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WWF MCS EMERGING TECHNOLOGIES INITIAL COST-BENEFIT ANALYSIS STUDY

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Paper by submitted by WWF

(*This paper was tabled as WCPFC-2014-TCC10-OP03* WWF MCS Emerging Technologies Initial cost-benefit analysis study)

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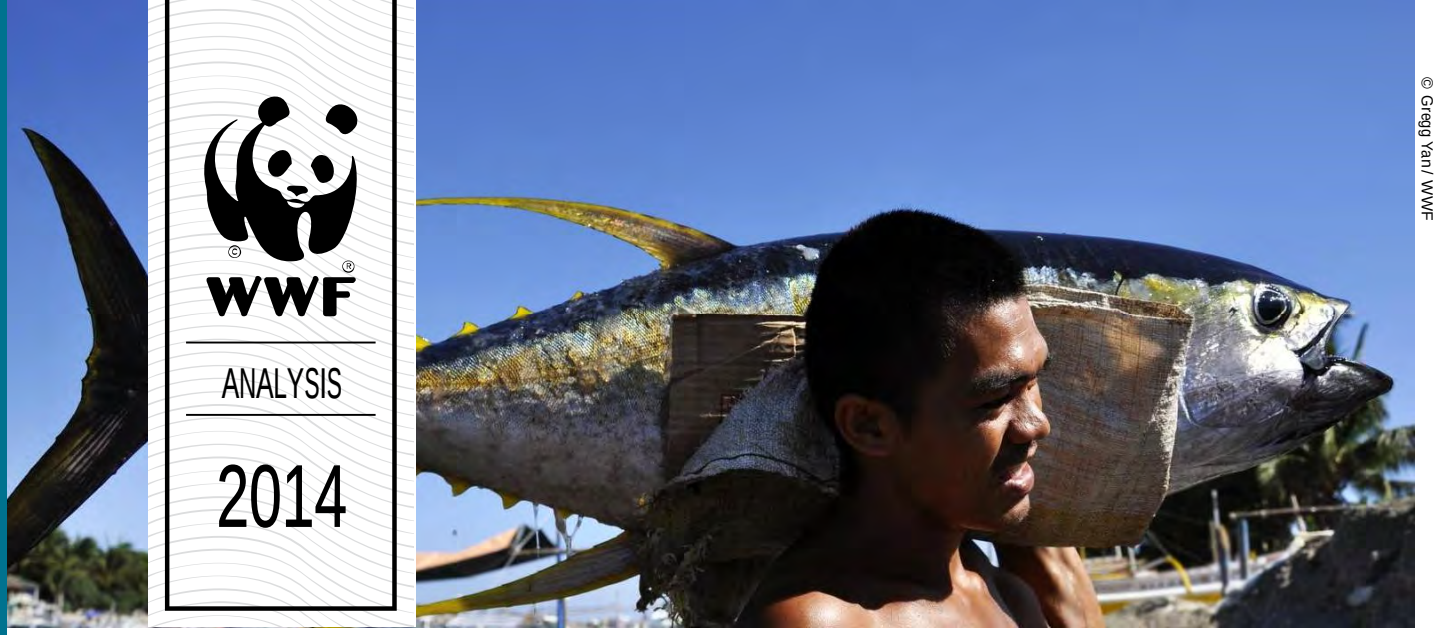

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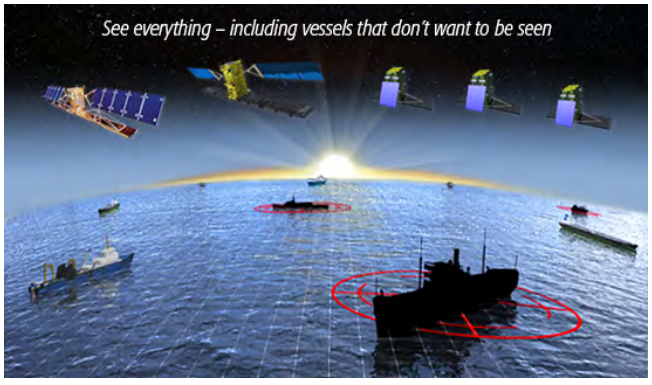
ANALYSIS

2014

Smart Fishing Initiative

"KAITIAKI HE O TE MOANA" GUARDIAN OF THE SEA PROJECT

Supporting Technological Solutions for MCS Challenges in the Western and Central Pacific Ocean – Initial Overview



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Abstract: This study builds upon the March 2014 WWF Emerging Technologies Workshop which held a goal to help FFA Member countries better understand the existing MCS environment and objectively review and assess available emerging technologies that might help to contribute to less expensive, more effective and more efficient MCS efforts at both a national and regional level. This study attempts to take a systematic approach towards estimating the strengths, weaknesses and financial costs of a range of emerging and evolving technologies that could assist in addressing the challenges of fisheries MCS in the Western and Central Pacific Ocean region.

Title: Guardian of the Sea Project - Technological Solutions for MCS Challenges in the Western and Central Pacific Ocean - Initial Overview

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Date: July 2014

Executive Summary

The genesis of this study began amid informal discussions between several FFA Member representatives and World Wildlife Fund (WWF) at the 9th meeting of the Technical and Compliance Committee (TCC) of the Western and Central Pacific Fisheries Commission (WCPFC) in September 2013 regarding monitoring and compliance challenges in the region. The representatives of these Small Island Developing States acknowledged to WWF the inherent difficulty of managing the large industrial tuna fishery in the region over a vast expanse of ocean where the vast majority of catch and effort was taking place within the Exclusive Economic Zones (EEZs) of Pacific Island coastal States comprising the membership of the Pacific Island Forum Fisheries Agency (FFA). At the TCC meeting, these representatives relayed to WWF a desire to explore new technologies that might address some of their Monitoring, Control and Surveillance (MCS) challenges in a more economical, effective and efficient way.

As a result, in March 2014 WWF coordinated an MCS Emerging Technologies Workshop – *"Seeking MCS Solutions for the Big Ocean Sovereignty States of the Western and Central Pacific Ocean"* whose goal was to help FFA member states better understand the existing MCS environment and objectively review and assess the available emerging technologies that might help to contribute to less expensive, more effective and more efficient MCS at a national and regional level.

As a result of the Workshop, several overarching informational needs were identified by participants as necessary to move forward implementation of some of the emerging technologies including:

- Basic cost estimates for each technology; and
- An objective and comprehensive cost/benefit analysis (CBA) of each of the current MCS measures as compared to the emerging technologies

This study represents the first step of work to address the two points outlined above and create a systematic approach towards estimating the strengths, weaknesses and financial costs of a range of emerging and evolving technologies which, if implemented, could assist in addressing the challenges of fisheries MCS in the Western and Central Pacific Ocean (WCPO) region. This work is intended to provide background, context and information to WWF, FFA Members, surveillance providers and MCS partners of FFA Members, donors and interested commercial entities about the relative costs and effectiveness of different emerging or evolving technologies which could supplement, complement, integrate with, or even replace MCS tools and techniques currently being used by MCS practitioners in the WCPO region.

CBA is a technique typically used to determine options that provide the best approach if a particular programme, tool or technique is considered to be a sound investment or decision in terms of benefits in labour, time and cost savings. Typically, a CBA will outline benefits and costs expressed strictly in monetary terms. However, it should be recognized that a perfect appraisal of all present and future costs and benefits involved with some of the evolving and emerging technologies outlined within this study proved difficult to achieve within the scope of this initial study.

Hence, this study is directed at providing the audience a broad overview analysis of both the current known characteristics of existing MCS tools being used in the region and available evolving and emerging MCS technologies. Every detailed cost element required for implementing some of the evolving or emerging technologies did prove difficult to determine and will require further detail at a later point within a larger, more comprehensive study that explores more deeply those technologies deemed best suited to enhance MCS efforts in relation to the overall existing MCS infrastructure in the WCPO.

The standardised methodology used for comparing and contrasting the costs and benefits of the various technologies included a focus on those technologies that would first and foremost enhance a combination of the *Information Management* and *Remote Sensing* MCS challenges faced by FFA Members so as to improve upon their existing MCS capability and capacity to detect, deter and eliminate IUU fishing in the WCPO region. The primary challenges faced by MCS practitioners in effectively detecting IUU fishing occurring in the WCPO include:

- Lack of comprehensive near real-time information and data;
- Immense area to monitor;
- Numerous targets;
- Remote locations; and
- Limited enforcement assets which, when used, are expensive to operate; and

As such, there is a need to *build upon the information infrastructure* in the region to allow those involved in fisheries MCS - program managers, licensing officers, fisheries analysts, port inspectors and fisheries compliance officers conducting at-sea boardings and inspections to name a few - to have access to timely information needed to make well-informed decisions and execute targeted inspections and investigations directed at identified risks of non-compliance. In addition, given the immense nature of this ocean region, the vast number of fishing vessels operating, and the remote locations requiring monitoring, there is a demonstrated MCS need to *increase ocean observation capacity*, primarily through the use of available remote sensing tools, so that when expensive enforcement assets are utilized, the response is risk-based, information-driven, and targeted at emerging threats.

Options were evaluated relative to the existing MCS infrastructure in in the region which provided a benchmark against which options were analysed. This base case is a 'status quo' option and maintaining the status quo should be considered as what still needs to be done, even without the implementation of any of the discussed options, so as to maintain the current level and quality of MCS service or performance for the region. For this study, there was a practicality to include a qualitative supplementary assessment. This was for two reasons; first, there are important, but hard-to-quantify, factors that need to be 'captured' as part of the analysis conducted to ensure the analysis does not rely too heavily on monetary valuations and there is not an omission of factors for which money valuations are difficult or impossible. Second, there was a necessity to use this supplementary assessment as some of the costs of each analysed option were not fully and satisfactorily identified, quantified and monetised. This qualitative assessment included the following five criteria:

- Capability for easily integrating/complementing existing national or regional MCS tools;
- Addresses the highest risks and/or directed at the biggest MCS gaps;
- Human capacity requirements;
- Legislative hurdles or obstacles; and
- Meets FFA Member interest and desire.

In conducting the analysis, was furthered recognized that:

- No single technology (data source or sensor) can solve the IUU problem (each has its own strengths and limitations);
- Data from multiple data sources or sensors must be fused together in order to create an effective Maritime Domain Awareness (MDA) solution; and
- Adding new data sources or sensors increases the efficiency of all tools or assets (rather than replaces existing tools or assets).

Recommendations

1. E-Reporting/E-Monitoring/E-Tablets:

There are no specific hurdles to implementing these e-technologies. There is a demonstrated need to improve compliance amongst licensed vessels as a strong case can be made that the highest risks of IUU activity in the region is associated with licensed fleets, especially with respect to inadequate reporting by longliners. The implementation of e-technology requirements represent concrete examples of how these emerging technologies can improve levels of compliance amongst licensed fleets. Their use will also undoubtedly facilitate FFA Member efforts to further establish a robust Catch Documentation Scheme which can then begin to address IUU risks throughout the entire supply chain. MCS effectiveness in the field can also be enhanced through the use of E-Tablet Job Aids by Fisheries Officers, Port Inspectors and Observers alike. These tools improve data capture and information management which ultimately improves analytical capability and decision-making.

2. Data Analysis - Optimizing the RFSC:

A detailed scoping study of the FFA Regional Fisheries Surveillance Centre directed at its current and future capabilities and the service it provides to FFA Members on both a national and regional scale should be considered. This study should include a concentration on staffing components, not just technological needs, especially in terms of increasing the ability of the RFSC to conduct comprehensive data fusion and analysis, an identified emerging MCS deficiency in the region. Multiple sources of fisheries information and data are already available now to accomplish this critical task. These datasets stand ready to be fused and analysed with the intent of developing specific and relevant national and regional IUU threat assessments, including estimated levels of risk that each fleet and vessel poses of conducting IUU fishing. Data analysis will increase national and regional prioritization of surveillance and patrol assets through more targeted and risk-based approaches towards non-compliance, thereby optimizing effective and efficient use of scarce enforcement resources.

3. Integrated Sensor Systems:

Collaborative engagement is recommended with both commercial entities and/or other like-minded third parties to develop agreements and/or arrangements that will provide the best "cost per value" service access to additional, previously unavailable, datasets as delivered via integrated sensor systems. Integrating additional data feeds into the existing FFA Regional Surveillance Picture such as Synthetic Aperture Radar data and acoustic detections would optimize the remote sensing capabilities of the FFA RFSC in detecting uncooperative or "darkened" vessels that would form the basis for initiating more effective and efficient national law enforcement responses. These data sets would increase the overall regional maritime domain awareness of the RFSC, an existing MCS tool.

4. Unmanned Aerial Systems (UAS) / Autonomous Surface Vehicles (ASV):

Further dialog is encouraged with commercial entities and like-minded third parties to coordinate a pilot project that specifically integrates these technologies as queuing tools in direct support of other aerial and surface enforcement assets. These technologies have a greater ability to enhance regional MCS efforts if used in direct combination with other enforcement assets to provide an integrated law enforcement response approach that could facilitate "end game" scenarios rather than their use as autonomous monitoring tools used solely in the hope of unilaterally detecting and documenting instances of illegal fishing activity. Evaluating results of this project would further inform decision-makers whether these technologies provide a sound return on investment on their widespread use.

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Introduction

Representatives of the Small Island Developing States comprising the membership of the Pacific Islands Forum Fisheries Agency have long acknowledged the inherent difficulty of managing a large industrial tuna fishery in the region over a vast expanse of ocean where the vast majority of catch and effort was taking place within their respective EEZs. As the resource owners for the majority of these fish stocks, they are seeking ways to ensure that not only the stocks are managed sustainably for the long-term benefit of their nations, but also that the revenues from the region's fisheries are fully captured and maintained by their nations. Collectively, they continue to express concerns with illegal, unreported and unregulated (IUU) fishing activities that continue to undermine their efforts to ensure proper management of their fisheries. These representatives also continue to demonstrate a strong collective desire to explore new technologies that might address some of their MCS challenges in a more economical, effective and efficient way.

The consultant engaged to undertake this study was Mr Mark Young. Mr Young is a fisheries compliance and enforcement consultant with extensive MCS experience in the domestic and international fisheries contexts primarily in the Western and Central Pacific Ocean region. He has 23 years' experience in the United States Coast Guard specializing in fisheries law enforcement and holds a Master's Degree in Marine Policy from the University of Washington. Mr Young was also the former Director of Fisheries Operations at the FFA. In his current role as an independent fisheries MCS consultant he remains involved in building MCS capacity and capabilities in the Western and Central Pacific.

Study Objective

Objective One: Research costs and benefits of the current MCS tools and techniques used in the Western and Central Pacific Ocean region.

Objective Two: Identify applicable emerging or advancing technologies that could potentially supplement or replace current MCS tools and techniques.

Objective Three: Research the proposed costs and benefits of the identified emerging or advancing technologies.

Objective Four: Develop a standardized methodology for comparing and contrasting the costs and benefits of the various technologies.

Objective Five: Draft an analysis comparing and contrasting the technologies or combinations of technologies according to identified standard methodology

Background

The Pacific Islands region in the WCPO hold some of the most productive tuna fishing grounds in the world. On a global scale, the EEZs of the 15 Small Island Developing States (SIDS) comprising the FFA membership (excluding Australia and New Zealand) together form an immense area of coastal State jurisdiction, covering nearly 20 million square kilometres.

SIDS is a global term that is used to describe small (in land area) island states around the world. Ocean and coastal fishery resources form the foundation of the economies of Pacific SIDS and collectively they represent a critical pathway for the future growth and prosperity of these countries. In fact, a majority of the total tuna catch in the WCPO is taken within the EEZs of the FFA Member

countries which comprise the majority of Pacific SIDS. The global benefits from the utilisation of these fishery resources are inequitable.

As such, FFA Members have placed a high priority towards addressing the unsustainable and destructive fishing practices of IUU fishing which adversely impact not only the region's abundant fish stocks, but the very economies of the Pacific SIDS. This issue is not new, but innovative approaches, renewed commitment and urgent implementation of MCS tools, techniques and strategies to combat IUU fishing within coastal State waters remain at the forefront of the agenda of FFA Members so as to safeguard food security and a ensure a sustainable future for all Pacific Islands.

On a more regional level, FFA Member countries have held ongoing discussions with Distant Water Fishing Nations (DWFN) whose fishing fleets operate in the WCPO region on how to jointly manage the remainder of tuna stocks in the region which are caught on the high seas and in the waters of non-FFA members. In 2000, these discussions led to the adoption of the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific and establishment of the WCPFC, one of five Regional Fishery Management Organizations (RFMO) responsible for managing global tuna resources.

The WCPO Tuna Fishery

The tuna fisheries in the WCPO region are complex with a range of four primary target species (yellowfin, bigeye, skipjack and albacore). These are primarily caught by vessels of three fishing gear types (purse seine, longline and pole-and-line) operated by both DWFN and Pacific Island domestic fleets.

The WCPO tuna fishery is complicated by the migratory nature of the tuna stocks, in that each typically migrate through numerous national jurisdictions and areas of high seas. These rich tuna resources are capable of generating sustainable revenues over time if managed effectively. This can only be achieved if fishing operators comply with the fishery management plans, rules and regulations put in place by FFA Member countries for their EEZs. However, FFA Member countries have experienced, and continue to face, the ongoing challenge of IUU fishing and inadequate reporting of tuna catches in their EEZs by the DWFN fishing fleets.

The provisional total tuna catch for 2012 in the WCPO region was estimated at over 2.6 million metric tons, the highest on record. Overall, this catch represented 82% of the total Pacific Ocean tuna catch and 59% of the global tuna catch of over 4.4 million metric tons. For the four primary tuna species, catch of skipjack (64% of the total catch) was the third highest recorded with yellowfin catch (25% of the total catch) more than 70,000 metric tons higher than the previous record catch taken in 2008. Bigeye catch (6% of the total catch) was the highest since 2004 and albacore catch (5% of the total catch) was the second highest on record. The albacore catch includes catches of both North and South Pacific albacore which comprised 78% of the total Pacific Ocean albacore catch. The South Pacific albacore catch in 2012 was the second highest on record (WCPFC, 2013).

