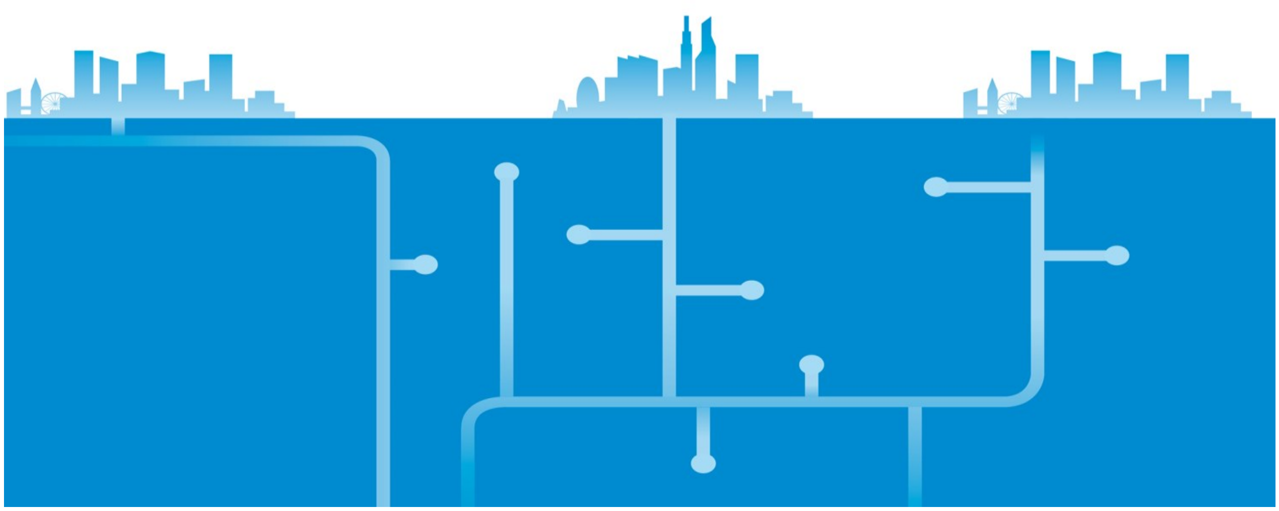
ITU-WMO-UNESCO IOC Joint Task Force

Frequently Asked Questions

Joint Task Force to investigate the potential of using submarine telecommunication cables for ocean and climate monitoring and disaster warning



Background information on the ITU-WMO-UNESCO IOC Joint Task Force (JTF)

The International Telecommunication Union (ITU), the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO/IOC), and the World Meteorological Organization (WMO) together established the Joint Task Force (JTF) in 2012 to investigate the potential of using submarine telecommunications cables for ocean and climate monitoring and disaster warning.

The JTF has over 80 members and is composed of experts from the science, engineering, business and law communities. It is focused on developing a strategy and roadmap to enabling the availability of submarine repeaters equipped with scientific sensors for climate monitoring and disaster risk reduction (tsunamis and submarine landslides). It will also analyze the potential renovation and relocation of retired out-of-service cables.

The concept has been reviewed and elaborated at workshops in Rome (2011), Paris (2012) and Madrid (2013). Three commissioned reports were published in 2012 dealing with Strategy and Roadmap, Opportunities and Legal Challenges, and Engineering Feasibility. These, along with the Terms of Reference, Membership List, Workshop Programs, and flyer are available on the JTF website: http://www.itu.int/go/ITU-T/greencable.

The JTF is supported by the ITU Secretariat and holds regular Executive and Plenary teleconference calls. Detailed work is undertaken through six standing committees, namely: Executive, Science and Society, Engineering, Business Model, Legal, and Publicity, Outreach and Marketing. Presentations are made at many national and international conferences and workshops, with supporting promotional materials.

