Topic	H2020 – INFRAIA-2018-2020
Short Title	Eurofleets+
Title	An alliance of European marine research infrastructures to meet the evolving requirements of the research and industrial communities
Project Number	824077
Delivery Date	30.06.2023
Deliverable No	D6.5
Lead Beneficiary	Marine Institute
Dissemination Level	Public

D6.5 Report on Pilot Study of Ship to Shore Programme

Document information

Document Name	D6.5 Report on Pilot Study of Ship to Shore Programme
Document ID	Eurofleets+_D6.5_ D6.5 Report on Pilot Study of Ship to Shore Programme
Revision	V3.0
Revision Date	04/09/2023
Author	Niamh Flavin
Security	Public

Approvals

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WP Leader	Andrea Caburlotto	OGS	24/08/2023

History

Revision	Date	Modification	Author
Version 1	11/08/2023	1st Draft	Niamh Flavin
Version 2	24/08/2023	1st revision	Andrea Caburlotto
Version 3	04/09/2023	Final	Niamh Flavin

TABLE OF CONTENTS

Contents

1. Eurofleets+ Pilot Ship to Shore Programme

Eurofleets+ piloted a 'Ship to Shore' expedition programme using telepresence communications technology which enabled live broadcasting from several Transnational Access surveys on-board research vessels. Use of this innovative technology facilitated dynamic, modern and innovative interactions with both public broadcasts and in classroom live tutorials from the ocean.

Communication technologies from vessels is advancing quickly, and the purpose of the pilot was to demonstrate what could be achieved using the available technologies to stream footage in real-time live from the vessel to enable audiences remotely access and engage with ocean exploration.

Initially a pilot was to be conducted using a VSAT Telepresence system deployed on a funded Eurofleets+ SEA Programme cruise, but due to delays and logistical challenges directly as a result of the COVID19 Pandemic, the system could not be shipped from the United States of America to Europe. In response to this challenge three different pilot activities were developed to test the available communications infrastructures on-board vessels. The types of communication options deployed on ships is extensively reported in **Deliverable 3.14 Guideline On Telepresence Implementation.**

2 Ship to shore Pilot Planning

The Eurofleets+ project included a dedicated VSAT communications infrastructure that was offered for access across both SEA Programme calls (Ocean and Regional). No applications for the telepresence unit were received in either call. Efforts were made to match an already funded cruise which would be suitable to utilise the unit (vessels needed to be compatible both in terms of space and logistically (shipping times etc.) Following a full review of all funded cruises by WP2 leaders, Marine Institute, three were selected as potentially viable. Despite great efforts by all parties it was apparent that it would be logistically impossible to implement. Although disappointing, it is a true reflection of the difficulty of interoperability across vessels and mobile infrastructures in general terms but especially during the COVID 19 pandemic.

Planning for alternative solutions was extensively explored and resulted in three Eurofleets+ 'Ship to Shore' ocean literacy broadcasts from funded TA expeditions using available communications technologies.

Three categories were chosen to pilot:

i. **Live stream to open audience**
    In the case of a live stream to an open audience the level of bandwidth needs to increase for the broadcast, a large increase on the uplink from the vessel is necessary and prudent traffic management must be enforced onboard.

ii. **Two-way video call**
    A video call requires the transmission of bandwidth bi-directional, or both ways. Thus, the additional bandwidth is required to and from the shore. Even if video is only enabled in a single direction, there needs to be an allowance for a return protocol to keep the connection alive. Further to this, if only minimal additional bandwidth is being applied to facilitate the video call than precise traffic management is crucial to achieving a usable connection. In short, other ships communications cannot be allowed impact the connection.

iii. **Classroom, Outreach and Public Relations Events**

Taking account of the VSAT hardware onboard is important, particularly when looking at the link from the ship to the shore. Again, onboard Bandwidth is of the utmost importance during such events. Large increase on the uplink from the vessel is likely required, unless prudent traffic management is in place. Download speeds are of equal importance in these cases to ensure smooth interactions.

A broadcast planning and report template was developed which can be found in ANNEX 1, outlining both technical, logistical and practical elements for consideration when broadcasting from vessels during expeditions. Participants were also provided with best proactive guidelines outlined in Deliverable 3.14 Guideline On Telepresence Implementation which provides step by step instructions from pre cruise planning to post cruise assessment of the event.