Prices in the major markets for skipjack (the primary tuna species caught by purse seiners) rose to in 2012 with the primary benchmarks averaging between $2,074 - $2,101 USD per metric ton, up nearly 20% over the previous year. On the other hand, the price trend for purse seine caught yellowfin was mixed with prices up by only 2% to $2,478 USD in some markets while still other markets averaged $3,304 USD per metric ton, a 14% decrease from the previous year. Despite this, the estimated total 2012 delivered value of the entire purse seine tuna catch in the WCPO was nearly $4.1 billion USD, 42% higher than 2011 (WCPFC, 2013).

The estimated total 2012 delivered value of the longline tuna catch in the WCPO was nearly $2 billion USD, a decline of over $71 million USD on the estimated value of the catch in 2011. The value of the albacore catch increased by $70 million USD, bigeye declined by $15 million USD and yellowfin decreased by $127 million USD (WCPFC, 2013).

Overall, the total 2012 estimated delivered value of the WCPO tuna catch came to $7.2 billion USD, an increase of 23% on 2011. The purse seine value accounted for 56% of the total value and the longline fishery 27%. By species, skipjack represented 49% of the total value with yellowfin 30%, bigeye tuna 15% and albacore 6% (WCPFC, 2013).

In 2012, more than 60% of the total volume of tuna caught by industrial purse seine vessels was caught inside the EEZs of the Pacific Island Countries that are Parties to the Nauru Agreement (known collectively as the PNA countries): the Federated States of Micronesia, Kiribati, the Marshall Islands, Nauru, Palau, Papua New Guinea, the Solomon Islands and Tuvalu. Add to that the total amount of longline catch that was caught within the EEZs of FFA Members and it can be clearly seen that the vast majority of WCPO tuna catch emanates from the coastal State waters of FFA Members.

With global demand for tuna growing each year, and limited scope for increased catches elsewhere, the WCPO region and the EEZs of the Pacific Island countries are destined to become an even more dominant source of the world's tuna in the future.

Fishing Fleets in the WCPO

There are ever increasing numbers of foreign fishing vessels operating in the WCPO. In 2013, approximately 5,889 fishing vessels were included on the WCPFC Record of Fishing Vessels (RFV) as authorised to fish in the WCPO. The RFV covered small, medium and large-scale tuna fishing vessels as well as support vessels. This total represented in an increase of approximately 1,365 vessels from the previous year. Of this amount, flag State members of WCPFC in 2012 reported a total of 2,783 of their fishing vessels had fished beyond their respective area of national jurisdiction of which over 54% were flagged to the seven largest tuna fishing nations in the world; Japan, Taiwan, Korea, China, USA, Philippines and the EU. Only 308 fishing vessels domestically flagged to Pacific SIDS fished beyond their respective EEZs, most of these operating under joint agreements. Fishing vessels flagged to China, Taiwan, Japan and the Philippines alone comprise nearly 65% of the total vessels authorised to operate in the region (WCPFC, 2013).

Of the total number of vessels on the WCPFC RFV, approximately 1,350 foreign flagged fishing vessels are licensed to fish within the EEZs of at least one Pacific Island country and are included on the FFA Vessel Register. In order for a foreign flagged vessel to be licensed to fish within an FFA member's waters and placed on the FFA Vessel Register, the vessel must first be listed on the WCPFC RFV as authorized to fish within the region. This means that in 2012, there were possibly as many as 1,400 foreign flagged fishing vessels fishing in the WCPO region without a license to fish within any Pacific Island coastal State waters; waters where the vast majority of catch and effort is occurring in the region. These unlicensed vessels represent a real risk of illegal fishing to FFA Members.

The DWFN fishing fleets that operate far from their flag State often do so via access arrangements with Pacific Island countries to fish within their EEZs. In doing so, these vessels take many times the amount of tuna than what is taken by locally operated vessels. These foreign fleets also dominate offshore fishing in the high seas where participation by Pacific Island countries is minimal primarily due to the lack of domestic fleet capacity to undertake this type of long range fishing. As developing countries, these small coastal States also often lack the capacity to effectively monitor and provide adequate surveillance of their EEZs where, as the vessel numbers and catch and effort indicate, they are left wide open to possible illegal fishing activities conducted by both legitimate and illegal fleets.

The Pacific Island Forum Fisheries Agency (FFA)

In the late 1970's, the FFA Convention resulted from a decision by the South Pacific Forum to decline a proposal to establish a regional fisheries commission like the current WCPFC and to establish instead a regional fisheries agency open only to members of the South Pacific Forum. This decision was in response to the refusal of some DWFNs to accept coastal State sovereign rights over tuna and a belief by Forum Members that they needed to cooperate amongst themselves to put in place their EEZs and associated legal and technical frameworks before entering into any type of regional fishery organisation with the DWFNs.

The Pacific Islands Forum Fisheries Agency (FFA) was formed in 1979 to strengthen national capacity and regional solidarity so its 17 members can manage, control and develop the tuna fisheries that fall within their EEZs well into the future. Based in Honiara, Solomon Islands, FFA's 17 Pacific Island members include Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu.

FFA is an advisory body that facilitates regional cooperation so that all its member countries benefit from the sustainable use of tuna which is so important for many people's livelihoods in the Pacific. To do this, and maximize the economic and social benefits of fisheries, FFA focuses on three broad tasks:

- Manage the fishery to ensure use is sustainable and will provide tuna now and in the future;
- Develop the fishery to harvest, process and market tuna to create jobs, income and a thriving industry; and
- Monitor, control and survey the fishery to stop illegal fishing and make sure fishing benefits goes towards fishers who follow the rules of development and management set by governments.

FFA accomplishes these tasks by providing advice, information, policy recommendations, regional strategies, technical support, and development opportunities to its members at both the national and regional level. At the national level, FFA provides support directly to countries and territories who are members of FFA. At the regional level, FFA solicits the views of leaders, identifies consensus areas and emerging areas for debate and briefs leaders on technical and policy issues in preparation for Pacific Island participation in the WCPFC and for negotiations regarding binding legal agreements representing the various treaties, agreements and arrangements pertaining to fishing in Pacific. Pacific Island leaders are active in setting the agenda and priorities of FFA through their involvement in the development of the annual work program and budget of FFA as formally determined and agreed upon through the Forum Fisheries Committee (FFC) (FFA, 2014).

Approximately 100 staff at the regional FFA headquarters in Honiara, Solomon Islands support the full membership of FFA via national contact points in departments of foreign affairs and fisheries in each member jurisdiction. The Operations Division of FFA focuses its work on supporting fisheries MCS as well as Information Technology. This includes the operation of the FFA VMS and FFA Vessel Register and running of the FFA RFSC which supports both the national and regional MCS efforts of the FFA membership.

IUU Fishing

IUU fishing is recognized as a serious global problem that is increasingly seen as one of the main obstacles to the achievement of sustainable world fisheries. Global estimates suggest a minimum of 20% of seafood worldwide is caught illegally, representing economic losses between $10 to $23 billion and 11 to 25 million metric tons of fish (Stiles, Kagan, Shaftel, & Lowell, 2013). However, according to a 2006 report:

> *"…Any attempt to quantify the scale of the IUU problem faces formidable obstacles. Most obviously, the people who fish illegally and in breach of regional and international management regimes don't report their catches for the convenience of official statistics. Estimates of illegal and unreported fishing are therefore extremely hard to come by. There may be some reports of unregulated fishing but we know they are incomplete. At the same time our understanding of fish stocks and their dynamics is by no means complete. The extent of our lack of understanding is compounded if we bear in mind that most of the IUU fraction of the catch cannot be taken into account in scientific assessments. The IUU fish harvest is thus an unknown percentage of an ill-defined resource…"* (High Seas Task Force, 2006)

While the precise estimates of IUU fishing are indeed difficult to calculate due to its illegal nature, it appears to be widespread with the majority of catch taken from the EEZs of coastal States. This means that IUU losses are borne particularly hard by developing countries such as the Pacific SIDS, who collectively provide the majority of all internationally traded fish products.

IUU fishing therefore imposes significant economic costs on some of the poorest countries in the world where dependency on fisheries for food, livelihoods and revenues is high. Moreover, it effectively undermines efforts by these developing countries to manage their own natural resources as a contribution to national, regional and global growth and welfare.

It is important to understand that while there are clear distinctions between fishing that is illegal, unreported and unregulated, there are also overlaps and the different categories of IUU fishing share many common characteristics. The development of the FAO International Plan of Action on IUU Fishing (IPOA-IUU), which was adopted in 2001, formally describes IUU fishing as:

- *Illegal Fishing* which refers to activities:
    - Conducted by national or foreign vessels in waters under the jurisdiction of a State, without permission of that State, or in contravention of its laws and regulations;
    - Conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by which the States are bound, or relevant provisions of the applicable international law; or
    - In violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organization.

- *Unreported Fishing* which refers to fishing activities:
    - Which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or
    - Undertaken in the area of competence of a relevant regional fisheries management organization which have not been reported or have been misreported, in contravention of the reporting procedures of that organization.

- *Unregulated Fishing* which refers to fishing activities:
    - In the area of application of a relevant regional fisheries management organization that are conducted by vessels without nationality, or by those flying the flag of a State not party to that organization, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organization; or
    - In areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law (FAO, 2001).

Despite this extensive definition, there is often a tendency to group all the elements of IUU fishing into a single grouping, which can be very misleading. IUU fishing is rarely conducted as a single type of activity and the actual fishing part of it is often the least difficult element to deal with. A more accurate description of the IUU fishing problem draws in the entire range of economics and financial transactions associated with catching fish and bringing them to market, from investing in and operating fishing vessels to transhipping catches at sea or in ports distant from the fishing grounds or coastal State waters where they were caught, and then selling them internationally on world markets (High Seas Task Force, 2006).

IUU fishing is first, and foremost, an economic activity which will continue as long as there are huge rewards coupled with low risks. Drivers of IUU fishing are primarily economic and include overcapacity in the world fishing fleet, the strong market demand for fish, the economic and social conditions of fishermen, the low level of sanctions and the low likelihood of being caught (High Seas Task Force, 2006). To be effective, management, conservation and compliance measures alike need to target the economic foundation of the illegal activity. The global nature of the IUU problem means that it is beyond the enforcement capabilities of any one country or single regional or international agency to fully address and tackle the problem (High Seas Task Force, 2006).

For the developing Pacific Island countries, whose respective national administrations are charged with the enforcement of fisheries laws, there is a real question as to whether their MCS resources will ever be enough to effectively eliminate IUU fishing given the amount of fishing effort occurring in the region, the increasing volumes of trade, the increasing complexity of fishing operations and the sheer size of the maritime areas in the WCPO that must be covered.

To deal successfully with the problem of IUU fishing in the WCPO, Pacific Island countries must take into consideration not only their current suite of MCS tools, techniques and activities, but also emerging technologies that could enhance and complement their MCS efforts.

Current MCS Tools, Techniques and Frameworks used in the WCPO

Three key elements of fisheries management include information of the scale and dynamics of the fishery and the relevant fish population (monitoring), development of effective fisheries regulatory controls to stop overfishing (control) and effective tools to enforce and deter the breaching of these regulatory controls (surveillance). Collectively these are known as MCS. The following represent some of the current MCS tools, techniques, technologies and frameworks in place in the WCPO and being used by FFA Members in their effort to detect, deter and eliminate illegal fishing.

FFA Vessel Register – Good Standing

All foreign fishing vessels wishing to obtain a national fishing license from any FFA member must first be authorized by their respective flag State to operate within the WCPFC Convention Area and be registered on the WCPFC RFV.

At this point, FFA members' licensing procedures stipulate they still cannot license a foreign fishing vessel to fish within their respective coastal State waters unless that fishing vessel is in Good Standing on the FFA Vessel Register, the primary FFA Member regional vessel register managed by the FFA Secretariat on behalf of FFA Member countries. This requirement is a condition of licensing and the fees required to be placed on Good Standing on the FFA Vessel Register are administration costs which have no bearing on national licenses or access fees.

The FFA Vessel Register procedures act as a basic entry level requirement into the region that ensures vessel operators provide a minimum set of registration elements such as meeting the *FAO Standard Specifications for the Marking and Identification of Fishing Vessels*, as well as reporting automatically, normally and consistently to the FFA VMS.

The FFA Vessel Register was established with a set of Standards, Specifications and Procedures (SSPs) whose purpose is to ensure that the FFA Vessel Register is maintained in a manner that maximizes its utility as a management tool for FFA and its Members. The SSPs are designed to ensure that information in the FFA Vessel Register is complete, up-to-date, accurate, unambiguous, and comparable across flag States, member registries, the WCPFC RFV and other Tuna RFMO vessel records. The SSPs apply strictly to the fishing vessels that are in Good Standing on the FFA Vessel Register, not the WCPFC RFV. Any application received which contains information that is incorrect, inaccurate, misleading or incomplete, is rejected. As part of the application process, vessel owners agree explicitly to have their vessel monitored by FFA VMS and that this data can be shared between FFA Members based upon agreed policies and procedures.

FFA Vessel Register registration is an annual requirement with a period of validity of registration of one year. Applications for registration may be made at any time during the year, but in no case does the period of validity of a registration extend beyond one year following the date on which the registration is accorded to the applicant by FFA. FFA members may require additional national licensing procedures prior to issuing a license to fish. FFA Vessel Register procedures are additional to any national registration and licensing procedures that are required (FFA, 2014).

Any vessel that contravenes FFA Vessel Register requirements is likely to have its Good Standing on the FFA Vessel Register suspended or withdrawn so that it will not be legally entitled to fish in any FFA member EEZ. Vessels on Good Standing on the FFA Vessel Register may be withdrawn if the vessel operator has been convicted of a serious offence against the fisheries laws or regulations of an FFA member and has not fully complied with any civil or criminal judgment in respect of such offence or evidence exists that gives reasonable cause to believe that the operator has committed a serious offence against the fisheries laws or regulations of an FFA member and it has not been possible to bring the operator to trial. Good Standing may be suspended if the vessel operator violates terms and conditions of access.

Each FFA Member also provides FFA with their updated respective national license list so as to ensure compatibility of details of registration or license numbers, as applicable and effective dates for licenses or registrations. FFA circulates FFA Vessel Register information to all members.

As of 2014, the FFA Vessel Registration Fee is approximately $2,850 per vessel (FFA, 2014), a fee which may be raised annually consistent with the annual increase in the Regional Index to take into

account inflation adjustments. This registration fee primarily pays for the continued maintenance and operation of both the FFA Vessel Register and VMS and represents a direct cost recovery mechanism from industry.

Those purse seine and longline fishing vessels operating in Parties to the Nauru Agreement (PNA) waters under the Vessel Day Scheme (VDS) are also required to pay an additional VDS management fee. This management fee is subject to change based on any review by the PNA parties and is paid directly to the PNA Office in Majuro, Marshall Islands.

FFA Vessel Monitoring System (VMS)

Fishing VMS is a cost-effective fisheries activities monitoring tool as it provides fishery management agencies and Fisheries Compliance Officers with accurate and timely information about the location and activity of a regulated fishing vessel via electronic equipment installed onboard the vessel. This type of monitoring is different from traditional methods, such as using surface and aerial patrols, on-board observers, logbooks or dockside inspections. If a fishery has a VMS requirement for vessels participating in the fishery, then each participating vessel within a fishery must carry onboard as shipboard equipment an approved VMS unit (also called a Mobile Transmitting Unit (MTU) or Automatic Location Communicator (ALC)). This shipboard electronic equipment is installed permanently on board a fishing vessel and assigned a unique identifier to clearly identify the vessel.

FFA's VMS allows FFA members to track and monitor the approximately 1,350 foreign-flagged fishing vessels that are registered on the FFA Vessel Register and licensed to fish in members' waters. Utilising the FFA VMS, FFA members are able to view all vessels they have licensed wherever they go during the validity of the licence due to the enactment of 'Port to Port' VMS monitoring legislation, or licence conditions, as outlined within the regionally agreed FFA Harmonised Minimum Terms and Conditions for Access by Foreign Fishing Vessels (HMTC). In addition to the foreign fishing vessels monitored on FFA VMS, some members (primarily Samoa, Tonga and Cook Islands) also monitor their own domestic fleets.

Vessel operators pay for the cost and installation of the FFA "Type Approved" ALC/MTU units that are fitted on the fishing vessels which then provide position reports to the FFA VMS and FFA pays for the satellite air-time costs of monitoring the vessels. The individual positions received are processed and viewed via a software application provided by a commercial software provider contracted to provide support to the FFA VMS. This software provides details such as position, speed and direction of the fishing vessel. Position reports are also extracted and processed near real-time to integrate with the PNA VDS, the FFA Regional Information Management Facility (RIMF) and the FFA Regional Surveillance Picture (RSP). Position reports are also provided to the Secretariat of the Pacific Community (SPC) to support their work as the FFA Members' science provider.

The FFA VMS ALC/MTU Type Approval Procedures is a process whereby FFA reviews the performance of VMS units annually for reporting issues not consistent with the requirements for ALC/MTUs to be reporting automatically, normally and consistently to the FFA VMS at all times. Where it is found that particular ALC/MTUs are problematic in meeting reporting requirements, they are removed from the FFA Type Approval list. Vessel owners/operators with ALC/MTU units not found on this list are required to replace and update these units to be consistent with the requirements for being listed as Good Standing on the FFA Vessel Register if they wish to be licensed to fish within FFA Member waters.