A current activity is to fund and complete a) a Functional Requirements Study that will meet the detailed evaluation needs of the telecommunication industry, and b) a Business Model Study to establish the financial basis for the development of the Pilot/Demonstrator Model and the later ongoing decadal Operational Phase.

This Questions and Answers document is designed to provide brief basic information to common questions dealing with the concept behind, and the work of, the JTF.

For additional information, please contact:
Mr. Hiroshi OTA
International Telecommunication Union (ITU)
Telecommunications Standardization Bureau (TSB)
Study Groups Engineer
Place des Nations CH-1211 Geneva 20 Switzerland
Tel: +41 22 730 6356
Fax: +41 22 730 5853
E-mail: hiroshi.ota@itu.int
Website: http://www.itu.int/ITU-T/climatechange/task-force/sc/index.html

Benefits to society

1. What proven benefits have been identified from putting sensors on submarine cables?	The world is undergoing a global transformation - ocean and climate change. Without deep ocean sensors, humankind cannot measure and understand the changes taking place now, let alone during the lives of our children and grandchildren. On a shorter time scale, tsunamis impact coastal communities with little warning and disastrous effects. Robust warning systems need to be in place to save lives. The benefits of better detection and quantification of tsunami propagation are apparent – better warning for the people around the Indian Ocean would have saved thousands of lives and billions of dollars in 2004. Cabled sensors will provide more reliable continuous data than the current array of buoy-supported sensors. The bottom pressure sensors will allow the science community to better understand the pressure wave propagation mechanisms in the deep ocean zones, enabling more accurate models to be built, leading to more efficient tsunami detection and prediction. The benefits of quantifying climate change will provide important information to guide government policies. Providing long-term data on changes in deep ocean circulation and thermal regime is central in understanding global climate change.
2. Although the features of the sensors may be evident, gathering more information and advancing theories, how will this benefit humankind?	The ocean is the greatest reservoir of heat on Earth's surface. Monitoring the heat on both the surface and at the seafloor is necessary for comprehending the changes taking place on the planet. Tsunami warning systems are currently unreliable, and often not operational due to their dependence on ocean surface buoys that are subject to vandalism or cannot survive winter storms. Seafloor sensors are necessary for reliable warnings to save lives. Humankind will benefit in various ways, including: • Fewer thousands of deaths due to tsunamis by providing better and more definitive warnings; • Fewer billions of dollars of capital and business interruption costs due to tsunamis; • Assist in quantifying the role of deep ocean circulation and temperature change in regional and

	global warming; • Provide governments and the public with data necessary to address human causes of climate change and track mitigation effects; • Increase understanding of the oceans to support efforts to reduce speed of collapse of the world's fisheries and develop sustainable fisheries.

Technical aspects

3. How could the sensors possibly address the varying thermal layers in the ocean when they are attached to submarine cables lying on the ocean floor?	At this point in time, science has relatively few ocean measurements below 2 km depth, and knows very little about the deep ocean compared to the near-surface. Sampling the temperatures on the seafloor is an essential boundary condition for understanding the system. The temperature sensors will not precisely locate thermoclines and other thermal changes in the ocean above the seabed, although the cables will lie at different depths along the continental shelf, continental slope, abyssal plain and mid-ocean ridges. However, a measurement of water temperature variations on the seabed, combined with surface temperatures from satellite imagery and data from mobile assets such as gliders can help to verify four-dimensional ocean models and improve understanding of small and large scale ocean processes.
4. Why is it not proposed to put more complex instruments, such as cameras and Acoustic Doppler Current Profilers (ADCPs), on the cables?	It is important at the beginning to keep it simple. This provides for confidence building and success, which may be expanded upon technologies' progress. The evaluation to date suggests that initially it may not be practical to install more complex instruments on the cables, due to size, shock resistance, long-term stability, maintenance requirements, capabilities of the cable technology and a number of other reasons. The instruments selected will provide valuable data to address key issues and appear to be technically feasible.
5. Why is it necessary to measure temperature so frequently? Surely the temperature at one point in the deep ocean varies very slowly.	In the very few instances where continuously sampled data are measured, temperatures show both long-term stability and sudden excursions. Without frequent sampling, our view of the ocean is inadequate. The intent is to measure temperature to at least 1/1000ºC. It is anticipated that information regarding

