited our operative range to 1 – 1.5 n.mi.

3
Application Services

3.1. Web Server

While the experiment was progressing, preliminary data were made available to the participating institutes using two WWW servers, one installed onboard R/V *Alliance*, the other at the shore laboratory in Marciana. Statistics for the WWW server onboard R/V *Alliance* show that 22090 files were requested by external sites in the course of the experiment, for a total of 525717 Bytes.

3.2. File transfers

File transfers were used extensively between ship and shore laboratory, to transmit and receive configuration files, software modules and limited quantities of scientific data. The radio link was not dimensioned to permit the effective transmission of large data volumes: data recorded by the AUV (e.g. echosounder or sonar) were transferred to the shore laboratory using portable media such as CD-ROMs or DAT tapes.

3.3. Multimedia Conferencing

In the course of the experiment, multimedia conferencing was successfully demonstrated between R/V *Alliance* and SACLANTCEN, using Microsoft NetMeeting. A problem with the adoption of multimedia capabilities across a packet switched network, such as the Internet, is related to the absence of a pre-determined quality of service (QOS). NetMeeting is compliant to the International Telecommunication Union (ITU) Recommendation ITU-T H.323, which defines procedures for adapting ITU-T G.711 and H.261- compliant systems to IP networks: the minimum required bandwidth is of 28.8 Kbps. In our activities we were able to demonstrate that an infrastructure such as the one we have devised, with an end-to-end bandwidth of 128 Kbps, is more than sufficient for the transmission of synchronous voice and video.

The compliance of the product we have tested to the H.323 international standard enables interoperability with other products, such as Netscape Communicator, although some issues are still left open on the compatibility of voice CODECs between different software platforms.

4
Security considerations

The experiment site, comprising the Elba shore lab and R/V *Alliance*, while being connected to the worldwide Internet using the SACLANTCEN infrastructure, was logically positioned outside the Centre's firewall. For this reason, it was necessary to install a set of address filtering rules at the Elba site, to deny unauthorized traffic originating from external sites.

During the course of the experiment, we noted that standard services, such as electronic mail, FTP and WWW browsing, were supported efficiently both at the Elba Shore lab and onboard *Alliance*, using the SACLANTCEN firewall as gateway.

However, a number of problems occurred when we tried to use audio-video conferencing software to communicate with users at the Centre. In particular, the Centre's firewall did not permit the exchange of UDP traffic across its interfaces, thus making communication impossible.

For this reason, in order to demonstrate the network conferencing capabilities to the SACLANTCEN management, it was necessary to arrange for the temporary installation of a computer outside the Centre's firewall.

If such services are to be provided therefore in future, it will be necessary to make arrangements in order to be able to deliver the service without compromising the overall level of security. These arrangements could include the establishment of *IP over IP* tunnels using strong encryption.

5
Conclusions

The radio network technologies which were introduced in support of the GOATS'98 experiment successfully provided the seamless integration of the LAN onboard the R/V *Alliance* with the LAN at the shore control centre, and from thence to SACLANTCEN and laboratories worldwide, *via* the Internet. The reliability and convenience of the COTS technologies setup guarantee system reproducibility.

The bandwidth increase in comparison to previous field experiments has opened a wholly new perspective: services provided at sea are comparable to those of shore-based facilities.

New services such as audio and video conferencing can now be supported, in addition to near real-time exchange of software and data. The capability to download larger archives of data and software allowed us to solve several problems and to obtain expert opinions from participating institutions within a useful timeframe.

In addition to that, this technology enabled us to communicate with commercial and non-commercial software providers, to obtain updates and assistance in problem solving.