The Type Approval process was instituted in an effort to consistently address problematic non-reporting MTU/ALCs and reduce the number of vessels that provided manual position reports to FFA members. Manual position reports provided by vessel operators to both national monitoring

agencies and the FFA Secretariat have historically been incomplete and prone to inaccuracies, both accidental and deliberate, all of which create an undue compliance risk for FFA Members.

FFA has already Type Approved several E-MTUs (electronic) for vessel operators. With new emerging technology developments facilitating more efficient and cost effectives means of electronic data transfer from vessels, this option provides greater opportunity for FFA and FFA Members to obtain vitally important near-real time operational catch and effort data from vessel operators and owners.

Under FFA VMS data sharing agreements, FFA members can expand their VMS viewing access to include within each other's EEZs for vessels that they have not licensed to fish within their respective waters. This VMS data sharing can be implemented either by reciprocal arrangement or unconditionally between members. The stated goal of FFA is to have 100% unconditional VMS sharing amongst all FFA members so as to maximize the MCS potential of FFA VMS and minimize any potential VMS "data" gaps. However, as of 2014 some members still have not agreed to share their VMS data unconditionally with all others. Promulgation of the FFA Information Security Management System (ISMS) policy in 2012, which clearly addresses the processes, procedures and protocols by which the FFA Secretariat manages, holds and processes VMS data on behalf of FFA Members, was done so in an effort to provide the assurances to FFA Members that their VMS data is managed and shared in a secure manner. This new ISMS policy may soon facilitate 100% sharing of VMS data between all FFA Members.

Automated Identification System (AIS)

AIS is a wireless communications system based on radio frequency that uses the transmission and reception of electromagnetic waves similar to that of wireless transmissions to and from cellular telephones. A ship's AIS transponder uses a VHF transmitter to broadcast specific ship information to receiver devices on other ships or land-based systems. By sending and receiving regular information such as course, speed and identity, vessels can greatly reduce the potential for collisions with other vessels and navigate more safely, even when the vessels can't see each other.

Since 2004, the International Maritime Organization (IMO) has required AIS transponders to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages, and passenger ships irrespective of size (International Maritime Organization (IMO), 2014). However, more and more countries are mandating AIS usage for smaller sized vessels, including fishing vessels of which a large component make up the various DWFN fleets operating in the WCPO region.

AIS transponders have become so prevalent that the data they transmit and receive has become increasingly valuable to other entities besides just the vessels themselves. Port authorities, naval forces, coast guards and other maritime authorities use AIS data to increase their respective MDA. As a result, many coastal AIS stations are being built to improve the safety and security of a country's shoreline. While these systems are expensive to build and maintain, they do allow authorities to monitor vast areas of shoreline that, prior to AIS, needed far more costly systems or assets to monitor.

In general, coastal AIS has a range of about 50 nautical miles, but the coverage area can be shorter depending on the site of the installation and height of the antenna. Coastal AIS has range limitations because the earth is round. This range limitation effectively prevents maritime authorities, especially those of Pacific Island countries in the WCPO, from completing an overall MDA picture of the maritime traffic occurring beyond their borders and on a bigger, regional scale.

Satellite AIS (S-AIS) greatly extends the range of traditional coastal AIS as the signals are sent and received from many kilometres above the land and sea, preventing the horizon from limiting the signals' propagation. As a result, authorities are able to capture a much more complete picture of maritime activity in the areas in which they're specifically interested allowing them to more readily identify potential threats and provide for more cost-effective asset usage. Satellites, many of which have a low-earth orbit of about 650 kilometres, collect AIS transmissions from every ship that is within the satellite's field of view which is often huge, many times reaching over 5,000 kilometres in diameter (Ball, 2013).

With S-AIS, maritime authorities can also validate a ship's reported position by comparing the latitude and longitude of the AIS coordinates, especially when coupled with VMS or other sensors. In this manner, authorities can identify potential "dark targets" or if a vessel purposely reports a position other than its actual position (Ball, 2013). The wide field view of S-AIS can enhance monitoring coverage along a country's complete maritime boundary line. In addition, other important, but remote, areas of the WCPO such as the high seas fishing grounds of the south Pacific albacore fishery can be monitored so as to validate fishing effort. AIS data service providers report that the low-earth orbiting satellites are able to accurately capture approximately 98% of all AIS position reports transmitted (Martin, 2014).

While the International Maritime Organisation (IMO) and/or flag State AIS carriage requirements may not currently extend to smaller fishing vessels such as the thousands of DWFN longline vessels that operate in the WCPO region, AIS is required on the large carrier or reefer vessels that ply the WCPO region which conduct high seas transhipping of large quantities of fish caught by these DWFN fleets. These larger vessels can be monitored on S-AIS and their activities analysed as compared to others operating in their vicinity to determine whether unreported and unauthorized transhipping is taking place.

The potential downfall to the use of S-AIS is that it is considered a "cooperative" monitoring tool; that is, they are only located on vessels that meet certain size criteria or regulatory requirements. Even if compulsory, an AIS transponder can easily be turned off by the vessel operator.

Various commercial data service companies collect and provide S-AIS data to interested paying customers, such as governmental agencies or even fleet owners and operators. Since 2012, FFA, through its RFSC, has incorporated the use of this dataset to complement FFA VMS as a component of the FFA-managed Regional Surveillance Picture.

Unique Vessel Identifier (UVI)

The lack of mandatory, unique vessel identifying numbers makes it hard for maritime and enforcement authorities to distinguish between specific vessels engaged in illegal fishing or to track historical misconduct of specific vessels in order to gather evidence of these activities. As a result, vessel owners can circumvent control measures and avoid being traced if their vessel is specifically placed on an IUU Vessel List. These vessels can operate for years without leaving a definitive paper trail of their activities, their operating condition, or their compliance status. Such evasion enables illegal fishers to exceed or ignore various conservation and management measures developed and implemented to make fishing sustainable and environmentally sound.

A UVI, or IMO number, provides an important component in the solution: that is, a mandatory, unique, and permanent ship number in accordance with IMO standards. Mandatory use of IMO numbers would help solve problems with both national and regional vessel records. The IMO ship numbering scheme, currently administered on behalf of IMO by IHS Fairplay, has already successfully served for decades as unique identifiers for merchant ships. While fishing vessels are currently

exempt from the numbering scheme, owners may voluntarily request an IMO number at any time. In 2013 the IMO Maritime Safety Committee recommended the organization remove the exemption for fishing vessels.

Requiring IMO numbers for fishing vessels helps improve MCS efforts in numerous ways. It allows flag States to more consistently and accurately manage vessels under their authority, give national authorities information to help them police their waters more effectively, bring clarity, consistency, and accuracy to national and regional vessel records to provide a better understanding of vessels authorized to fish, help port authorities ensure that they are accepting only legally caught fish and help fish and seafood retailers ensure that the fish they sell is caught legally (Pew Charitable Trusts, 2013).

In 2011, FFA amended the FFA Vessel Registration Application and updated it to include all fields required for vessel owners to obtain a UVI, or IMO number. This was further revised in 2014 when the requirement was further revised so that foreign flagged vessels of more than 100 gross tons, whose owners wish to register on the FFA Vessel Register, must provide FFA with an IMO number itself as part of the application process.

WCPFC VMS

Article 24(8) of the WCPFC Convention obliges each Member of the Commission to require its fishing vessels that fish for highly migratory stocks on the high seas of the Convention Area to use an ALC/MTU that meets agreed WCPFC SSPs which were developed to support the WCPFC VMS. The SSPs also require the Secretariat to develop and manage a service level agreement with FFA for provision of VMS services as the approved structure of WCPFC VMS allows vessels to report to WCPFC via one of two ways: either directly to the WCPFC VMS, or to WCPFC through the FFA VMS.

WCPFC VMS first and foremost covers all of the high seas waters of the Convention Area. However, in 2013 WCPFC operationalized Article 24(8) of the Convention which provided the ability for coastal State Members to request and receive WCPFC VMS data for their respective national waters when fishing vessels, including unlicensed fishing vessels, transited into their waters from the high seas. Since this decision became final, nine FFA members (New Zealand, Tokelau, Cook Islands, Niue, Australia, FSM, Palau, Tuvalu and Samoa) have made specific requests to the Secretariat to commence this coverage.

In 2013, a total of 2,409 vessels reported on WCPFC VMS, over 87% of which were vessels flagged to DWFN nations (WCPFC, 2013). Unfortunately, the only form of advice the Secretariat receives from Commission Members regarding vessels which actively operate on the high seas is after the fact, in the form of a "fished" or "did not fish" report that is provided by Members to the Secretariat each July for the previous calendar year. This process restricts the ability of the Secretariat to determine in a more real-time manner which, or how many, fishing vessels are operating on the high seas in the Convention Area but not reporting on WCPFC VMS.

In 2012, WCPFC approved an amendment to the VMS SSPs that provided a reporting requirement and format for vessels to provide manual reports to the Secretariat when their VMS malfunctions. However, despite this requirement, some vessels continue to not report until urged by their respective flag State or when they did report, did not provide their manual reports in the right format or frequency. It is the responsibility of a vessel's flag State to ensure compliance with this requirement. In the first year of implementation, 4,466 manual reports were received by the Secretariat from 74 different fishing vessels (WCPFC, 2013).

The 2009 WCPFC Rules and Procedures for the Protection, Access to and Dissemination of High Seas Non-Public Domain Data and Information allows Members who conduct MCS activities to request and receive WCPFC VMS data from high seas areas up to 100 nautical miles adjacent to, and outside their EEZs. Fifteen Members have requested access to this high seas buffer VMS data, some on an ongoing basis, and others for the purposes of specific MCS activities. In addition, a number of Members have also requested and received high seas WCPFC VMS data for high seas MCS activities where the Member demonstrated they have an MCS presence or capability on the high seas (WCPFC, 2013).

WCPFC Record of Fishing Vessels (RFV)

The WCPFC RFV was established pursuant to Article 24 of the WCPF Convention and implemented through Conservation and Management Measure for the Record of Fishing Vessels and Authorisation to Fish. The RFV operates as a combined list of all the details that each Member and Cooperating Non-Member has provided to the Secretariat of its vessels that are authorized to fish beyond its respective national jurisdiction within the Convention Area. The RFV is a publicly accessible list through the WCPFC website. In 2013, 30 Members and Cooperating Non-Members submitted 5,889 records of their respective fishing vessels to the Secretariat (WCPFC, 2013).

Unfortunately, vessel information contained in the RFV is incomplete as most flag State Members and Cooperating Non-Members have not provided complete vessel details for each of their vessels despite a requirement for doing so. If a flag State has provided the Secretariat vessel information, the Secretariat is obliged to list a vessel on the WCPFC RFV even if the information provided is incomplete. This is in contrast to the FFA Vessel Register whereby FFA is under no obligation to register a vessel and place it on the FFA Vessel Register if the vessel owner has not provided FFA the requisite vessel information.

WCPFC High Seas Boarding and Inspection (HSBI) Scheme

In 2006, pursuant to Article 26 of the Convention, WCPFC adopting a Conservation and Management Measure (CMM) outlining a High Seas Boarding and Inspection (HSBI) Scheme. This scheme facilitates the ability for Members to conduct high seas boarding and inspections of fishing vessels flagged to another Member or Cooperating Non-Member of the Commission for the purpose of ensuring compliance with the provisions of the Convention and conservation and management measures adopted by the Commission and in force.

Currently, there are 12 Members (Australia, Canada, Cook Islands, FSM, France, Japan, Korea, New Zealand, Papua New Guinea, Chinese Taipei, Tuvalu and the United States) that have notified the Commission of their intention to participate in conducting boarding and inspection activities under the WCPFC HSBI Scheme. As of 2013, these Members have listed 136 vessels on the WCPFC Register of Authorised Inspection Vessels (WCPFC, 2013).

During 2012 the Secretariat received 55 reports from three Members conducting HSBI. Thirteen (13) fishing vessels were detected to have committed serious violations. In the first half of 2013, the Secretariat received an additional 54 reports from seven Members conducting HSBI. Fifteen (15) of these vessels were detected to have committed serious violations (WCPFC, 2013). This represents an approximate 26% non-compliance rate for vessels boarded during the period. The flag State of 25% of the vessels found with serious violations provided the Secretariat and other Members of the Commission no further information or indication that any follow-up investigation or enforcement action was taken as required by a responsible flag State.

FFA Regional Fisheries Surveillance Centre (RFSC)

When established in 1997, the primary role of the FFA RFSC was to administer the FFA Vessel Register and manage the FFA VMS on behalf of FFA Member countries. The development of the Operations Room in 2009 added a new dimension to the national and regional MCS role and functions of the RFSC which now includes the collection, analysis and dissemination of a range of fisheries information.

Each FFA Member remains responsible for the conduct of national MCS in its EEZ and in some cases adjacent high seas areas. The development and dissemination of the Regional Surveillance Picture (RSP) by the FFA RFSC allows national MCS entities authorized access to not only positional FFA and WCPFC VMS and AIS data on vessels in waters under their respective national jurisdiction and, in cases where data sharing agreements are in place, vessels approaching their areas, but also access to analysed fisheries information which identifies an estimated level of risk each vessel poses of conducting IUU fishing. This manual analysis conducted by the FFA RFSC allows for national prioritization of surveillance and patrol assets facilitating greater efficiency in the use of these limited resources.

Additionally, the RFSC plans and coordinates several annual major regional fisheries surveillance operations and provides day-to-day liaison and support to FFA member countries as fulfilled by their "surveillance partners" (the defence forces of Australia, New Zealand, France and the United States). This support is provided through the Quadrilateral Defence Coordinating Group (QUAD) framework where an Operational Working Group (OWG) was formed to share and coordinate with FFA operational plans for the FFA Member region so as to enhance the regional MCS efforts of FFA Members.

The primary aim of the operations are not only to detect, deter and eliminate IUU fishing, but also to foster regional MCS coordination and cooperation and national self-sufficiency and continue to improve the availability and use of a range of MCS tools and communications to support the regional and national MCS effort. These operations have developed significantly over time to become medium to large multilateral events involving a range of air and surface surveillance and patrol assets.

The decision to centralise the planning and coordination of these operations at the FFA RFSC was taken when it became apparent that the size and complexity of the operations were growing beyond the capability of individual island nations to handle. This, coupled with the increasing amount of fisheries information securely held, managed and processed by FFA on behalf of its Members, saw the need for a well-established and equipped Joint Coordination Centre (JCC) for planning and coordination functions. The RFSC has thus taken on this role and function and undertakes all operational planning and the processes involved with executing the regional operations.

FFA, through the FFA RFSC, also liaises on a regular basis with the WCPFC Secretariat to ensure enhance coordination of the regional MCS effort, especially with respect to the high seas areas. In planning and coordinating regional MCS operations, the RFSC will often encourage and in some cases assist FFA member countries in gaining authorized access to high seas VMS and other non-public domain data in accordance with the WCPFC data rules regarding this information. This is particular relevant as FFA has been named as an Authorized MCS Entity by 10 FFA Members and are officially authorized to have access to this particularly sensitive information held by WCPFC.

FFA utilizes a software program called TUFMAN MCS in the FFA RFSC as a reporting tool to support documentation of the efforts involved in the planning and execution of regional MCS operations. This tool significantly increases MCS reporting efficiency and accuracy. FFA has also installed this

software within the headquarters of the maritime enforcement agencies of FFA Members to facilitate their ability to accurately document MCS statistics and generate timely situational reports both in and outside the realm of regional MCS operations.

This method of capturing metrics (statistics) helps justify expenditures in MCS activities which has become of increasing importance to both FFA Members and their surveillance providers. Nations are tied to justifiable expenditures and will increasingly be reluctant to fund activities which have neither financial nor commercial benefit, including MCS. Australia, as a major contributor of funds to the FFA members through the Defense Cooperation Program (DCP), requires regular statistical feedback from FFA and the FFA RFSC for regional MCS operations and from Australian Maritime Surveillance Advisors (MSAs) embedded on staff of the maritime enforcement agencies of FFA members on Pacific Patrol Boat usage and upkeep so as to ensure quantitative evidence is present to justify the expenditure involved (Pounder, 2014). FFA likewise encourages FFA members themselves to focus on the metrics for the MCS activities their patrol boats and fisheries agencies conduct.

The TUFMAN MCS software allows operators on a national level to record MCS activities such as patrols, sightings and boardings and save the information in their national databases as well as share the information with the FFA RFSC on a regional level to assist in the analysis of MCS efforts from a regional perspective to ensure MCS efforts remain targeted and risk-based.

Pacific Patrol Boat (PPB) Program/Pacific Maritime Security Program (PMSP)

Australia's PPB program was implemented as a large part due to the interests of Australia and its relationship with the Pacific Island nations. The program was first announced in August 1983, with the first patrol boat delivered to Papua New Guinea (PNG) in 1987 under Australia's DCP. The impetus for the program emanated from the UN Convention on the Law of the Sea (UNCLOS) treaty in 1982 which established EEZs extending 200 nautical miles from a nation's established baseline. The PPB program was designed to give Pacific Island nations the capability to patrol their own EEZs to enforce their own respective fisheries rules and regulations. Twenty-two Pacific class patrol boats were gifted to 12 countries in the South Pacific (PNG with four; Tonga, FSM and Fiji with three each; Solomon Islands with two; and Marshall Islands, Palau, Kiribati, Vanuatu, Cook Islands, Tuvalu and Samoa each with one). The PPBs are each 31.5 metres in length, can travel at 21 knots and have a range of 2500 nautical miles.

Each boat was designed to last 15 years. In 2000, Australia extended the program out to 2027, with the DCP funding a life-extension package for the patrol boats at a cost of $350 million increasing the lifespan of the fleet from 15 to 30 years. A new program of third-iteration refits commenced in 2010 to take the boats through to their extended end-of-service life. In addition to the direct support for the boats, PPB crews are brought to Australia for extensive training where, over the space of 20 years, over 4000 crew attended training at the Australian Maritime College (McCann, 2013).