	local ocean circulation and conditions will be provided by measuring temperature with great accuracy once per second. The high frequency of data collection, which can only be achieved with instruments on cables, will allow scientists to analyze micro-systems. Sensors will be places at selected locations along the cable route to measure temporal variations as well as for specific point indicators.
6. Will a pressure sensor in 5000m water depth really show the passage of a tsunami that may only measure cm high in the open ocean?	Yes. The pressure sensors are extremely accurate, and can measure pressure differences equivalent to a change in water depth of less than 1/10 mm. The periods of the tsunami wave and the data rate for collection provide sufficient information to identify a tsunami occurrence.
7. How well do the sensors perform under the pressure/temperatures at ocean depth?	These instruments are qualified to ocean depth, but may require additional quality assurance to meet the longevity goals of ocean cabled systems (~25 years). It is not seen as an insurmountable issue for these small, relatively simple instruments. Furthermore, the demands to meet cable standards will raise the bar for high-performance oceanographic sensors, leading to improvements in the technology.
8. Is deployment on an existing cabled ocean observatory, such as NEPTUNE Canada, sufficient for a sensor to be considered qualified to full ocean depth?	Deployment on NEPTUNE Canada does not qualify sensors to full ocean depth, limited to 2700m. It may qualify them for long-term deployment. Other ocean observatories (EMSO, DONET) are reaching depths down to 5000m. Qualification of equipment for long-term deployment will be done in test facilities prior to deployment.
9. What is the useful life of the sensors? If relatively short, would it seem to negate somewhat the advantage of installing the sensors on a new build?	Based on NEPTUNE Canada, their useful life is at least 5-10 years. Some similar instruments that have been deployed on cabled observatories off Japan have exhibited useful lives of more than 20 years.
10. Will sensors require intervention for maintenance or calibration?	No. It is a fundamental goal that there will be no intervention on behalf of a sensor. Sensors on adjacent repeaters serve for redundancy. However, with technology advances in remotely operated underwater vehicles (ROVs), autonomous underwater vehicles (AUVs), and wet-mate connectors, future deployments will have additional calibration and maintenance options.

11. To reduce capital expenditure, why not focus on implementation on either retired or redeployed cables rather than on new builds?	Retired cables have been and are now being used for scientific sensing the deep-sea environment. A few of the seafloor measurements available today result from this successful re-use of cable technology. However, this step-wise approach, while good at certain locations, does not achieve the basin-wide coverage necessary to achieve monitoring ocean/climate and tsunamis. Only a systematic inclusion of sensors in upcoming cables can achieve this coverage over time.
12. Since submarine telecommunications cables can operate with many wavelengths on each fibre pair, and 100 Gb/sec for each wavelength, is data transmission from the instruments an important issue?	The spectrum suitable for high transmission rates is dedicated to the telecommunications traffic. The data transmission path used for sensors is likely to be outside the main transmission band, and will support lower data rates.
13. How will the sensors be powered?	Submarine telecommunications systems include optical amplifiers ("repeaters") that draw power from a constant DC current that runs in a copper conductor in the cable. The sensors will also draw power from this constant current, but will be carefully engineered to be failsafe to faults.