The three pilots implemented were:

i. Live stream event to Zoological Society of London, Facebook page from the ROV on the 06/08/2021. One way (ship to shore) audio and video, interactive with Facebook audience using the comments section, using boosted VSAT connection. Category A **Live stream to open audience**

ii. Live stream event to Eurofleets+ Facebook page from the RV SOCIB during the launch and recovery of Underwater Vehicles in Mediterranean Sea. Ship to shore audio and video using 4g connection, interactive with Facebook audience using the comments section. Category B **Two-way video call**

iii. Live stream using Skype and Microsoft Teams from the RV Belgica using vessels own VSAT connection. Category C **Classroom, Outreach and Public Relations Events**

Pilot a) and b) took place during the COVID19 Pandemic period lock down and used open broadcasts via Facebook to ensure a wide audience was reached. Pilot c) activities were closed broadcasts directly to schools in Ireland and Spain.

3   Ship to Shore Activities

3.1   BENCHMARK GO SARS/ROV AEGIR,

Additional Bandwidth, Streamed Via OBS to Facebook

Summary of the cruise:

The objective for this cruise was to increase knowledge on benthic habitats on the Denmark Strait and the Greenland-Iceland Rise (GIR), focusing on Vulnerable Marine Ecosystems (VMEs). The primary objective was to collect underwater video and photographs to characterise the composition and distribution of epibenthic fauna in the Denmark Strait, with a particular focus on taxa considered indicators of Vulnerable Marine Ecosystems. This was done via dives using an ROV (Remotely Operated Vehicle) in 20 stations located along three transects running in a NW-SE direction across the Denmark Strait.

Overview of activity:

Live stream event to Zoological Society of London, Facebook page from the ROV on the 06/08/2021. One way (ship to shore) audio and video, interactive with Facebook audience using the comments section.

Date:

Cruise Dates August 1 – August 10, 2021

Broadcast Date:

1x Live stream to open audience. 06/08/2021

1 X Live steam with video only, no audience interaction. 09/08/2021

Interactive: Yes, Q&A via Facebook Live and moderated onshore

Acknowledgments: IMR, GOSARS Crew, ROV Aegir Technicians, BENCHMARK PI and Party, ZSL outreach and communication departments.

Special Acknowledgment to Emmeline Broad for coordinating the broadcast, pre cruise, moderating the live session and post cruise feedback.

Bandwidth Increased: Yes, existing capacity had bandwidth of 2.5 Mbps to the ship, and 600 kbps from the ship

Additional cost: €250 per day for the duration of the cruise.

Bandwidth Used: 4.0 Mbps the maximum measured was 3.7Mbps and we streamed at an average of 2.5Mbps

Shore support: Shore support and publicity from internal ZSL departments

Viewing Figures:

Interactive broadcast hosted by Zoological Society Facebook 3.2k Views to date

Live from the Deep, Video only 631 Views to date

Interactive broadcast post to the Eurofleets+ YouTube Channel 46 Views to Date

Lessons Learned and Recommendations

It was recommended that future streams have the capability for science panel to use wireless headsets mixed into a single audio input which is then added to the stream via OBS.

Funding is required for good quality and dedicated outreach. Where possible, this should include funding for roles pre, during and post cruise and factor in dedicated individuals to conduct these roles both at sea and on shore.

Funding and support should be made available for publicising telepresence events.

Extra ship time may be required for interactive streaming events at sea, this should be discussed at the cruise planning stage with PI's.

The technology and microphones used for streaming activities should be standardised.

Ensure where possible that a recording of the event is saved.

Figure 3-1 Stills form BENCHMARK Cruise Telepresence Broadcast

3.2 GRASSMAP, RV SOCIB,

4G, Interactive Live Broadcast Via Zoom to Facebook Live

Summary of the cruise:

Experiments with different autonomous systems: an Autonomous Underwater Vehicle, an Autonomous Surface Vehicle and a Lagrangian Drifter. These different platforms were deployed to demonstrate in situ capabilities for marine data collection and seabed exploration, targeting endemic seagrass mapping using artificial intelligence.

Overview of activity:

Live stream event to Eurofleets+ Facebook page from the RV SOCIB during the launch and recovery of Underwater Vehicles in Mediterranean Sea. Ship to shore audio and video, interactive with Facebook audience using the comments section.

Date:

Cruise Dates: 14th - 20th September 2021

Broadcast Date:

1x Live stream to open audience. 19/09/2021

Interactive: Yes, Q&A via Facebook Live and moderated onshore

Acknowledgments: Cruise PI: Miguel Massot Campos, GRASSMAP scientific party, RV Socib crew and all SOCIB operations and communications team.