As a part of the PPB package, the Australian Government also provided recipient countries the support of an MSA and a technical adviser to support the boats and crews. In many cases, DCP funding has extended to purchasing fuel for the boats, to ensure they can participate in the regional surveillance operations that occur each year. The Pacific Island Countries have embraced this program as the PPBs provide them with a credible maritime surveillance capability, allowing them to protect their own fishery resources within their respective EEZs.

For most countries, these patrol boats are the only fisheries enforcement assets and while Australia plays a facilitating role, it is the Pacific Island nations themselves that actually operate the boats. A

breakdown of the number of sea days per vessel from 2006-2012 has indicated that for some countries such as RMI, FSM, Cook Islands and Tonga, the patrol boats have all averaged over 70 sea days per year with at least one of their boats. However, overall fleet average is approximately 59 days per year per vessel (McCann, 2013).

When it comes to physical surveillance and enforcement by the Pacific Island countries, most people think of the PPB fleet which are collectively sent out to intercept illegal fishing vessels. The problem is that these patrol vessels are not only expensive to maintain, but are of limited capability to patrol beyond the EEZ and onto the high seas. There is also a limit to what these conventional maritime surveillance assets can achieve. Physical apprehension of illegal fishers is, of course, the ultimate solution, but this rarely occurs for legal and practical reasons. Even if a patrol vessel succeeds in intercepting a fishing vessel, the physical challenges of conducting a boarding at sea are immense.

Despite these factors, the PPB program has served to bring Pacific Island nations together with a common purpose. The FFA motto of "strength through cooperation" is borne through the PPB program as neighbouring nations work together to meet common objectives strengthens their overall position, making it easier to resist outside influences from those nations with dissimilar interests. Importantly, in August 2012, Australia, New Zealand, France and the US jointly released a 'Pacific Maritime Surveillance Partnership' statement, committing to:

- *"…strengthening maritime surveillance activities in the Pacific region, with a particular focus on fisheries surveillance…"*
- *"…work closely together, in partnership…with Pacific Island countries to ensure maritime surveillance activities—including overflights and surface patrols—are coordinated to maximise their operational effectiveness…"*

With the PPB program quickly approaching its eventual end of project timeline, in June 2014 Australia announced that the new $1.9 billion Pacific Maritime Security Program (PMSP) will provide new patrol boats to the twelve original Pacific Island nations with patrol vessels under the PPB program. Timor-Leste may become a beneficiary of this new program as well although they are not a member of the FFA. The new vessels will replace those previously donated by Australia and this announcement signals Australia's intention to keep its role as a regional leader in the WCPO through this type of security assistance to its Pacific Island neighbors. However, the new program will have an increased focus on combating transnational crime and, in the case of Timor-Leste, will likely also focus on combating illegal human migration – a particularly sensitive issue for Australia (McCann, 2013).

The Australian government intends to continue funding both the vessels' construction and life-time sustainment, as well as personnel costs such as training the crews. The government estimated the construction costs to be $559 million and the sustainment and personnel costs over thirty years to be $1.3 billion (McCann, 2013).

Shipriders

Commencing in 2008, the U.S. completed a number of bilateral maritime law enforcement agreements, all containing shiprider components, with key FFA Member nations. Agreements were originally completed with the governments of Palau, FSM, RMI, the Cook Islands, and Kiribati. One additional one with Tonga was signed in 2009, two signed in 2011 with both Tuvalu and Nauru and the most recent agreement was signed in 2012 with Samoa. These agreements have greatly increased the ability of both FFA Members and the U.S. to collectively work together to combat IUU fishing and violations of the national sovereignty of each of these Pacific states.

These agreements allow for an enforcement official from the host country to embark a U.S. Coast Guard Cutter for the purposes of patrolling within the EEZ and/or Territorial Seas of that nation. Shiprider operations occur in concert with Coast Guard patrols of U.S. EEZs and surrounding high seas under the WCPFC. While operating in Pacific Island Country EEZs and territorial sea, the U.S. Coast Guard operates under the authority of the embarked country official to enforce the laws of their country. Law enforcement actions are led by embarked country officials with support provided by U.S. Coast Guard cutter and boarding teams.

2011 also saw the first air surveillance operations with embarked plane-riders in accordance with these same bilateral agreements. Coast Guard C-130s supported three air surveillance operations patrolling Kiribati EEZs, one of which was in support of a regional surveillance operation.

The U.S. Coast Guard and Navy have also recently completed joint missions in the WCPO under a new agreement between the services specifically designed to enforce fisheries laws and enhance regional security. This partnership supports the Oceania Maritime Security Initiative, a Secretary of Defense program, which leverages U.S. Department of Defense assets transiting the WCPO to increase maritime domain awareness and support maritime law enforcement operations. As part of the most recent mission in 2014, Pacific Island shipriders from Tuvalu and Nauru accompanied a Coast Guard law enforcement team embarked on a U.S. Navy frigate to conduct law enforcement boardings within their EEZs while the vessel transited through (U.S. Coast Guard, 2014).

Observers

Fisheries observer programmes vary according to the management objective. In the WCPO, one of the main objectives of observers is monitoring of activities. This includes assessments of fishing and/or transhipment activities to ensure fisheries management measures are followed, verification of logbooks with fishing and/or transhipment activities and registering compliance with all regulations. In accomplishing this, observers document operational activities of the vessel and collect data according to standardised protocols.

Observers, by their nature of collecting independent data directly onboard vessels during fisheries operations, represent the “eyes and ears of fisheries management”. They are trained to be skilled technicians that collect, accurate and impartial data that can then be interpreted by scientists or MCS officers for their own respective purposes. Observers are skilled in understanding the operation of the fishing vessel, are able to accurately identify species, equipment and fishing practices and follow protocols for recording and sampling as required.

It is important to note that, while observers are taught the background behind some of the data they collect to get a better understanding of why and how they collect it, they are not enforcement officers and do not have powers of arrest. Observers have no right to direct the vessel or captain in any activities, have no formal MCS training and are alone on the vessel. Therefore, their role is not to know all laws, interpret whether a violation has occurred, decide whether an action can be prosecuted, and in particular not to act on any observed “offense” while at sea. Due to the fact that observers may observe and document non-compliant activities occurring aboard a vessel, their records must be entirely independent to those the vessel collects and must be kept secure from the captain and crew of the vessel.

The role of observers in the WCPO under the WCPFC Regional Observer Program (ROP) is defined in the WCPFC Convention as: “…*to collect verified catch data, other scientific data and additional information related to the fishery from the Convention Area and to monitor the implementation of the conservation and management measures adopted by the Commission*…”. Similarly, other bilateral and multilateral instruments allowing foreign fishing access highlight the role of observers

to monitor "vessel compliance with Treaty" (under the U.S. Treaty) or "for the purposes of implementing and achieving the objectives of this Arrangement" (under the FSM Arrangement).

Observers collect most of the operational data on a set of forms that are collected together into a workbook. In addition there is the journal for separate detail on daily events and length measurement waterproof pads for use on the wet-deck. The forms and hence workbooks are specific for the particular gear type and fishery hence there are sets of forms, bound into workbooks, for purse seine, longline and pole and line, with some modifications for specific fisheries. In addition there is a set of GEN (general) forms used in all of the fisheries, which tend to be related to surveillance and compliance roles.

There is a current move away from use of paper forms by observers to E-Reporting although this is still undergoing trials as to which data this can be applied to and to prioritise the data into time frames for submission, such as which data is needed in more real time than others.

Observers also fill out a full trip report for each fishing trip they complete. The trip report also allows observers to provide more detail than in the forms. It is written at the end of the trip in summary format structured as answers to set questions, rather than chronologically like the journal. Its purpose is to provide an easy reference of more detailed information required by debriefers and investigators. It is usually the second place that MCS officers look after the GEN forms to substantiate possible incidents of non-compliance so the trip report is an important tool used for debriefing, clarification and as evidence

There are three tiers of observer programmes operating in the WCPO: National Observer Programmes, Sub-regional Observer Programmes and a Regional Program. The key characteristic for each is their defining fisheries access instrument and sphere of authority.

National Observer Programmes obligate vessels to carry observes through bilateral agreements and licences; their sphere of authority is inside coastal States' waters (EEZ). National observers form the principal cadre of observers. These observers are often "borrowed'' by sub-regional observer programmes and operate under the ROP where a trip is considered an ROP trip. Currently, there are approximately 720 national observers among FFA Member's national programmes.

Sub-regional Observer Programmes cover multilateral arrangements such as the U.S. Treaty (since 1988) and the FSM Arrangement (since 1995) and their observer programme's sphere of authority is the collective Members' EEZs under the respective Treaty. The ROP covers the WCPFC area and has authority over the full WCPO Convention Area. A national or a sub-regional trip becomes an ROP trip when the vessel fishes either the high seas area, or an EEZ and the high seas or in two or more EEZs on the same trip.

FFA observer training initiated in 1987 to supply observers under the U.S. Treaty. This was principally coordinated and funded by the FFA Secretariat with SPC scientific input. Training funded by the FSM Arrangement observer programme further expanded training for national programs. FFA and SPC training teams have funded and conducted almost all the observer training in the region since 1995.

The philosophy of establishing the Pacific Islands Regional Fisheries Observer (PIRFO) programme was to establish regional standards for observer accreditation and training. Furthermore their adoption established the first certification standards of observers in the region and hence created a benchmark throughout the rest of the WCPO. The development of the PIRFO programme was also in response to the purse seine 100% observer coverage requirement established through the PNA Third Implementing Arrangement (3IA) and WCPFC obligations. PIRFO accreditation standards are competency based, equivalent to technical trade training (similar to Australian Certificate III level). This means that it is vocational rather than academic training; based around demonstrating the

essential skills required in the observer accreditation standards. The PIRFO concept has been developed into a career pathway from observer (three levels of skill), debriefer, trainer and manager. The curriculum has progressively evolved to meet national, sub-regional and regional requirements for observer data collection, an increasing role in monitoring and scientific sampling.

Once a trip has finished, an observer is obligated to report to the observer provider to arrange a debriefing. Debriefing, in part, provides a mechanism for observer programmes and MCS officers to quickly report and respond to critical incidents or possible non-compliance that took place on the trip. An Observer Data Analysis Procedure Manual was developed by FFA and circulated amongst Members to assist debriefers and MCS officers with the observer data analysis. Between observers, VMS, logsheets and operational reports, there is a very large and growing body of fisheries information that can be effectively integrated and analysed to ensure vessels operate in compliance with all national and regional management measures.

Some consistent areas of possible high IUU risk that observers have documented while onboard fishing vessels operating in the WCPO include misreporting of target and by-catch species, fishing on Fish Aggregating Devices (FADs) during FAD closure periods, protected species interactions and observer obstruction.

However, similar to other regions, observer-reported instances of non-compliance are prosecuted less often than cases directly identified by MCS officers. While the reasons for lower prosecution rates are unclear, they do not appear to result from incorrect identification of violations. As non-compliance with fisheries regulations is becoming an increasing concern in some fisheries, observers do represent a unique enforcement resource that can facilitate detection and penalization of instances of non-compliance. Recently, Pacific Island observers were used as witnesses for cases which were developed largely based upon the reporting and documentation provided by the observers. These cases resulted in the issuance of over $1.5 million USD in fines (NOAA Fisheries, 2013). This shows observers and their data can be extremely effective in legal proceedings. However, increased prosecution of observer-reported data is needed to reduce incentives for non-compliance when observers are onboard.

The increased reliance on observers for compliance purposes has raised legitimate concerns of increased incidences of attempted bribery, harassment, intimidation and bodily harm. This is manifest in the increase in the number of physical altercations between observers and crew and even one alleged murder of an observer. Observers also express concerns of reprisal against them on subsequent trips if crews of other vessels know of their involvement in prosecutions.

Importantly, observer data can be used by MCS officers to develop compliance profiling. Analysed observer data can be used to help develop individual vessel compliance indicators by looking at patterns of incidents reported by observers on specific vessels or by specific masters through time. Similarly fleets may also be characterised to determine their patterns of behaviour that might be used to better utilise MCS resources during closures or times to increase monitoring such as VMS polling during likely time of sets.

GeoEye Seastar

In 2012, a commercial provider of fish-finding solutions was contracted to provide service to the FFA RFSC as a sponsored trial. The aim was to assess the usefulness of the GeoEye SeaStar tool, originally designed for industry to minimize vessel search times and reducing fleet operating costs to commercial fishing operators. The thought was to use SeaStar as a “predictive intelligence” tool in the planning and execution of fisheries surveillance operations.

One of GeoEye's products is the OrbMap software, which produces electronic fish finding charts with embedded oceanographic information, combining data from satellite and other sensors. The OrbMap software utilises data on plankton concentrations, sea surface temperatures and currents, sub-surface temperatures, estimated thermocline depths, sea surface height anomalies, salinity estimates and marine and weather forecasts. Another component was MasterCast, a layer of oceanographic information with fishing hot spots or 'recommendations', which was designed to be draped over the FFA Regional Surveillance Picture to allow simple comparison of the draped product 'recommendations' with the near-real time location of fishing vessels on VMS. However, due to some unresolved issues, the inclusion of this product in the Regional Surveillance Picture proved very manually intensive which limited its usefulness.

Although results varied with the different geographical locations, through trial and error and a lot of reverse engineering, the FFA RFSC was able to identify certain environmental conditions that would contribute to a particular area being a recommended fishing spot for a particular gear type. Reverse engineering, beginning with vessel concentrations and then extracting the environmental conditions on a particular area helped the RFSC build profiles on the fishing spots in the WCPO. The trial highlighted the ability to determine 'recommendation' hot-spots and more broad areas where, according to GeoEye, preferred conditions exist for the four main tuna species.

Fisheries Information Management Systems (IMS)

A 2009 MCS Study (Pacific, 2009) outlined three important gaps in MCS information management:

- Limited national capacity in MCS Information Systems;
- Lack of an MCS 'Regional Information Management Facility' (RIMF); and
- The need for a Regional 'Information Exchange Model'

For the past several years, FFA has been in the midst of improving and further developing these three components by building upon existing successful systems and processes. Improving national capacity for fisheries data and IMS is an essential element in building the future WCPO fisheries management environment, one that will adequately support FFA Member MCS information needs. Development of both the national IMS and the RIMF is modular in approach with policy, rules and mechanisms for information sharing outlined within FFA's Information Security Management System (ISMS) policy so as to reassure FFA Member countries that data managed, processed and used in these systems is secure and will not be misused.

The national IMS and RIMF are designed to be a comprehensive information management environment that includes a number of databases, systems, tools and services that combined would provide the required support for both fisheries IMS and MCS across all components, nationally, sub-regionally and regionally. The modules developed, or currently in development, are templates which are tailored to individual national fisheries administrations.

The concept of RIMF can be likened to an information clearinghouse where the main function is to act as a repository that collects, stores, and disseminates fisheries and MCS information to geographically and organizationally-dispersed stakeholders. Centrally, the RIMF core infrastructure provides the services to allow FFA Members to connect, validate their authority to access data, log all data requests in the database and, provided the access criteria has been met, return a package of data or receive a data package to be uploaded.

RIMF functionality is based on a "core database' that includes the following data: vessels, licenses, VMS, masters, owners/operators and standard reference data. With the core database in place, national MCS officers will be equipped with the capability to retrieve and make appropriate use of

this essential MCS information. Examples of core MCS functionality available to national MCS officers include:

- Find and uniquely identify a vessel in the database;
- Based on a location, determine if a specific vessel is authorized to fish;
- Review the compliance history for any given vessel;
- Review the compliance history for a particular vessel master;
- Plan for targeted surveillance;
- Extract information as required by a surveillance operation;
- Provide access to multiple MCS officers at various locations at the same time;
- Boarding and inspection of vessels, both at sea and in port;
- Planning and execution of regional surveillance operations;
- Management of national, sub-regional and regional observer programs; and
- Acting upon committed violations and recording outcomes, including any court prosecutions

This approach has a number of benefits, including minimizing up-front and on-going costs, ensuring consistency in how systems are used and providing for a more effective training. In time, the IMS and RIMF architecture and design principles allow for incremental development of new modules and systems. This is quite important since it provides flexibility to build new modules in order of national priority and without having to commit to all of the systems up front, but rather once the concept is proven through initial modules.

Fisheries Frameworks in the WCPO

FFA Harmonized Minimum Terms and Conditions for Access by Fishing Vessels (HMTCs)

The FFA HMTCs were developed in the early 1980s in response to a need for a coordinated approach by FFA Members in providing access to fishing within their respective EEZs by DWFNs. They represent a key strategic tool for FFA Members not just in dealing with DWFN access into their waters but also strengthening in-zone measures so that WCPFC adopts compatible measures for the high seas. The HMTCs are not self-executing and do not automatically apply to foreign fishing vessels. They must be incorporated into FFA Members' national laws or regulatory framework to carry the necessary authority over foreign fishing vessels operating in their waters. As legal requirements, this ensures their indisputable and uniform application to foreign fishing vessels.

Niue Treaty

In 1992, FFA members adopted the *Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific* (Niue Treaty). The objective of the Niue Treaty is to enhance regional coordination and cooperation in fisheries surveillance and law enforcement, and increase the ability of Pacific Island countries to effectively enforce their fisheries laws. To maximise the potential for cooperation, Article VI of the Niue Treaty provides for Parties to establish Subsidiary Agreements, by which the Parties can cooperate in the provision of personnel, vessels and aircraft, and agree to undertake fisheries surveillance and law enforcement activities in each other's waters. Parties have agreed to cooperate in the enforcement of their fisheries laws and regulations and to develop regionally agreed procedures for the conduct of fisheries surveillance and law enforcement. In its substantive Articles, the Treaty addresses:

- General cooperation;
- Cooperation in the implementation of the harmonised minimum terms and conditions of fisheries access;
- Exchange of information;
- Cooperation in fisheries surveillance and law enforcement;
- Cooperation in prosecution;
- Cooperation in enforcement of penalties, and
- Consultation.