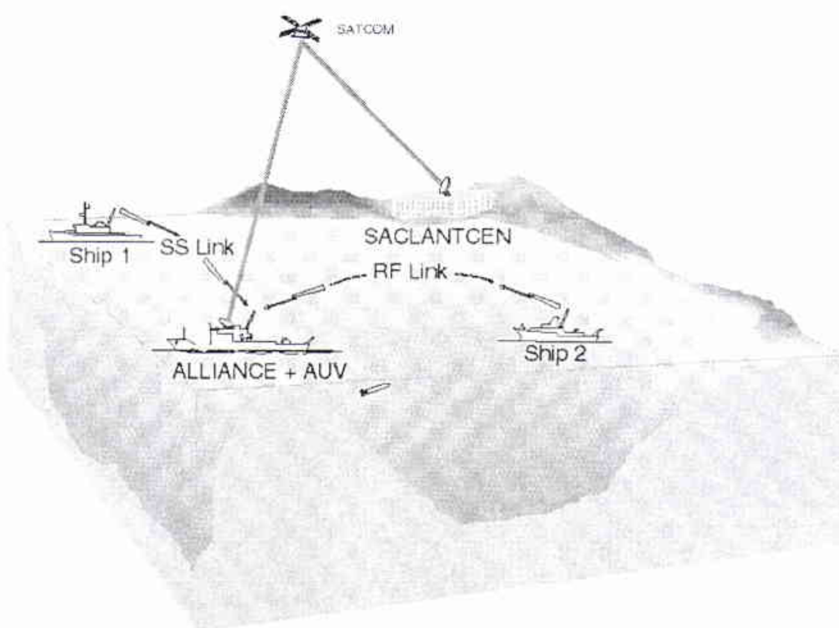


Figure 2 *Generic concept of REA communications network*

In order to be able to supply an infrastructure suitable for the transfer of large data volumes (such as sonar data to be processed remotely), it will be necessary to make provision for an upgrade to the communication infrastructure onboard R/V *Alliance*. Satellite Communications (SATCOM) offer an excellent solution to our problem of obtaining a larger bandwidth, up to 2Mbps: in consideration of the wide availability of commercial SATCOM providers, we would recommend an investigation of market alternatives to INMARSAT.

Spread spectrum radios have demonstrated excellent performance whenever it is necessary to establish data communication links between mobile platforms, in consideration of their natural resistance to adverse phenomena such as multipath. However, their use to provide connectivity to remote locations (e.g. an ashore command) is only possible with adequate support infrastructure ashore, which is not always feasible, e.g., REA activities could be conducted in denied areas (Fig. 2).

Taking into account the requirements imposed by tactical networks in support of REA operations, spread spectrum radios do offer a viable solution for ship-to-ship communications, but SATCOM is the only solution for ship-to-shore data relaying.

Organizers of future REA activities, such as MILOC Rapid Response [2], are recommended to make provision for adequate SATCOM support infrastructure in their experiment.