Bandwidth Increased: No

Additional cost: None

Bandwidth Used: Broadcast via 4G

Shore support: Shore support from Eurofleets+ Coordination office and Dissemination and Communications Work Package leader.

Viewing Figures:

EUROFLEETS + GRASSMAP Ship to Shore hosted on Eurofleets+ FACEBOOK 248 Views to date

EUROFLEETS + GRASSMAP Ship to Shore hosted on Eurofleets+ YouTube 51 Views to date

Lessons Learned and Recommendations

This broadcast was an example of what can be achieved with minimal equipment. Using only a mobile phone onboard and a computer onshore a live broadcast was achieved.

To ensure that there would be adequate bandwidth from the broadcast area, a test broadcast took place the day before. Recommended that this type of test is scheduled more in advance of the broadcast to ensure adequate time to publicise the event. This event was only published two days before due to the uncertainty around the available bandwidth.

The event took place on a Sunday which led to low numbers engaging with the live broadcast. Weekdays would be more favourable as there is a better opportunity to reach a wider audience.

Zoom Webinar to Facebook live worked well and the connection did not drop at any point. However, latency was poor at certain points.

Additional ship time may be required for interactive streaming events at sea, this should be discussed at the cruise planning stage with PI's.

In the event of low audience participation, a list of questions should be prepared and agreed with the broadcast moderator to ensure continuous dialogue during the broadcast.
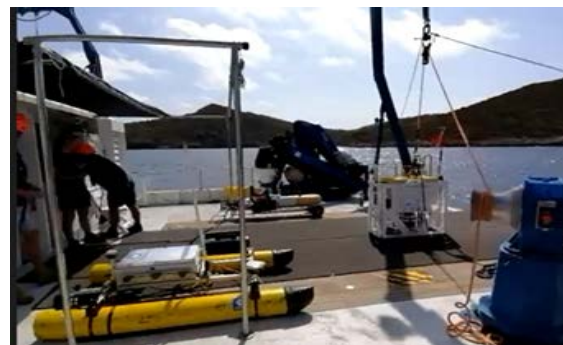
3.3 GRACE and SEAQUAKE CoPI, RV Belgica & AUV Barabas

Summary of Cruise:

The GRACE Cruise aimed to study the geological risks in the Ceuta Canyon and its annex areas with a multidisciplinary lens, focusing on the sedimentary processes, chrono-stratigraphy, and oceanography. To properly tackle this task, ultra-high resolution imaging of the seafloor must be carried out. The incorporation of an AUV allowed geohazard mapping with unprecedented precision, providing higher resolution datasets than those achieved from surface vessels with traditional techniques. The GRACE Cruise also hosted the SEAQUAKE CoPI.

Overview of activity:

1. Skype meeting using ships VSAT Connection with 30 students in Ireland. Pre-recorded video followed by a Q&A with scientists.

2. Microsoft TEAMS meeting using ships VSAT Connection with 30 students in Spain. Pre-recorded video followed by a Q&A with scientists.

The classroom lesson consisted of a pre-recorded video (no sound) of an AUV launching/recovery operation, during which the students could ask questions related to the methods of marine geology and marine biology that were implemented during the cruise. The students were given the opportunity to develop questions before the broadcast and also to ask questions during the event. The questions raised ranged from specific questions related to the scientific methodology, how to pursue a career in science and associated remuneration!

Date:

03/05/2022 Students of Transition Year (15 to 16 years) from Calasanctius College, Oranmore, Galway, Ireland

05/05/2022 Students of 4th ESO (~16 years) of the Centre IES Eduardo Janeiro, Fuengirola, Málaga, Spain.

Type:

Two ship to shore classroom broadcasts.

Interactive:

Yes

Acknowledgments: Cruise PIs: Carmen Juan & Sara Martinez-Loriente, all of the GRACE Cruise Scientific Team and RV Belgica technical team and crew.