The principal provisions of the Niue Treaty are found in Article VI. The Treaty paved the way for effective MCS cooperation among FFA members especially with dealing with the problem that island countries face with respect to vessels committing an infringement in the EEZ of one country and then continuing to fish with impunity in the EEZ of another FFA member. The Treaty closed loopholes in the Pacific Island region with respect to IUU fishing and served to deter unauthorised fishing by both regional and DWFN vessels.

Multilateral Niue Treaty Subsidiary Agreement (NTSA)

In 2010, Pacific Islands Forum Leaders further recognised that in order to combat IUU fishing and protect the region's fisheries resources, there was a clear need to strengthen their current surveillance and enforcement mechanisms. As directed by FFC and Law Enforcement Ministers in July 2010 and endorsed by Forum Leaders in August 2010, the Parties to the Niue Treaty formed the Niue Treaty Drafting Group to develop a Multilateral Subsidiary Agreement under the *Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific* to be completed by the end of 2012. The Niue Treaty Drafting Group completed its work on the Niue Treaty Subsidiary Agreement in August 2012 and forwarded this to the meeting of the Parties to the Niue Treaty on 2 November 2012 for their consideration as (i) a final draft of the Agreement for adoption and to be opened for signature, and (ii) a draft Final Act for signature by the Parties. At this meeting, the Parties adopted the Agreement and opened the Final Act for Signature.

The draft text addresses both of the issues requested by Leaders and Ministers:

- *The cross-vesting of enforcement powers to enable cooperative surveillance and enforcement activities* - the cross-vesting of enforcement powers is dealt with in the text, which provides for flexible cooperation in conducting a broad range of cooperative surveillance and enforcement activities, ranging from at-sea patrols and aerial surveillance to the provision of investigation and follow-up assistance, and the conduct of port inspections.

  The draft text establishes the Niue Treaty Information System which contains the authority and information received from Parties, which are necessary to conduct cooperative fisheries surveillance and law enforcement activities; and

- *The exchange of fisheries law enforcement data and the use of fisheries data for broader law enforcement purposes* - the text establishes a minimum standard of data and intelligence that is to be exchanged under the Agreement for fisheries purposes. The draft also establishes optional mechanisms which Parties may use to share fisheries data and intelligence for broader law enforcement purposes (including with non-fisheries agencies and broader law enforcement organisations) and to receive relevant information from broader law enforcement agencies or organisations.

The agreement also set up a framework for cooperation with non-Parties. The nature of cooperation is not limited and it is completely up to the Parties as they see fit. Parties are encouraged to seek to cooperate with non-Parties either on an individual or collective basis, which could include (a) the provision of authority and information to facilitate and support fisheries surveillance and law enforcement activities (b) the conduct of cooperative surveillance and enforcement activities; and (c) sharing or exchange of fisheries data and intelligence.

There are four important Annexes associated with the new NTSA. Annex A outlines the minimum fisheries data and intelligence that parties are required to provide under Part III of the Agreement. Annex B outlines the duties and responsibilities of the Administrator of the NTSA (FFA). Annex C outlines the information and authority to be provided in the notifications used by members under the framework of the NTSA which will have the same legally binding status as the text within the Articles of the Agreement. Annex D details the Niue Treaty flag which is required to be flown by surveillance and enforcement vessels operating under the framework of the NTSA.

The NTSA is supported by the Niue Treaty Information System (NTIS) which is managed by FFA as Administrator which is designed to store and make available to members the authority and information provided by the Parties. The notifications constitute the legal basis for the conduct of activities covered under the framework of the NTSA. Parties will be able to access the NTIS to make plans for, request assistance with, or consent to engage in cooperative surveillance and enforcement activities.

As of July 2014, eleven FFA Members have signed the updated Agreement (Australia, Niue, Solomon Islands, Cook Islands, FSM, Nauru, Palau, PNG, Marshall Islands, Samoa and Tuvalu). The Agreement will enter into force on the date of the fourth instrument of ratification, acceptance or approval is lodged with the Depositary (FFA). Three Parties to the Niue Treaty have completed their ratification processes (Palau, Cook Islands and Nauru), and have formally deposited their instruments of ratification with FFA.

FFA Regional MCS Strategy (RMCSS)

While many FFA MCS initiatives exist to deter IUU fishing, significant gaps still exist that undermine fisheries management measures and the integrity of scientific and management information upon which those measures are based. A real need was identified to improve coordination and cooperation both within and between FFA Members, and, in a wider context, with other members of the Commission of existing MCS programs, personnel and assets.

In recognition of the need for comprehensive MCS arrangements, Pacific Island Forum Leaders committed themselves and their governments to the development of a comprehensive Regional MCS Strategy.

The primary purpose of the strategy was to support compliance with fisheries management frameworks and measures at national, sub-regional and regional levels to ensure the long term sustainability of the WCPO fishery and the economic benefits that flow from it to Pacific Island Countries. The RMCSS was developed based on determining national needs, and then identifying ways to meet these through a variety of means, including direct national assistance and regional and sub-regional coordination and cooperation.

In the RMCSS, FFA Members collectively identified outcomes that require both regional collaboration and cooperation as well national action. While a wide range of MCS interventions are outlined, the strategy recognizes that MCS risks and priorities will differ between members and not all strategic objectives, outcomes and activities will be applicable to all Members. In simple terms, ‘one size will not fit all’. It will be for the individual country to identify and develop an effective MCS

program using its own national and/or sub-regional Implementation Plans, cooperating regionally and sub-regionally where appropriate (FFA, 2010).

The following Strategic Objectives are outlined under two primary Goals:

Goal 1: Enhanced MCS, integrated with fisheries management planning and implementation

- Strategic Objective 1: National MCS frameworks based on best practice risk assessment
- Strategic Objective 2: Improved Management of information useful for MCS purposes
- Strategic Objective 3: Improved integration of MCS advice in fisheries management planning
- Strategic Objective 4: Improved understanding of the drivers and level of compliant and non-compliant behavior
- Strategic Objective 5: Capacity and capability to respond to risk/information/intelligence including human resources/institutional set-up and enforcement assets
- Strategic Objective 6: Increased focus on voluntary compliance and innovative tools for awareness, enforcement, detection and penalty

Goal 2: Contribute to other strategic objectives

- Strategic Objective 1: Enhanced influence on WCPFC measures for high seas/convention area
- Strategic Objective 2: Increased MCS coverage in support of fisheries management outcomes through application of MCS tools via market based measures and mechanisms
- Strategic Objective 3: Cost efficient and effective MCS programs

The successful implementation of the RMCSS is primarily dependent on the support, political commitment and actions of FFA Member countries, especially to allow integration of regional approaches into national fisheries planning at the country level. Given the rapidly changing nature of some risks, variability in key drivers and importance of current risk assessments in compliance planning, FFA Members committed themselves to review and update key risk assessments and compliance reviews annually via the MCS Working Group Meeting (FFA, 2010).

FFA MCS Working Group

The MCS Working Group Meeting reports to the Forum Fisheries Committee (FFC) and is responsible for recommending appropriate in-zone, high seas pockets and high seas areas adjacent to FFA members' waters MCS operations necessary to effect the agreed management plans for the tuna fisheries of FFA member countries. The Group reviews, coordinates and advises on regional and national MCS activities related to:

- Aerial and maritime surveillance;
- National and regional observer programmes;
- Port state enforcement;
- Vessel Monitoring System (VMS) for FFA member countries; and
- FFA Vessel Register requirements.

This is done by Identifying opportunities for increased cooperative MCS activities among FFA Member countries, identifying equipment and training requirements, both at the FFA Secretariat and at the national-level, to implement effective MCS operations, and in relation to the high seas areas within the FFA region, reviewing opportunities for joint MCS activity with non-FFA parties within the WCPFC membership.

Quadrilateral Defence Coordinating Group/Quad Assets

Australia, New Zealand, France and the United States all have an interest in the WCPO region. In the case of Australia and New Zealand, both FFA Members, this is through historical linkages. In the case of France and U.S. it is governance as both have immense areas of their own respective EEZs they must monitor.

In recognition of their common interest in the area, these four nations formed the Quadrilateral Defence Coordinating Group (QUAD) to coordinate and synchronize support to FFA Member countries. This has primarily taken the form of surveillance, maritime response and training. The QUAD Operational Working Group (OWG) is the forum within the QUAD framework that conducts operational-level review of QUAD members' past, current and planned defence and related interagency support to FFA Member country military and maritime law enforcement organizations. The OWG assesses the effectiveness of previous QUAD-supported activities and operations and endeavours to incorporate lessons learned from these experiences into current and planned operational programs with FFA Members.

FFA originally facilitated the coordination of aerial and surface surveillance support through an annual meeting with representatives from the defence forces of Australia, New Zealand and France and the defence forces and Coast Guard from the U.S. Since 2006, this coordination of this support has occurred via the QUAD OWG taking into consideration guidance from the FFA. In the last several years, the annual meeting of the QUAD OWG has been held in conjunction with the FFA MCS Working Group Meeting to maximize opportunities for close cooperation, collaboration and coordination in the planning and execution of surveillance support and operations. This parallel meeting arrangement also allows direct confidential dialogue between individual FFA Member nations and the QUADs (one nation to one nation) where desired by FFA Members, equipping the surveillance providers with key information regarding national limitations and opportunities.

The QUAD OWG produces an annual Operations Calendar to better support FFA member national and regional activities and operations. This calendar identifies periods that QUAD members are able to provide aerial surveillance to FFA members, promulgates QUAD surface ship surveillance and response patrols and ships visiting or transiting the FFA member region, and outlines planned training activities that FFA members could participate in, including land based activities. The calendar also takes into account the availability and planned patrols of FFA Members' surveillance and response assets (i.e. Pacific Patrol Boats) and identifies dates for regional maritime surveillance operations and their associated planning meetings. This process is designed to promote cooperative surveillance and information sharing amongst FFA members and QUADs and have a single point of reference for all FFA member nation activities.

The QUAD Defence Forces provide a range of support to regional surveillance operations. This includes not only their participation in the FFA-led annual regional operations, but also in coordinating the conduct of similar activities and operations such as Operation TAUTAI in French Polynesia and surrounding areas.

Regular patrols and transits by QUAD nation surveillance aircraft and vessels are also undertaken throughout the region and year supporting specific FFA Member national tasking. Sightings of fishing vessels and fishing activity are reported to the FFA RFSC as coordinated between the relevant FFA Member and supporting QUAD nation. Where possible, these transits are planned to coincide with the PPB availability of member countries who's EEZs are involved with the planned QUAD transit or patrol route.

Regional Surveillance Operations

Annual regional multilateral operations such as Operation KURUKURU and RAI BALANG have evolved over a number of years with changes to the size, complexity, structure and objectives of the operations. These changes reflect not only lessons learnt from the conduct of previous operations, but also in the need to maintain pace with advances in regional MCS capabilities and emerging technologies and improvements in cooperation and coordination between FFA member countries. Determining these changes is primarily the remit of FFA members; bearing in mind that two of the QUAD nations (U.S. and France) involved in these operations are not members of FFA but provide significant resources in support of their conduct.

Each year FFA briefs FFA Members on the outcomes, achievements and shortcomings of these operation during the annual FFA MCS Working Group Meeting. The views of FFA Members on changes and improvements to future operations is sought in this forum to allow for technical input from all FFA Member national MCS practitioners. Outcomes and recommendations are then taken forward for consideration by FFC.

It is the role of FFA, through the RFSC, to develop the proposed operation schedule and MCS programs taking into account a range of factors such as seasonal fishing patterns, closure periods, patrol asset and funding availability and possible conflicting national and regional activities and operations. Close liaison with FFA Member countries and the QUAD OWG is therefore essential. To this end, representatives attending the FFA MCS Working Group Meeting come armed with bids for aerial and surface support and, where possible, a collation of forecasted PPB availability for the coming year. The QUAD OWG representatives are then charged with both coordinating and deconflicting their annual programs to achieve maximum effectiveness of these scarce assets by supporting the bids for support. The agreed schedule and program form the basis for the upcoming yearly schedule although there is flexibility built into it to account for emerging and unforseen threats or other higher priority missions.

The involvement of the RFSC in the medium and short term planning of national MCS operations depends largely on specific national requests for support and whether a QUAD surveillance asset is involved or not. Whilst it is important for the RFSC to be aware of planned individual nations PPB patrols, it is very much a national decision as to the scope and area of that patrol and how much involvement the nation desires from FFA and the RFSC. If requested, the RFSC is always available to provide advice or recommendations to FFA Members on the implementation of national MCS activities.

This can differ slightly if a QUAD asset is transiting independently on a surveillance mission through a member's EEZ. QUAD nations can be sensitive regarding third party involvement (including FFA and the RFSC) in some national operational commitments as they sometimes represent national diplomatic engagements. In these cases, QUAD nations many times prefer direct liaison with the Pacific Island nation involved. However, it is not uncommon for QUAD nations or individual FFA Member National Headquarters (NHQs) to consult with FFA and the RFSC on recommended patrol areas and emerging IUU fishing risks and threats.

The planning and coordination of the annual regional surveillance operations is the responsibility of FFA and the RFSC. Having previously identified dates for the operations, the RFSC maintains continuous liaison with those countries involved to ensure they remain committed to participating. The provision of QUAD nation aerial surveillance assets is imperative to the success of these operations and adjusting the final agreed dates to ensure their involvement is not unusual. The RFSC develops and promulgates a draft Planning Directive for comment and input from both the participating QUAD nations and involved FFA Members. As the planning develops and the program

firms-up, the Planning Directive is reworked and retransmitted, using an iterative process. Closer to the time of the operation when direct and continuous daily liaison and communications between the RFSC and FFA Member NHQs is essential, the final Planning Directive and other operational details are finalized and posted. Ideally, by the time the operational phase of the Operation commences all elements essential for the successful conduct of the operation should be in place.

FAO Port State Measures Agreement (PSMA)

Port State Measures (PSM) are requirements established or interventions undertaken by port States which a foreign fishing vessel must comply with or is subjected to as a condition for use of ports within the port State. National PSM would typically include requirements related to prior notification of port entry, use of designated ports, restrictions on port entry and landing/transshipment of fish, restrictions on supplies and services, documentation requirements and port inspections, as well as related measures, such as IUU vessel listing, trade-related measures and sanctions. Many of these measures have in recent years seen their inclusion and development in international instruments.

Acknowledging the urgent need for a comprehensive suite of PSM to combat IUU fishing, the FAO Committee on Fisheries endorsed in 2007 the global call for a binding agreement on PSM based on the IPOA-IUU. The Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing was approved by the FAO Conference at its Thirty-sixth Session on 22 November 2009. The PSM Agreement (PSMA) aims to prevent illegally caught fish from entering international markets through ports. Under the terms of the treaty, foreign vessels will provide advance notice and request permission for port entry, countries will conduct regular inspections in accordance with universal minimum standards, offending vessels will be denied use of port or certain port services and information sharing networks will be created.

The PSMA's most potent effect in terms of its potential to curb IUU fishing is that through the implementation of its provisions, including those relating to denial of access to ports, port inspections, prohibition of landing, and detention and sanction, can prevent fish caught from IUU fishing activities from reaching national and international markets. By making it more difficult to market fish through the application of PSMs, the economic incentive to engage in IUU fishing is reduced.

The adoption of the PSMA should enhance fisheries conservation and management, combat IUU fishing and reduce the volume of IUU-caught product entering national and international markets. Used in combination with other tools, PSMs should reduce the level of IUU fishing globally.

However, ratifying the PSMA places certain obligations upon that Party; obligations which are viewed as onerous to comply with by developing countries with small fisheries administrations such as the Pacific Island Countries. As it stands, while the PSMA outlines that assistance "needs" to be provided to developing States with regard to implementation of PSMs, it has only outlined that an ad hoc working group will be established to report on and make recommendations to the Parties on such financial matters. Countries will *first* need to become a Party to the PSMA in order to be able to receive any such assistance in implementing PSMs; this is *after* they are placed under obligations to comply with the PSMA.

This conundrum is an issue for Pacific Island Countries and could result with not many FFA Members formally becoming a Party to the PSMA in the short term; at least until the issue of financial and technical assistance to developing countries for implementing the PSMA is fully resolved. As of July 2014 only ten countries have ratified the PSMA (with one of those being New Zealand).

WCPFC Compliance Monitoring Scheme (CMS)

The WCPFC CMS was established in 2011, 2012 and 2013 as initial trials. A further revised Conservation and Management Measure for the CMS was agreed upon in 2014 still as an initial trial. The WCPFC is dependent on the submission by each Member of the Commission of their Annual Report Part 1 and Part 2 covering activities from the previous year.

The purpose of the WCPFC Compliance Monitoring Scheme is to ensure that Members, Cooperating Non-Members and, where appropriate, Participating Territories implement and comply with obligations arising under the Convention and conservation and management measures (CMMs) adopted by the Commission. Each year the Commission evaluates compliance by CCMs during the previous calendar year with the obligations in the Convention and CMMs adopted by the Commission with respect to:

- Catch and effort limits for target species;
- Catch and effort reporting for target species;
- Spatial and temporal closures, and restrictions on the use of fish aggregating devices;
- Observer and VMS coverage; and
- Provision of scientific data through the Part 1 Annual Report and the Scientific Data to be provided to the Commission.

MCS programs and officers can reference the finalized Compliance Monitoring Report developed and agreed upon by the Commission to help determine areas of potential IUU risk arising from fleets of various flag State members of the Commission whose vessels are licensed to fish both within FFA Members' waters as well as on the high seas in the Convention Area. For 2014, seven primary DWFNs with fleets operating in the WCPO were placed in a Compliance Review category indicating the overall level of compliance their respective governmental controls and fleets had with complying with Commission obligations. This Report represents an important MCS reference for helping to focus MCS efforts to more targeted and risk-based activities.