Costs and sponsorships

14. Is it up to the suppliers to develop the solution as to how to add (not integrate) the sensors?	The responsibility for adding sensors falls on various entities to work in concert to achieve a reliable, cost effective solution. Scientists must confirm that the instruments will meet their goals; suppliers must confirm they can power the instruments and provide a data path to shore without impact on the telecom traffic and system reliability; owners must be comfortable that the impact on their business will be minimal, and that there is some commercial sense to the scheme; military must confirm that it has no significant issues; and governments, whether national or international, which control the landing points and any transit areas, must express support. The initiative is moving forward on all of these fronts – first to canvas the various interests, then to start dealing with issues raised. Many issues and decisions will be system-specific.
15. Is connectivity between observatories and sensor equipped	There is no plan to physically connect the networks. The bandwidth requirements for the sensor data are trivial

cable systems required? If so, will the cost for the connectivity be borne by the user and NOT the cable owners?	compared to current internet traffic: less than 1 part in a million. Connection to data sets is ongoing, through programs such as the Incorporated Research Institutions for Seismology using the basic Internet, and national academic facilities such as CANARIE, National LambdaRail, JANET etc. There is no intention that costs for connectivity to these existing systems will be borne by the cable system owners.
16. Is industry technical involvement and owner approval required prior to installing sensors on a cable system?	Yes. The system suppliers are the sources of the technologies used in submarine telecommunications systems, and hence will be relied on for technological innovations to allow their systems to support sensors. System owners will be asked to approve of adapting their proposed systems to support sensors.
17. What are the proposed arrangements for payment/cost sharing?	Individual owners, equipment vendors, and consortia will weigh and judge the merits for their particular business plans. Governments can exert their own influences into the negotiations on landing rights. Traditional scientific monitoring systems have been wholly government run in the past, and this new paradigm for submarine telecommunication systems is evolving. While there is no well-defined funding model as yet, there is general agreement that costs must be addressed.
18. How will any increases in system operating and maintenance costs be addressed? What happens if a sensor fails and needs to be replaced? If there are no incidences of sensor failure, would operating and maintenance costs still be shared if only on a nominal basis?	Initially there is likely to be no intervention for the sensors whether for repair, maintenance or calibration. Decisions as to the details of any funding arrangement with a system owner will be made on a system-specific basis, and may include annual fees. However, increases in operations and maintenance costs, if any, are likely to be very small.
19. Should initial funding for proof of concept be on a cost causer basis, or at least discretionary by respective governmental sources and/or individual owner discretion?	It appears likely that funding for proof of concept will come from existing government programs, in combination with individual owners. Nonetheless, philanthropic interests may intervene to "prime the pump."

Data usage and access

20. Is there any harm over misusing the data?	The intent is that the data will be innocuous, delivered in real time, and public.
21. Could the sensors be remotely altered to generate false/misleading data?	Very unlikely to be possible, and if done, would likely be noticed in comparisons with other data sources.
22. Could the sensors be remotely altered to allow access to the telecommunications data transmitted on the cable itself?	A principal requirement of the system suppliers is that the sensors be firewalled away from the telecom traffic. Any potential for cross-over between the sensor data and the telecommunications data will be denied by design. The two data traffic streams (scientific and telecom) will be segregated on the cable systems and no interaction is expected. No risk is identified here.
23. Could the sensors be remotely altered to generate denial of service/ access to the cable?	Since cross-over between sensor data and telecommunications data will be denied, there will be no means of impacting the telecommunication service by any remote sensor access. One of the principal requirements will be that it be firewalled away from the telecom traffic.
24. Since tsunami warning is a high value to this venture, what will the role of the cable owner be in dominating such critical data?	The system owners will have in advance provided avenues for immediate dissemination of the data to appropriate authorities. System owners will have no responsibility beyond the obligation to provide the information in a timely manner.

Legal aspects

25. Climate change has been recognized by the United Nations but not yet formally recognized by all governments. Is this effort premature?	This effort is intended to provide crucial quantitative data that will assist governments in making rational policies, both national and international, based on science. As such, it is most timely and not at all premature.
26. Will not the addition of sensors affect the protection given cables under the United Nations Convention on the Law of the Sea (UNCLOS)?	Jurisdictions that appreciate the benefits offered by the sensors (as detailed above) will encourage owners of new cables to include the sensors, and will not attempt to use UNCLOS to place roadblocks in front of projects.