Bandwidth Increased: No

Additional cost: None

Bandwidth Used: Vessels own VSAT

**Shore support:** Shore support from Eurofleets+ Coordination office and teachers from both schools.

Reach

Specific lessons for total 60 students

Lessons learnt and recommendations

- The first lesson used SKYPE, but it was recommended to use Teams for the second broadcast as it is more responsive and adapts to the available bandwidth automatically when can deliver a better experience.
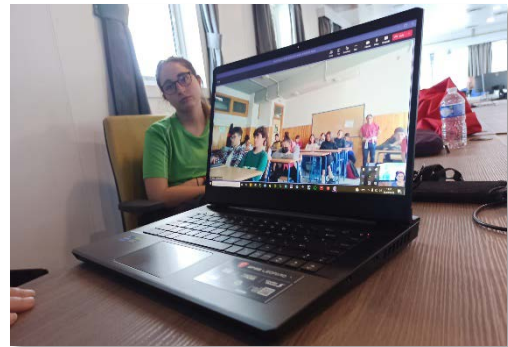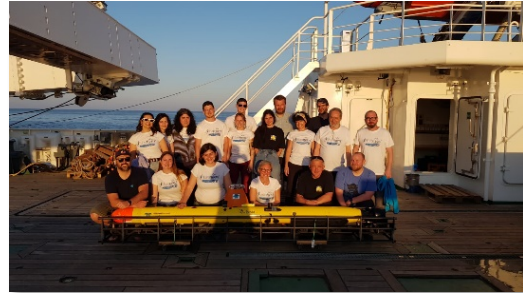
3.4 Challenges

The concept of ship to shore broadcasting during Eurofleets+ Funded cruises although simple presented a number of challenges on implementation. These have been summarised below.

- Available bandwidth for broadcasts on vessels in the geographic operational area. This can be unknown until a vessel reaches an area, because although a provider may stipulate that there is good bandwidth availability, weather and other variables can affect transmission quality on the day resulting in low latency.
- Test broadcasts are often needed and can only be done when the vessel reaches the broadcast area. This is especially applicable for broadcasts using ROVs and cameras. Weather conditions have a big impact on visibility in the water and the quality of images being sent back from the ROV. This presents a big challenge for scheduling live broadcasts, as although the event can be set up and publicised, its quality or event whether it can go ahead can only be made 24 hours or less before the event. This is not as important if the broadcast is to onshore scientific members but can be problematic if broadcasts need to be delayed, rescheduled or cancelled at the last minute.

- It can be difficult to schedule broadcasts to correspond with school terms, and days. A lot of surveys take place in the summer season when schools are closed. Additionally, most scientific work takes place during the day when schools are available thus any live engagement needs to be planned into the cruise schedule and may require additional survey days to facilitate.

4   Conclusion

There is an expectation in today's world that the level of connectivity we have come to expect on land should also exist when at sea. However, this is not the case and the types of communication and connectivity services currently available on vessels, especially those working in remote locations have not yet reached terrestrial solutions.

The Eurofleets+ Ship to Shore pilot programme successfully demonstrated what can be achieved via ships own communication systems or if working close to shore 5g/4g options. The lessons learned and the best practice on implementation has been captured in Deliverable 3.14 Guideline On Telepresence Implementation.

In the short number of years that the Eurofleets+ project has been underway huge advances have been made in satellite communications that will see Ship to Shore broadcasts become common place in the coming years. As recently as 2023 a number of the Eurofleets+ Research Vessels are trialling new technology developments such as Low Earth Orbiting Satellites (LEOS) as alternatives to the existing KU or KA VSat bands most used in the maritime environment. LEOS are seen as the solution to connect the unconnected and bridge the digital divide even in very remote locations. These new solutions, (many of them hybrid systems using a combination of solutions) promise to deliver guaranteed speeds and coverage in more remote areas such as polar regions.

5   Annexes

5.1   Annex 1: Eurofleets Telepresence Implementation Report Template

Eurofleets Telepresence Implementation Report	
Telepresence Cruise Planning	
Name of TA cruise:	
Name of Research Vessel:	
ROV/AUV Deployed:	
Expected UNOLS Telepresence Level to be implemented (see appendix 1):	
Existing VSAT Comms (Mbps) on vessel:	
Bandwidth Booster required (Y/N):	
Additional Funding Required to implement (Y/N):	
Cost of additional bandwidth:	
PI Name:	
Outreach Activity Lead:	
Activity Planned:	
Estimated Bandwidth Required:	
Implementation	
What streaming software was used	
Was it effective (please detail): • **Quality** • **Speed** • **Latency** • **Other**	
Bandwidth Available at broadcast site	
Broadcast Site Coordinates	
Shipboard Equipment Used?	
Shipboard Personnel Involved (number, background, role played)	
Shore based equipment Used	

Shore based personnel support number, background, role played)	
Objectives Achieved Y/N	
Summary of activities:	
Audience Reached:	
Were the event(s) broadcast only or interactive with shore based participants	