Review and Analysis of Emerging Technologies

An effective fisheries MCS program is one that not only can demonstrate it is able to quickly evolve to address emerging threats, but also holds the flexibility to incorporate new tools, methods or technologies into its framework which create greater efficiencies in meeting the overall programmatic MCS goals of detecting, deterring and eliminating illegal fishing. These emerging technologies should be targeted to address the highest priority areas of identified risk or fill existing gaps in the MCS framework by complementing or enhancing current MCS tools and techniques, not necessarily replacing them wholesale.

IUU Risks in the WCPO (Pacific, 2009)

The 2009 MRAG MCS study undertook an assessment of risks to oceanic fish stocks in the WCPO arising from fishing that undermined fisheries management frameworks and objectives. Over 40 separate risks were identified and assessed with three being rated as 'severe' risks, and a further 20 were rated as 'high' risks. The assessment identified risks across the geographical range of stocks and throughout the supply chain and documented that some of the highest risks occurred outside the WCPO region, most notably as a result of overfishing by domestic fleets in Southeast Asia.

However, unlike other parts of the world, there was strong evidence to suggest that the majority of IUU fishing activity occurring within the WCPO region is associated with licensed vessels. Inadequate

reporting – particularly of target species – was identified as one of the highest risk areas (Pacific, 2009). Notwithstanding that, unlicensed fishing still remained a risk amongst some fleets and areas, an activity that actually may increase as the WCPO fishery becomes increasingly more regulated.

The most important takeaways regarding illegal fishing risks are that:

- *Risks exist across the geographical range of stocks and throughout the supply chain:* Areas of high risk occurred throughout the full geographical range of target species. The broad scale and diverse nature of the identified risks, together with the interconnectedness of stocks within the WCPO region, clearly demonstrated that a comprehensive and inclusive approach to MCS must occur (Pacific, 2009).

- *Inadequate reporting is a key risk area:*
    - *Historically:* More than five years ago, the MRAG study identified that of the various forms of non-compliance associated with licensed fleets, failure to comply with reporting obligations was one of the highest risks. Access to timely and accurate catch, effort and other data is central to achieving regional fisheries goals. Misreporting (including under-reporting) of target species was rated a severe risk in both the purse seine and longline fisheries, although stronger MCS arrangements in the purse seine fishery (100% observer coverage, greater inspection coverage) resulted in a moderate residual risk rating. Non-compliance with catch reporting obligations in the longline fishery was a particular concern given its potential to undermine catch reduction targets as well as scientific data used in stock assessments of key species. Misreporting (including non-reporting) of by-catch species was also identified as one of the most widespread compliance problems. Along with the problems associated with inaccurate reporting, significant weaknesses were observed in the rates of logsheet submission to relevant coastal States, particularly amongst the longline fleet (Pacific, 2009).
    - *Currently:* Since MRAG's original risk assessment, little has changed to diminish the risk associated with inadequate reporting. In 2013, the WCPFC Secretariat reported that while 2012 operational level catch and effort data was mostly complete for the purse seine fleet, the same could not be said for the longline fleet. Gaps in operational level data were particularly notable for the DWFN fleets from China, Japan, Korea and Chinese Taipei. Most telling is that none of these DWFNs have submitted plans to the Commission for how their impairments to data provision could be resolved (WCPFC, 2013). This may be seen by some to be a clear demonstration of inadequate flag State responsibility.

- *Unlicensed fishing remains a threat in some areas and fleets:* While the majority of high risk is centered on authorized fleets, unlicensed fishing remains a risk in some areas and fleets. Illegal incursions by unlicensed vessels continue to occur throughout the WCPO but has become a more significant issue in both the western WCPO region due to an influx of small scale Southeast Asian vessels (primarily from Indonesia and the Philippines), as well as in the east from unlicensed purse seiners migrating to the WCPO from the Eastern Pacific Ocean (Pacific, 2009).

MCS Challenges in the WCPO

The primary challenges faced by MCS programmes and practitioners in effectively detecting, deterring and eliminating IUU fishing in the WCPO region revolve around:

- Lack of comprehensive near real-time information and data;
- Immense and remote areas to monitor;
- Vast numbers of vessels operating at any given time throughout the year; and
- Limited range and availability of enforcement assets which are expensive to operate.

When the highest identified risks of illegal fishing in the WCPO are compared with the primary challenges faced by MCS programmes, it is clear that efforts to incorporate emerging technologies into the existing MCS framework should focus on those that enhance the *Information Management* and *Remote Sensing* needs of Pacific Island countries as these will provide the greatest opportunity to impact IUU fishing.

Information Management

Information Management Systems (IMS)

Inadequate, misreporting and non-reporting of fisheries information and data has linkages to the information management capabilities of the regulatory authorities that manage a fishery. As such, integrated Information Management Systems (IMS) form a core component of effective national fisheries management regimes and, likewise, integration of these systems within and between national, sub-regional and regional organisations is essential for the collaborative management of a fishery. Given the importance of the WCPO tuna fishery to FFA Members, development and implementation of integrated IMS across the broad membership of FFA is a high priority.

A truly integrated IMS framework couples a system designed strictly to manage fisheries data and information with a system of data collected via key MCS functions typically carried in support of fisheries compliance. This integrated approach provides both an operational MCS aspect such as supporting licensing and other MCS functions as well as scientific and management data collection and recording. This capability allows fisheries authorities to access all relevant data needed to make timely and effective fishery management decisions. Equally as important, it facilities the ability for MCS programs to access and analyse MCS data and information needed to identify anomalies or emerging threats, thereby ensuring that enforcement responses, actions and activities are more targeted and risk-based.

E-Reporting Technology and IMS

E-Reporting is already operational in the WCPO as well as other global fisheries. This technology is not only widely recognized for improving the efficiency, quality and timeliness of fisheries data and information, but it also facilitates considerable cost savings for managing authorities. E-Reporting has also become increasingly popular and in demand with both industry and Regional Fisheries Management Organizations such as WCPFC. In fact, in 2013, WCPFC sponsored the development of a report on the *Potential for E-Reporting and E-Monitoring in the Western and Central Pacific Tuna Fisheries* (Knuckey & Dunn, 2013) as well as a follow-on E-Monitoring and E-Reporting Workshop in April 2014 with the goal of advancing efforts towards achieving Commission-wide agreement on E-Reporting and E-Monitoring requirements in the WCPO tuna fishery. One of the primary Strategic Recommendations emanating from this study was:

> *"…To improve quality and timeliness of the data available for science, compliance, and management, to enhance and streamline reporting obligations, and to provide an additional means of effective observer monitoring, this report recommends the Commission, its members, and its partner regional organizations within the WCPO implement both E-Reporting and E-Monitoring programs without delay…"*

However, based upon recent Commission ineffectiveness in advancing important and necessary conservation and management measures, achieving consensus on what these WCPFC E-Reporting and E-Monitoring programs will eventually look like and obligate all CCMs to will undoubtedly take more than a few years to achieve. As such, FFA Members, as like-minded small developing coastal States, should consider as a matter of priority taking control of the issue themselves and implement without delay their own E-Reporting and E-Monitoring programs as a condition to obtaining a license and fishing within FFA Member coastal State waters.

It is particularly relevant that, if FFA Members do establish in-zone E-Reporting and E-Monitoring requirements specifically meeting their own respective needs and requirements, the Commission then, in its own effort to establish similar programs, must recognize Article 8(1) of the WCPF Convention. This Article requires the Commission take into consideration compatibility of conservation and management measures established for the high seas with those adopted for areas under national jurisdiction. Therefore, this compatibility requirement will place strong pressure on DWFNs to agree with adopting Commission E-Reporting and E-Monitoring requirements that are compatible to those first implemented by FFA Members.

If FFA Members commence this process in earnest, one step critical for implementing robust and sustainable E-Reporting requirements is facilitating early on in the process full consensus on specific E-Reporting data standards, specifications and procedures (SSPs) required for the secure collection, storage, transmission and access of data associated with E-Reporting. This is especially critical so as to ensure not only regional consistency, but also compatibility with existing SSPs currently being used by FFA, PNA and SPC in their ongoing work developing and implementing national and regional fisheries IMS. If this step is done correctly, E-Reporting data can very quickly and easily be incorporated as an additional dataset within the fisheries IMS of FFA Members.

Given the work that has already taken place by FFA Members regarding both E-Reporting and national IMS development, strong consideration should be given to build upon these existing efforts and systems when it comes to implementing E-Reporting requirements. Doing so would undoubtedly maximize cost efficiencies, ensure regional compatibility and increase the likelihood of short term implementation.

For instance, the Fishery Information Management System (FIMS) developed by Quick Access Computing (QAC) for Papua New Guinea's (PNG) National Fisheries Authority (NFA) is one of the more advanced fisheries IMS in place supporting an FFA Member's fisheries interests. FIMS manages a wide range of data associated with the WCPO tuna fisheries including: licensing; electronic vessel registration; trip tracking; Vessel Day Scheme (VDS) management and trading; observer management and tracking; FAD tracking; and port sampling. QAC has built three independent databases associated with this IMS; one that is used strictly by the NFA for managing PNG's national fishery (NFA FIMS); a second that is being used by the purse seine industry (iFIMS); and a third that the Parties to the Nauru Agreement are using (PNA FIMS) to assist in managing the implementation of the PNA purse seine VDS (Oates, 2014).

E-Reporting is a component of the web-based iFIMS industry portal, a portal adopted by the fishing industry as a management tool for those purse seine and longline vessels licensed to fish within PNG's waters. Vessel owners also use iFIMS to view their own fleet VMS and FAD tracking data as

well as a reporting mechanism for many PNA members and non-PNA parties for purse seine vessels to report non-fishing days under the PNA-managed VDS. With E-Reporting capability already incorporated in the iFIMS portal and being used by industry, PNA FIMS stands system ready to receive E-Reporting from all vessels via iFIMS, including, if FFA Members so choose, all vessels on the FFA Vessel Register, not just the purse seiners (Oates, 2014). This could facilitate the ability of all FFA Member national fishery management authorities to access and view near real-time catch and effort data from all vessels licensed to fish in their respective waters.

PNG's NFA is also using Android Tablets for Port Sampling purposes with over one million samples taken in 2013 using eForms installed on these devices. These tablets come at a cost of approximately $350 USD each. An Observer Android application for E-Reporting is also in the midst of field testing and is expected to be rolled out for use by PNG and Marshall Islands observers before the end of 2014. The Observer Android application includes all the necessary forms and information required for regional reporting to SPC as well as the additional needs for an electronic Catch Documentation Scheme (CDS) and Marine Stewardship Council (MSC) documentation. After data entry, the information remains on the tablet until in range of a mobile network system, at which time it is downloaded to either a FIMS or national IMS database where the data is then verified and checked prior further uploading into regional databases. Both of these E-Reports are included as modules within PNA FIMS (Oates, 2014). FFA likewise is trialing the use of handheld deLorme devices for use by Observers to provide concise daily reporting of vessel activities as well as the health and well-being of the observer. The near real-time data obtained from observers using these devices has provided beneficial towards the collective enhancement of information management.

All FFA Members currently have access to the PNA FIMS for the purpose of monitoring fishing activity conducted within the framework of the multilateral treaty between Pacific Island Parties and the United States which provides fishing access to the U.S.-flagged purse seine fleet within Pacific Island waters. As E-Reporting is already an integrated component of PNA FIMS, of which all FFA Members already have access, there are no additional costs to the PNA Office, PNA members or non-PNA parties to use PNA FIMS to manage non-U.S. flagged purse seine or longline vessels licensed to fish within their respective national waters.

However, it is also important to note that, parallel to the work of QAC in supporting PNG and PNA parties IMS needs through the development of FIMS, FFA and SPC have also been working collaboratively for over two years to develop and implement web-based modular national fisheries IMS for other FFA Members to support their specific IMS requirements. This work has been conducted through the approved annual work program of the FFA Secretariat at essentially no additional direct cost to those members receiving this support. However, some budgetary funding and human IT technical capacity constraints have limited the overall comprehensive rollout of this national IMS to all members in the short term. Even more importantly, FFA has recently received a huge boost to their IMS development efforts in the form of multi-year funding under a New Zealand Aid program that specifically targets identified shortfalls in the technical, software and hardware requirements associated with FFA-led IMS development (Walton, 2014). This financial support should facilitate timelier implementation of national fisheries IMS across the broad membership of FFA.

Given the advances in E-Reporting and eForms as implemented in iFIMS and PNA FIMS, FFA may wish to give consideration to working collaboratively with PNG, PNA and QAC to possibly incorporate iFIMS and PNA FIMS as a component of the FFA-developed national IMS. Doing so could facilitate the ability for all FFA Members to implement E-Reporting in the short term and thereby provide an opportunity for FFA to field a more robust national IMS for its members.

FFA Members do have options with respect to IMS. A Member may choose not to implement and use either the "cost neutral" national IMS option being developed by FFA or PNA FIMS as their own respective national IMS platform. To meet their own specific national needs or requirements, they may choose to implement a subset of the NFA FIMS; however, this option would come at a cost. QAC charges approximately $37,600 USD as an initial setup cost for the use of NFA FIMS in this manner. These costs cover initial installation and configuration of a "national" FIMS in the QAC-managed Brisbane Data Center, set up of user log-ins, and initial in-country training of national staff on both the FIMS training system and the "live" system. Additionally, there would also be annual recurring costs to the FFA Member for their use of FIMS in this manner such as user access and software license fees, per vessel costs and technical and training service fees (Oates, 2014).

Preliminary Analysis: E-Reporting and IMS

There exists no real barriers to FFA Members on implementing full E-Reporting requirements for all longline and purse seine vessels licensed on the FFA Vessel Register. As such, E-Reporting requirements should be implemented without delay. Some steps to consider in this process include:

- Consider incorporating iFIMS and PNA FIMS as major components of the FFA-developed national IMS;
- Consider mandating mandatory use of iFIMs by all vessel owners with vessels on the FFA Vessel Register as an initial regional licensing requirement to facilitate immediate implementation of E-Reporting;
- Consider further development of, and field training on, the Android Tablet and eForms for Port Sampling in all major FFA Member port States;
- Consider conducting regional roll out of handheld deLorme devices for observer use;
- Agree to specific E-Reporting SSPs to ensure the secure collection, storage, transmission and access of data;
- Incorporate E-Reporting SSPs within the FFA HMTCs and national licensing requirements;
- Initiate an E-Reporting Type Approval process to facilitate the capability of national and regional IMS to receive E-Reporting data from industry via means or devices other than iFIMs.

E-Monitoring Technology

E-Monitoring is still in the early stages of development in the WCPO although other purse seine and longline fisheries around the globe such as those managed by Canada, the U.S., Australia, New Zealand, Netherlands, Scotland, England and Denmark are all using E-Monitoring to effectively and efficiently monitor and review their fleets' fishing activity at sea. The efficacy of E-Monitoring varies between fisheries but the technique has been successfully applied in monitoring a range of issues including fishing location and time, catches of both target and by-catch species, retains and discards, fishing effort, protected species interactions and mitigation measures (Knuckey & Dunn, 2013).

Due to the significant potential of video and sensor systems to improve the quality and quantity of fisheries information supporting both MCS and science objectives, a number of E-Monitoring trials in the WCPO have been completed or are currently underway. In one of the latest initiatives, FFA and SPC are trialling E-Monitoring to determine whether it improves data collection efforts specifically on longliners (Walton, 2014).

There are reasons for the strong incentive of FFA and SPC to focus these trials on longliners. Although WCPFC requirements call for 5% longline observer coverage, various challenges such as limited space on smaller vessels, logistics and costs has resulted this coverage rate being much lower. This has resulted in a lack of comprehensive data specific to WCPO longline target catch, non-

target catch and overall longlining operations. This data is critical not only for improving scientific understanding and assessment of the WCPO longline fishery and strengthening relevant management measures, but also in promoting better compliance and enforcement of national and regional conservation regulations. (Knuckey & Dunn, 2013) Importantly, E-Monitoring technology can be used to effectively integrate with and supplement the goals and objectives of the current Regional Observer Programme to ensure the needed data is provided.

An important consideration regarding E-Monitoring is that its use is not precedent-setting. There are fisheries found globally that have already successfully implemented E-Monitoring technology to meet the regulatory requirements of the respective fishery. While there may be some short-term barriers to implementing E-Monitoring in the WCPO such as agreeing to regional technical specifications and management objectives, politics, legal frameworks, and human capacity, none of these limitations represent an insurmountable obstacle to the implementation of E-Monitoring (Knuckey & Dunn, 2013).

However, it is important to recognize that implementation of E-Monitoring in the WCPO is at a different stage than E-Reporting. The steps involved with implementing E-Monitoring as a requirement are complex, and how soon it can be implemented will depend on how quickly FFA Members can, in part, not only commence a comprehensive planning and implementation process, but also integrate E-Monitoring into the existing framework of the Pacific Islands Regional Fishery Observer (PIRFO) program managed by SPC and FFA.

Understanding the impact of E-Monitoring on the current PIRFO program is an important consideration. To be effective, E-Monitoring must first be able to generate information sufficient enough to fulfil the minimum data requirements of the WCPFC Regional Observer Program which is currently collected by human observers certified under the PIRFO framework. If this is able to be done, the kind of information collected from an E-Monitoring program and its subsequent analysis would undoubtedly lead to a marked increase in the efficiency and effectiveness of both the management and compliance aspects of the WCPO fishery.

While there may be initial concerns that E-monitoring may come at a cost to employment opportunities for Pacific Islanders, it appears this may be unfounded. E-Monitoring should create additional and better quality employment for those currently engaged in the PIRFO observer program through opportunities tied to the information analysis aspect of E-Monitoring. Lastly, given the concerns that many Pacific Island National Observer Program managers have with the ongoing health, safety and treatment of some of their national observers while onboard vessels of foreign fishing fleets, the change in employment opportunities may resolve some of these issues.