Annex A: Listing of assets

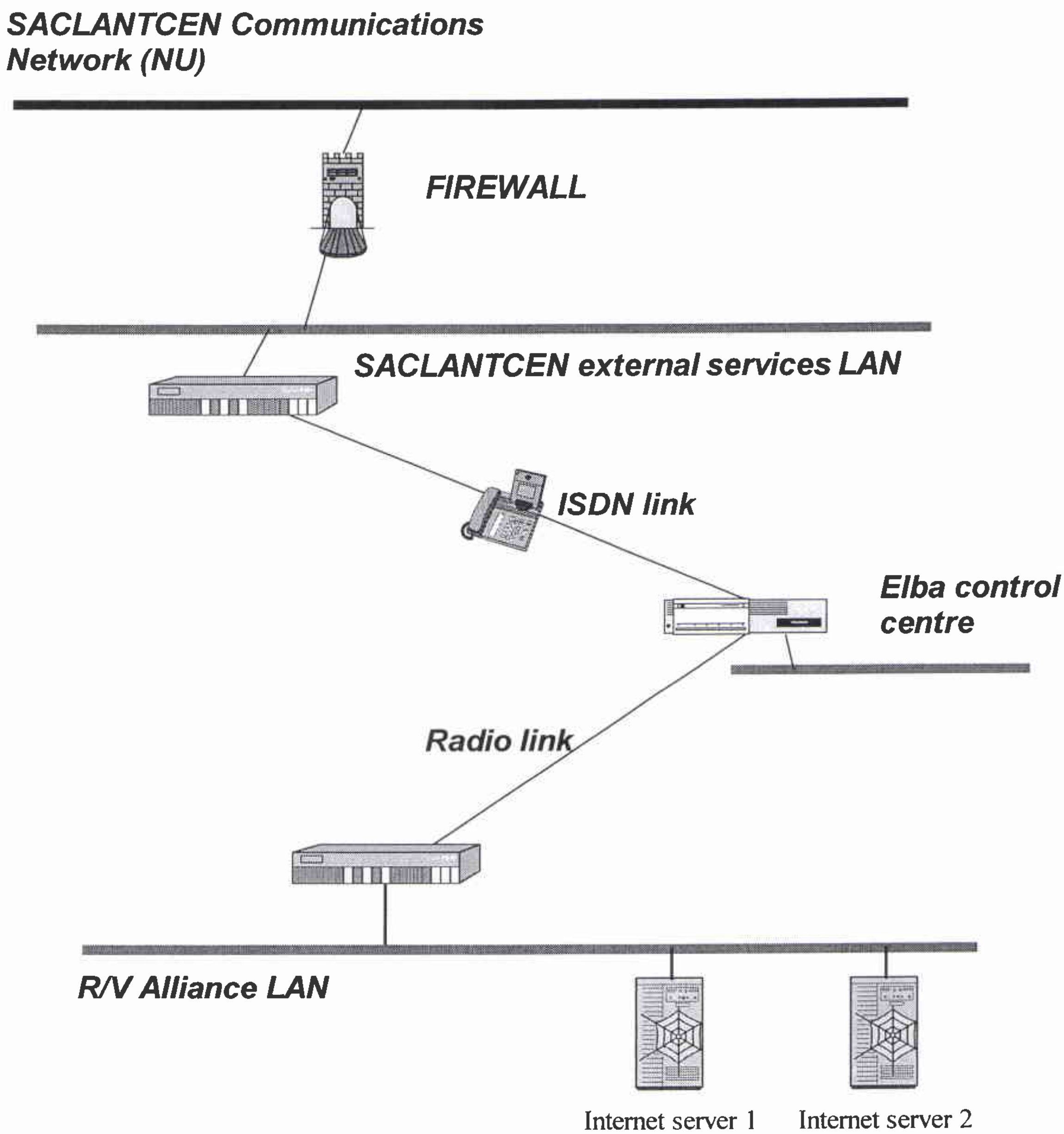
RF System

Model:	Cylink 128S (Direct Sequence Spread spectrum)
Frequency:	2407 – 2474 MHz
Modulation:	Bi-Phase Shift Keying (BPSK), Non-Coherent
Receiver sensitivity:	-92 dBm (BER 10^{-6})
Transmit power:	1 – 650 mW
Channel bandwidth:	10.2 MHz
Transmission delay:	5.1 milliseconds
Burst period:	8.5 milliseconds
Antenna type:	omnidirectional, 8dB gain

Routers

Cisco 4000	(onboard R/V Alliance)
Cisco 1000	(ashore control centre)
Cisco 4000	(SACLANTCEN)

Annex B – Network topology



References

[1] Schmidt, H. *et al.* Generic Oceanographic Array Technologies (GOATS) '98 - Bistatic seabed scattering measurements using autonomous Underwater Vehicles, SACLANTCEN SR-302, NATO UNCLASSIFIED. La Spezia, Italy, NATO SACLANT Undersea Research Centre, 1998.

[2] Sellschopp, J., Experience gained and lessons learnt in three years of rapid response. *In*: Proceedings of Undersea Defence Technology conference (UDT 98), London, UK, 23-25 June 1998. Nexus, 1998:pp 69-73. [ISBN 1-899919-28-7].

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Author(s)

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Abstract

Communication technologies play a vital role in supporting and making Rapid Environmental Assessment activities more effective. This paper presents the advances that were introduced during the **GOATS 98** experiment, conducted in the Tyrrhenian Sea in May 1998. R/V *Alliance* was connected to SACLANTCEN and the Internet *via* radio link to a shore control *via* an ISDN link. Preliminary experimental data were made available using WWW servers installed onboard R/V *Alliance* and at the shore laboratory. Videoconferencing experiments were conducted from R/V *Alliance* to SACLANCEN and *vice versa*.

Keywords

data communication — Internet – multimedia – network security – Rapid Environmental Assessment – ship-to-shore communication – wide area networking – wireless communications

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SACLANT Undersea Research Centre
Viale San Bartolomeo 400, 19138 La Spezia, Italy

[From N. America: SACLANTCEN (New York) APO AE 09613]

Tel: +39 0187 527 361
Fax:+39 0187 524 600

E-mail: library@saclantc.nato.int

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SACLANT Undersea Research Centre
Viale San Bartolomeo 400
19138 San Bartolomeo (SP), Italy

tel: +39 0187 527 (1) or extension
fax: +39 0187 527 700

e-mail: library@saclantc.nato.int

NORTH ATLANTIC TREATY ORGANIZATION