An additional complexity with E-Monitoring is the simple fact that many fishing vessels are licensed to fish within multiple FFA Member waters as well as the high seas and a single trip may cover fishing activity conducted under more than one jurisdiction. Clear processes, procedures and protocols would need to be developed with respect to who actually conducts data analysis for specific trips that cover multiple jurisdictions and how this data is shared, analysed and disseminated nationally between FFA Members as well as regionally with SPC and WCPFC.

A fully integrated region-wide E-Monitoring program is capable of effectively addressing the highest IUU risk posed by licensed longline vessels; inadequate reporting. If this requirement was implemented on all longliners included on the FFA Vessel Register, the program would encompass approximately 870 vessels. The FFA Vessel Registration process could be amended to include the requirement that approved E-Monitoring equipment be installed and operational onboard a longliner as a requisite for listing on the FFA Vessel Register; a process very similar to current FFA requirements related to VMS equipment.

A fully integrated E-Monitoring approach would also need to take into account more than an at-sea E-Monitoring system consisting of sensors, cameras, and a computer system and satellite communications. It would also likely include the development of land-based information monitoring capability, data analysis software and program for technician training and certification integrated within the existing PIRFO framework.

An estimated hardware cost of E-Monitoring equipment for a vessel is approximately $10,000-$15,000 USD per vessel. This, however, does not include recurring satellite airtime costs needed to monitor in near real-time the functionality of the installed equipment onboard a vessel during a trip. A typical system is usually comprised of one or more video cameras and a central computer system linked to a satellite modem or Fleet Broadband. This set-up enables potential shore-based monitoring of both vessel location and gear activity and, as management objectives might dictate, the capability for near real-time video streaming.

To manage costs from both an industry and fishery authority perspective, management objectives should allow for complete review of video upon completion of a trip when the hard drive can be removed for analysis. However, with weeks or months of records to interpret, the task of reviewing the data does present a challenge. This can be overcome through the use of data analysis and reporting software that can assist technicians in analysing the information. This software integrates all GPS, sensor and video data and synchronizes these records along a single timeline for easy reference, thereby greatly reducing the time required to process and review fishing activity records. Software licensing fees associated with these products can run anywhere between $5,000-$10,000 USD per license per year.

Using a baseline of approximately 870 longline vessels, the complete initial cost of outfitting these vessels with E-Monitoring equipment would cost anywhere between $9 and 13 million USD. Clearly, due to the costs associated in implementing such a program, close engagement with industry should occur to maximize opportunities for cost recovery in sustaining the long term viable of E-Monitoring.

Preliminary Analysis: E-Monitoring Technology

There exists no insurmountable barrier to FFA Members with implementing E-Monitoring for all longliners on the FFA Vessel Register. However, the E-Monitoring implementation process is much more involved than E-Reporting and even if efforts began in the short term, it would likely take a full three to five years to implement. Some steps to consider in this process may include:

- Compile comprehensive lessons learned from recent E-Monitoring trials and include these for consideration in program planning processes;
- Advance development of E-Monitoring SSPs;
- Engage in industry stakeholder discussions, especially with respect to cost-recovery;
- Define monitoring objectives addressing end of trip or real-time data transmission protocols;
- Outline specific roles and responsibilities of national and regional agencies;
- Ensure national regulatory frameworks meet all legal obligations and requirements;
- Incorporate E-Monitoring SSPs within the FFA HMTCs and all national licensing requirements; and
- Integrate E-Monitoring into the existing framework of the Pacific Islands Regional Fishery Observer (PIRFO) program.

Vessel Gaps in E-Reporting and E-Monitoring

One important factor should be recognized, understood and addressed, if at all possible, should FFA Members implement E-Reporting and E-Monitoring requirements for vessels listed on the FFA Vessel Register. That is, a gap will still remain in overall vessel E-Reporting and E-Monitoring carriage requirements until such a time these requirements are implemented regionally on a Commission level. There may be as many as 1,400 foreign flagged fishing vessels that are authorized to fish and operating on the high seas in the WCPO region during any given year that FFA-specific E-Reporting and E-Monitoring requirements will not initially apply to until this becomes a Commission obligation, which could still be years away. As such, FFA Members should consider whether their own respective legal and regulatory frameworks currently facilitate requirements for port inspector access to real time operational catch and effort logsheets and reports as a condition of port entry should any of these non-licensed high seas vessels wish to enter and use FFA Member ports. The ability for port inspectors to have access to this near-real time catch and effort data for any unlicensed fishing vessels that pull into their port would help validate the origin of catch onboard as legally caught, delineate where the fish was caught - in coastal State waters or in the high seas, and provide details on any portion of catch subjected to transshipping activities.

E-Tablet Technology

Very similar to the Android Tablets and eForms developed by QAC to support both Port Sampling and Observer Reporting and the deLorme program being implemented by FFA for observers, an E-Tablet Job Aid designed for Fisheries Officers conducting at-sea compliance boardings and inspections would enhance the overall effectiveness of this important compliance task. The ability for field officers to have comprehensive real-time access to all the regulatory rules, regulations and requirements of the fishery at their fingertips allows them to more easily detect and document instances of non-compliance. In addition, these E-Tablet could be designed to provide a flow chart that clearly outlines established fisheries compliance boarding processes and standard, consistent questions to be asked by Fisheries Officers during compliance boardings and inspections. By also including the ability to capture the inspection with digital photos and on a standardized electronic boarding report, E-Tablet usage could ensure consistent job performance via effective, thorough and standardized compliance inspections.

E-Tablets, if regionally-implemented by FFA Members, would also greatly facilitate the operational implementation of the new multilateral Niue Treaty Subsidiary Agreement (NTSA). The NTSA establishes a framework for cooperative fisheries surveillance and enforcement via the sharing of enforcement assets and cross-vesting of powers of Fisheries Officers to conduct enforcement actions in one another's waters. E-Tablets can provide Fisheries Officers of one FFA Member fingertip access to the specific licensing conditions, rules and regulations of another FFA Member to assist them when conducting enforcement activities on behalf of that FFA Member under the umbrella of the NTSA. Likewise, E-Tablets would also enhance the ability for Fisheries Officers to quickly reference the complex and multiple array of WCPFC conservation and management measures established by the Commission so as to complete a more thorough and effective high seas fisheries compliance boarding conducted under the WCPFC High Seas Boarding and Inspection Scheme.

Panasonic and other companies have developed a wide array of rugged E-Tablets that are currently being used in the field worldwide by many law enforcement and other government agencies. These E-Tablets incorporate technology that could enhance the efficiency of at-sea compliance inspections such as GPS capability, digital camera, USB connection, and wireless printing. While more expensive than Android devices, the ruggedness of the E-Tablet to work effectively in a maritime environment

is a demonstrated critical need. The current cost of a typical rugged E-Tablet is approximately $3,500 USD. Developing the software and outfitting each of the 22 Pacific Patrol Boats being used to support the maritime enforcement agencies of 12 of the FFA Members with two of these E-Tablets each plus the additional hardware and accessories to support them would cost less than $200,000 USD.

Importantly, software used to support these E-Tablets should be developed with compatible data standards as national fisheries IMS to allow for easy linkages to IMS. This compatibility enhances opportunities for more targeted compliance inspections by providing Fisheries Officers the ability to download vessel-specific MCS information into an E-Tablet prior to conducting targeted inspections. This increases the ability of compliance officers to more easily cross-check and operational catch and effort data and other licensing requirements during the conduct of the inspection. A compliance inspection eForm (boarding report) would then provide the ability for a Fisheries Officer to accurately document each at-sea compliance inspection and then provide the follow-on capability to seamlessly transfer and integrate the captured data into the national fisheries IMS for near real-time use and analysis by the regulatory agency.

The approximate cost of implementing this technology across the region is comparatively low when evaluated against other emerging technology. An initial investment of approximately $30,000 could be used to confirm the viability of Fisheries Officers using rugged E-Tablets in the field. A Pilot Project could be initiated that could encompass:

- Writing of software and development of eForms for compliance inspections;
- Purchase of 4-5 rugged E-Tablets;
- Installation of software and eForms on E-Tablets and beta testing both data capture and transfer to ensure data integration with and between national and regional fisheries IMS;
- Providing E-Tablets to the maritime enforcement agencies involved in the Pilot Project and conducting classroom and field training on its use and capabilities;
- Field testing E-Tablets and evaluating results for improvements; and
- Consideration of expanding the initiative across broad membership of FFA.

Preliminary Analysis: E-Tablet Technology

Providing a means by which E-Tablets and eForms can be quickly integrated for use by Fisheries Officers in the field would assist them in more efficiently and effectively conducting their compliance inspections. This provides a tremendous return on investment by increasing both the professionalism and competence of FFA Member Fisheries Officers as well as their ability to more easily detect and document instances of non-compliance. Android devices and eForms have already been developed and are currently in use for Port Sampling and Observer Reporting purposes. Similar technology can, and should, be easily developed for Fisheries Officers who also operate “at the tip of the spear” of the MCS regime.

FFA may wish to consider conducting a Pilot Project to confirm the usefulness and viability of E-Tablet and eForm usage by Fisheries Officers in the field. Paper Job Aids have already been developed for use by at least one FFA Member to assist their Fisheries Officers in conducting compliance boardings and inspections. Likewise, a paper Job Aid for conducting high seas boardings of fishing vessels under the WCPFC High Seas Boarding and Inspection Scheme has also been developed. These existing Job Aids stand ready to be used as templates for developing the software and eForms that would be installed on rugged E-Tablets and subsequently used by Fisheries Officers.

Improved Data Fusion and Analysis Capability

An identified emerging MCS deficiency in the WCPO region is the relative lack of human capacity, on both a national and regional level, with fusing available MCS data obtained from multiple sources, analysing the results and presenting this information in a manner that national and regional compliance programs can make better and more informed decisions. No single sensor, platform or technology can provide the level of monitoring and surveillance needed to compel high levels of compliance and deter illegal fishing from taking place across the WCPO region. An effective MCS strategy incorporates multiple technologies which not only requires data integration and fusion, but the human capacity for analysing the data to identify anomalies, risks and emerging threats. While FFA Members have already made incredible strides in their MCS framework via regional solidarity that includes the sharing of data and information, considerable improvements in MCS effectiveness can be achieved, at little expense, by optimizing existing assets, especially by increasing human analytical capabilities on both the national and regional level.

Given the immense region of the WCPO, there is a need to optimize the risk-based deployment of surveillance and enforcement response assets. This need can be supported either partially, or in full, through the enhancement of the FFA RFSC, a fisheries-focused surveillance centre that is already in place and operational in supporting MCS efforts of FFA Members at all levels (national, subregional and regional). FFA is already a repository of FFA Member fisheries and MCS information where, under the framework of the FFA Information Security Management System policy, the processes, procedures and protocols for the secure receipt, handling, management, processing and dissemination of this data is tightly governed. The FFA RFSC has authorized access to this information to support its role as an MCS entity working on behalf of FFA Members. As such, the framework of the RFSC provides an opportunity, via an already established and running surveillance centre, to build upon this envisaged analytic capability. Priority should be given to strengthening the analytical capability of the RFSC by effectively enhancing the technical and human components of the RFSC.

Preliminary Analysis: Improved Data Fusion and Analysis Capability

FFA may wish to consider initiating a technical level scoping study of the RFSC formally undertaken by a suitably selected team of third-party technical, MCS and human staffing experts. The scoping study should capture the information relevant to a more detailed design of the RFSC and its role as a fisheries surveillance centre supporting both national and regional MCS efforts. The scoping study should include an assessment of existing RFSC datasets, systems and processes and their inter-relationships so as to support consideration of possible future hardware, software and staffing requirements or improvements to the RFSC. At a minimum, the study should focus on the FFA RFSC and its role and relationship with national fisheries MCS headquarters and the WCPFC Secretariat. The scoping study output would be an assessment report used to refine the parameters and approaches used by the RFSC to support the MCS effort in the region. The important aspect of this study is to provide sound recommendations on adequate core expert and technical staffing requirements of the RFSC needed to enhance the MCS support role it provides members, especially with increasing its capability and capacity for conducting data fusion and analysis that could then be used to greater effect by FFA Member national fisheries authorities.

Remote Sensing

The collective EEZs of the Pacific Island coastal States are an immense area, with remote locations and limited enforcement response capabilities. This presents a much greater challenge to effective MCS than other smaller coastal areas. Most of the EEZs are difficult to monitor effectively with traditional tools such as manned surface or aerial assets. However, effective surveillance is critical to enforcement efforts so as to ensure vessels observe high levels of compliance with both national and regional management measures. While some advanced technologies can be used to great effect for surveillance purposes, they do not negate the need for an active law enforcement presence in the region to ensure these high levels of compliance; nevertheless, they do represent a necessary component of an overall MCS scheme. Many current surveillance technologies have been designed and implemented for managing activities of regulated or licensed vessels such as VMS. However, the bigger task is incorporating a range of sensors and platforms into the suite of MCS tools that can be applied to the more challenging task of detecting non-reporting or unlicensed vessels.

Vessel Monitoring Systems (VMS)

As previously indicated, fishing VMS is a cost-effective fisheries monitoring tool as it provides fishery management agencies and Fisheries Compliance Officers with accurate and timely information about the location and activity of a regulated fishing vessel. FFA VMS allows FFA Members to track and monitor approximately 1,350 foreign-flagged fishing vessels licensed to fish in Members' waters and view them wherever they go during the validity of the licence. Vessel operators pay for the cost and installation of the VMS units fitted on the fishing vessels and FFA pays for the satellite air-time costs of monitoring the vessels.

The WCPFC Convention requires fishing vessels that fish for highly migratory stocks on the high seas of the Convention Area to use VMS monitored by the WCPFC Secretariat. Operation and maintenance of the WCPFC VMS is paid for by all Members of the Commission. Over the last several years, approximately $400,000 has been budgeted by the WPCFC Secretariat for operating the WCPFC VMS.

WCPFC VMS first and foremost covers all of the high seas waters of the Convention Area. However, a recent Commission decision provided the ability for coastal State Members to request and receive WCPFC VMS data for their respective national waters when fishing vessels, including unlicensed vessels, transited into their waters from the high seas. In addition, WCPFC VMS data (vessels directly reporting to WCPFC) is made available to coastal State Members for the 100 nautical mile high seas buffer adjacent to maritime boundary lines. Also, Members may request and receive high seas WCPFC VMS data for high seas MCS activities where the Member demonstrated they have an MCS presence or capability on the high seas.

Preliminary Analysis: Vessel Monitoring Systems (VMS)

FFA has currently Type-Approved two types of E-MTUs (electronic) for vessel operators. With new emerging technology developments facilitating more efficient and cost effective means of electronic data transfer from vessels, FFA may wish to consider expanding E-MTU Type Approvals and E-MTU requirements to facilitate greater capability to obtain near-real time operational catch and effort data from vessel operators and owners.

In addition, not all FFA Members have requested the provision of WCPFC VMS data for their respective national waters when fishing vessels enter their waters from the high seas. All FFA

Members should consider taking advantage of the opportunity to request and receive this data and thereby eliminate an important VMS "data gap".

Automated Identification System (AIS)

IMO has required AIS transponders to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages, and passenger ships irrespective of size. However, more and more countries are mandating AIS usage for smaller sized vessels, including fishing vessels of which a large component make up the various DWFN fleets operating in the WCPO region.

Satellite AIS (S-AIS) greatly extends the range of traditional coastal AIS and as a result, authorities are able to capture a much more complete picture of maritime activity in interested areas allowing them to more readily identify potential threats and provide for more cost-effective asset usage. With S-AIS, maritime authorities can validate a ship's reported position, especially when coupled with VMS or other sensors. In this manner, authorities can identify potential "dark targets" (Ball, 2013).

Since 2012, FFA, through the RFSC, has incorporated the use of this dataset to complement their current MCS toolset and, along with FFA and WCPFC VMS are currently using these datasets as the primary components of the FFA-managed Regional Surveillance Picture. S-AIS is provided to FFA under contract by a commercial company which charges FFA an annual service fee for the data. This cost of receiving this data is currently not subject to cost-recovery mechanisms by industry like FFA VMS is.

Preliminary Analysis: Automated Identification System (AIS)

FFA should continue to incorporate S-AIS data into the Regional Surveillance Picture as an additional dataset to FFA and WCPFC VMS in order expand the usage of the Regional Surveillance Picture as the primary MCS common operating picture in the region for FFA Members.

FFA may wish to consider mandating AIS as a carriage requirement and condition of registration on the FFA Vessel Register. This is not meant to take the place of VMS, but provide an additional monitoring tool that would facilitate the capability for FFA to continue to monitor a vessel's activities if a VMS unit malfunctions and/or ceases reporting. The vessel could then be closely monitored to ensure it continues to comply with appropriate national or regional management measures until it returns to port to repair the malfunctioning VMS unit as required by FFA licensing conditions.

In the absence of FFA-mandated AIS carriage requirements and to assist in cost recovery for receiving AIS data, FFA may also wish to consider charging those vessels on the FFA Vessel Register an additional fee if the vessel does not have AIS installed onboard.

Long Range Identification and Tracking (LRIT)

LRIT is a designated IMO system designed to collect and disseminate vessel position information received from IMO member State ships that are subject to SOLAS in an effort to improve maritime safety and increase security. Vessels required to report with LRIT largely overlap with those required to carry AIS, that is primarily vessels that are 300 gross tons or greater on international voyages. However, despite this overlap and the fact that both AIS and LRIT are governed by the SOLAS convention, there is no interface between the two sensors and they function totally independent of each other. This results in considerable redundancy and duplication of data.

LRIT works essentially the same as VMS by using GPS to determine its position and then that position information is transmitted to a data centre via a vessel's on-board Global Maritime Distress and Safety System (GMDSS) radio. In addition to position, vessels are identified by their respective IMO and maritime mobile service identity (MMSI) numbers. Per the LRIT international guidelines, the default ship reporting rate is every six hours. However, functionality is built in to allow authorized end users such as the vessel's flag State or coastal State authorities to request a onetime poll that gives an on-demand current position. The reporting rate can also be increased remotely without the vessel's knowledge to every three hours, one hour, 30 minutes, or 15 minutes for a specified period of time (U.S Coast Guard, 2014).

The huge difference between LRIT and AIS data is that LRIT data is very tightly controlled, transmitted to and processed by a limited number of national, regional or international data centres. Only specific parties are entitled to access LRIT vessel position information, a flag State may track vessels flying its flag, coastal States may track any LRIT-equipped vessel operating within 1,000 nautical miles of its coast, and port States may track vessels that declare their intent to enter their port.

For FFA to obtain LRIT data as an additional dataset of the RSP to complement monitoring of VMS and AIS by the RFSC, there are other factors to consider besides just the cost of receiving the data from an authorized data centre. FFA would need to work closely with specific FFA Members to have their respective governmental authorities, as either a flag State, coastal State or port State, authorize FFA to receive this data on their behalf. Given the geography of the region, both Federated States of Micronesia, Fiji and the Cook Islands represent the most likely candidates for this engagement. However, given the overlap that LRIT data has with AIS, which is already being used by FFA to supplement its MCS monitoring capability, the time, effort and costs associated with obtaining this data may not be worth the investment.

LRIT carriage generally excludes fishing vessels, the primary MCS monitoring target in the region. Should IMO extend LRIT carriage requirements to smaller fishing vessels, dedicating the work and costs for obtaining the data to complement the RSP may prove worthwhile.

Preliminary Analysis: Long Range Information and Tracking (LRIT)

FFA may wish to not actively pursue the effort and cost required to supplement its Regional Surveillance Picture with LRIT data unless IMO carriage requirements are extended to smaller fishing vessels. However, it may be worthwhile to investigate and engage the broad membership of FFA as to which Members currently receive LRIT data in their own respective national data centres as an authorized flag State, coastal State or port State and whether these members would be willing to authorize FFA, through the RFSC, to receive this information on their behalf as an authorized entity.

Integrated Sensor Systems

Through its efforts in integrating VMS and AIS into the RSP, FFA has recognized that, despite the increased complexity, individual technologies are more powerful when combined and integrated than when they are used as stand-alone systems. Commercial companies have also recognized this and have developed systems with integrated datasets designed specifically for maritime surveillance.

As an example, S&T Airborne Systems has developed the MSS-6000 (Maritime Surveillance System), a comprehensive system consisting of several sensor datasets designed for the explicit surveillance of maritime traffic and pollution. The core of this management system is that it links all the data from the sensors and instruments to present an overview to the client (such as a national MCS

agency or the FFA RFSC) for analysis and interpretation which may facilitate an enforcement response. The data can be provided in near real-time or recorded for later analysis. The system is based on GIS technology with data overlaid onto digital nautical charts.

This system is being used in Canada for surveillance of the arctic and Great Lakes primarily for detecting maritime pollution. This system consists of a SLAR (Side-Looking Airborne Radar); an IR/UV (Infrared/Ultraviolet) scanner; an airborne AIS for receiving ship identity information; an electro-optical infrared camera system, a satellite communications system, a high-resolution digital photography camera and a video system for visual documentation for evidence purposes. Data from these systems is processed, integrated and presented to a monitoring centre in one integrated view. All recordings are annotated with GPS data and digitally stored in an onboard geographical database. Data and digital images are integrated with an electronic nautical chart database, and also correlated with a mission report to ensure maximum efficiency during surveillance missions (S&T Airborne Systems, 2014).

While this type of integrated sensor system would greatly benefit current MCS efforts of FFA Members, it is costly as it requires the use of a dedicated aircraft to support the MSS-6000 equipment. In fact, Canada is investing $5 million USD alone to modernize a government Dash-7 surveillance aircraft to equip it with this maritime surveillance system (S&T Airborne Systems, 2014).

A web-based managed service for delivering an integrated sensor system that monitors the marine environment in the WCPO is another option for FFA Members. For instance, MDA Bluehawk, a Canadian commercial company provides this as a subscription-based service; meaning there is no requirement for FFA Members to be involved in IT investment, maintenance or the tremendous capital costs associated with maintaining and operating an aircraft equipped with a surveillance system such as MSS-6000. MDA Bluehawk integrates three sets of data; 1) Satellite and terrestrial AIS data, 2) satellite RADAR from the use of wide swath Synthetic Aperture Radar (SAR), and 3) comprehensive vessel registry information through IHS Fairplay. It provides a platform for identification of uncorrelated/unknown vessels where SAR enables increased monitoring of large, remote areas such as that found in the WCPO. The SAR-based ship detections are correlated with AIS or VMS and the near real-time data capability allows for analysis to cue expensive and scarce enforcement assets for more effective and cost-efficient responses (Hurley, 2014).

A potential drawback to this system is the availability of SAR data which is obtained from polar orbiting satellites. These satellites do not provide the ability for continuous surveillance as they are not geostationary satellites. In addition, as the satellites are polar orbiting, passes nearer the equator are fewer per day than nearer the earth's poles. The relatively long revisit times and possible patchy coverage of SAR images on any given day in the WCPO may mean that IUU activity may still go undetected between periods of coverage. However, the addition of SAR data as a dataset of the FFA RSP could still complement the current use of VMS and AIS and provide FFA Members greater opportunities to uncover "dark" targets.

MDA Bluehawk does provide its clients a subscription option of only obtaining a SAR data feed rather than their entire web-based managed service which may save FFA Members on overall costs of implementing this service as FFA already receives AIS data into its RSP under another separate contract. However, by doing so, this does take away the analytic capability that the MDA Bluehawk product provides its clients of finding non-reporting targets, highlighting possible suspicious self-reporting, fusing the known and unknown data, and adding route prediction, geo-fencing and alerts related to the non-reported targets uncovered and leaves these tasks to be accomplished by the client themselves.

A subscription service of the full BlueHawk data feed which would provide optimized coverage of the EEZs of the 15 Pacific Island Countries (approximately 77% of all EEZ area covered within a seven day timeframe) has an estimated annual cost of $1.5-3 million USD. A data feed of just the SAR data as an additional dataset inserted into the FFA RSP as a subscription service would run approximately $1-2 million USD per year (Hurley, 2014).

In addition to commercial entities providing FFA Members value-added MCS data of an integrated sensor systems at a cost, there are nongovernmental and nonprofit organizations that may also willing to provide this same service at similar or even lower cost. For instance, SkyTruth is a nonprofit organization that uses satellite images, digital mapping and data analysis to investigate and illuminate global environmental issues. In 2013, and in partnership with the Global Ocean Legacy and Stop Illegal Fishing campaigns of the Pew Charitable Trusts, they initiated a 12-month program to monitor 700,000 square kilometers of Chile's territorial waters surrounding Easter Island via by also integrating AIS and SAR data to monitor the behavior of reporting vessels and uncover non-reporting targets. In the first nine months of monitoring, more than 40 unidentified vessels were detected operating in the vicinity of Easter Island that were likely non-Chilean commercial fishing vessels (Skytruth, 2014). Even more recently, in May 2014 the UK-based Satellite Applications Catapult organization announced a partnership with Pew Charitable Trusts to capture and analyse satellite imagery to detect, track and prosecute illegal fishers (Satellite Applications, 2014). The partnership is designed to give people charged with fisheries MCS access to emerging technologies such as satellite-derived data to combat illegal fishing. The service and support provided by these organizations may possibly be coordinated to assist in the monitoring of the EEZs of one or even more FFA Members.

Preliminary Analysis: Integrated Sensor Systems

It would likely be cost-prohibitive, both nationally for one FFA Member and even regionally for all FFA Members via collective agreement, to seek to implement and maintain manned aerial assets with integrated sensor system MCS capabilities such as the MSS-6000 due to the capital costs of purchasing, operating and maintaining the assets capable of delivering this service.

Consideration should be given to pursue the integrated sensor capability of AIS and SAR data either via a web-based subscription-service, a direct feed of SAR data into the FFA RSP, however costs for this service and additional dataset could still be considered pricey. FFA may wish to make initial queries to determine whether a collaborative agreement could be made with an interested nongovernmental or non-profit organization such as Pew Charitable Trusts, Satellite Applications Catapult or SkyTruth who are willing to work closely with FFA and its FFA Members to deliver this capability at possibly lower cost or other manner than if just implemented unilaterally by FFA via commercial means.

Unmanned Aerial Vehicle/Systems and Autonomous Surface Vehicle (UAV/S and ASV)

Unmanned aerial vehicles or systems and remotely-controlled or autonomous aircraft and surface platforms provide observation or imagery capabilities similar to manned aircraft and vessels. Larger UAV/UAS may have the capability of using a combination of sensors including search radar, SAR, optical/infrared imaging sensors and even AIS which is then combined with positioning information from GPS to provide near real-time detection observation of vessels to a management authority or operations centre. Some ASV can add acoustic detection capabilities as an MCS tool and be deployed in the maritime environment for months at a time. These capabilities enhance remote

sensing and offers a greater capability to detect and deter unlicensed vessels from conducting illegal fishing in FFA Member waters.

It is important to note that UAS/ASV are no longer experimental prototypes and they are actively being used in a variety of roles around the globe such as supporting military operations, monitoring meteorology or meteorological conditions and even monitoring of sensitive marine environments such as Marine Protected Areas.

Despite the capability offered by UAS and ASVs, they have yet to be deployed beyond pilot project stage for widespread use solely directed at monitoring and surveillance of coastal State EEZs to detect and document possible IUU fishing. This was historically due, in part, to the affordability and cost-effectiveness of operating and maintaining UAS and ASVs due to the immense and remote nature of the WCPO. For effective MCS use in monitoring EEZs, endurance is an important consideration so as to allow for greater on station time along the portion of a coastal State's waters that pose the highest risk of illegal fishing by unlicensed vessels, the first 25-30 miles of water within the outermost EEZ boundary line. Effective aerial or surface monitoring of these areas has rarely ever been achieved with manned aircraft or vessels due to limited endurance, payload and staging requirements. An ASV might be able to provide this capability due to its ability to remain within the marine environment for long periods of time. However, given the immense areas of maritime boundary lines of FFA Members which require constant surveillance, multiple and even numerous ASV might need to be deployed to provide acceptable levels of coverage.

There are commercial companies that currently provide clients a UAS option that meets the remote sensing needs and requirements related to detection and documentation of illegal fishing which may prove to not be so cost prohibitive. One specific UAS was recently trialled to monitor and conduct surveillance of the Palau EEZ in 2013. The platform used in this pilot project was capable of more than 20 hours flight endurance, day/night optical and infrared imagery capability extending over 100 kilometres, and autonomous operation. The operating cost for this platform to provide 1,000 hours of flying time per year is approximately $900 per operating hour (approximately $900,000 per year) although this cost may be further reduced through the use of Pacific Islander personnel on a permanent operational basis (Gonella, 2014). The flight cost of this type of UAV is approximately $1/10^{th}$ of the operating costs of a typical military Maritime Patrol Aircraft (MPA) which flies a typical 10 hour mission profile costing over $100,000 USD total. A unit cost for a single UAS platform currently runs up to $250,000 per airframe, the total cost of purchasing and operating a single UAV to support MCS efforts in the WCPO over the course of a year should still not be considered cheap.

ASV, such as the Wave Glider SV2 developed by Liquid Robotics, can carry preconfigured suites of sensors and enough power to support a broad array of cross-compatible sensor payloads, WiFi and cellular communication options as well as onboard processing power. This technology represents the first unmanned autonomous marine robot to use only the ocean's wave energy for propulsion, allowing it to more cost-effectively collect and transmit data gathered during missions lasting up to a year, over distances of thousands of miles, or while holding station (Liquid Robotics, 2014). Specific sensor/software suites can be designed to acoustically detect, track and develop contact reports on vessels that are then transmitted to a command and control centre such as the RFSC or other ship or aircraft platforms. The contact reports contain spatial information that allows for data fusion with other sensor sources to achieve a better common operating picture (Liquid Robotics, 2014). As such, ASVs such as the Wave Glider can complement and improve the efficiency of patrol vessels, surveillance aircraft and satellite data used for MCS purposes. While persistent maritime presence and queuing of targets direct to national MCS headquarters or the FFA RFSC is extremely useful, the number of platforms needed to provide for this persistent presence in the entire WCPO region at one time may be cost prohibitive.

A more cost-effective scenario may be the risk-based and targeted deployment of UAS and ASV as regional capabilities to support the broad membership of FFA where high risks to illegal fishing have been clearly identified, especially to support more efficient and effective use of the Pacific Patrol Boat fleet. These UAS and ASV could be managed by FFA and deployed where needed as a regional MCS assets to enhance the capabilities of existing national MCS programs or in direct support of regional surveillance operations. This could be seen as an extension of the MCS capability of the FFA RFSC in conjunction with the national and regional MCS support it provides to FFA Members.

Preliminary Analysis: UAV/S and ASV

While UAV/UAS and ASVs provide FFA Members an additional option for addressing their remote sensing needs, a UAV/UAS requires either considerable IT, technical, training and capital investment or, in the case of an ASV, a large number of platforms, to be implemented wholesale as effective MCS tools. As indicated previously, the highest risk of IUU fishing in the region relates directly to inadequate reporting, primarily from vessels already licensed to fish in the region. UAV/UAS/ASV, used in conjunction with other sensors such as VMS, AIS and SAR, represent excellent tools that could be used to identify the presence of a non-reporting unlicensed vessels in the region and elicit targeted law enforcement responses if used in tandem with patrolling PPBs. However, the ability to use these platforms beyond a queuing capacity to clearly and unilaterally document illegal activity may be akin to "catching lightning in a bottle" as the number of opportunities a UAV/UAS/ASV might have to clearly document an instance of illegal fishing may not justify the financial and human capacity costs it would take to operate or deploy these systems beyond that of a risk-based and targeted queuing tool.

The use of UAV/UAS and ASVs for fisheries surveillance and MCS is still cutting edge and relatively expensive. The integration of these platforms in the immense maritime environment of the WCPO as effective MCS "force multipliers" directed at the detection and documentation of illegal fishing may require further collaborative "proof of concept" trials between FFA, interested FFA Members, QUAD partners and the commercial entities that market these platforms.

In the near term, FFA Members may wish to consider implementing remote sensing technology that requires lower IT, human capacity or capital investment to implement. Integrated sensor systems such as those provided through MDA Bluehawk, Satellite Applications Catapult or SkyTruth via either a web-based subscription service or the support of like-minded third parties interested in eliminating illegal fishing may provide a more cost-effective queuing tool option for FFA Members for detecting non-reporting vessels operating in the region.

Estimating Emerging Technology Costs

This study represents just the first step of work to create a systematic approach towards estimating the strengths, weaknesses and financial costs of a range of emerging and evolving technologies which, if implemented, could assist in addressing the challenges of fisheries MCS in the WCPO region.

A CBA is a technique typically used to determine options that provide the best approach if a particular programme, tool or technique is considered to be a sound investment or decision in terms of benefits in labour, time and cost savings. Typically, a CBA will outline benefits and costs expressed strictly in monetary terms. However, it should be recognized that a perfect appraisal of all present and future costs and benefits involved with some of the evolving and emerging technologies outlined within this study has been difficult to achieve within the scope of this initial study.

Hence, this study is directed at providing more of a broad overview analysis of both the current known values and characteristics of existing MCS tools being used in the region and available evolving and emerging MCS technologies. Every detailed cost element required for implementing some of the evolving or emerging technologies has been difficult to determine and undoubtedly requires further detail at a later point within a larger, more comprehensive study that explores more deeply those technologies deemed best suited to enhance MCS efforts in relation to the overall existing MCS infrastructure in the WCPO.

The following table attempts to capture approximate costs of implementing relevant emerging technologies into the current suite of MCS tools and frameworks being used by FFA Members to combat illegal fishing in the WCPO.

Table 1: Current MCS Tools and Emerging Technology Costs

	E-Reporting	E-Monitoring	E-Tablet	UAS	Integrated Sensor System	ASV	Data Analysis - Optimizing RFSC
Existing Method or Capability	Paper-based forms used by industry	Paper-based forms used by PIRFO program observers	Paper-based forms used by Fisheries Officers	QUAD assets PPBs	FFA Regional Surveillance Picture of VMS and AIS data	QUAD assets PPBs	No dedicated RFSC staff conducting full time data analysis
Strengths of existing method or capability	Costs borne primarily from industry	Unbiased data collection 100% coverage on purse seiners Job opportunities for Pacific Islanders	Minimal costs	QUAD surface and air patrols provided at no cost Shipriders and NTSA framework are force multipliers Australia follow on program to PPB	Fusion of VMS and AIS data in one common picture provides increased maritime domain awareness	QUAD surface and air patrols provided at no cost Shipriders and NTSA framework are force multipliers Australia follow on program to PPB	RFSC conducts some manual analysis to develop visual vessel compliance index within the Regional Surveillance Picture
Weaknesses of existing method or capability	Untimely submission Incomplete data Manual integration of data into IMS	Incomplete data Low coverage on longliners Inaccurate data Manual integration of data into IMS Potential for bribery or influence Observer attrition rate Training costs dependent on donor funding support	Inconsistent and incomplete inspections No standardized protocols or processes Manual integration of data into IMS	QUAD coverage based upon asset availability QUAD coverage impacted by other mission priorities Limited PPB patrol endurance and range	Vessels with VMS or AIS malfunctioning or turned off may go undetected Current datasets provide incomplete maritime domain awareness	QUAD coverage based upon asset availability QUAD coverage impacted by other mission priorities Limited PPB patrol endurance and range	No dedicated full time analytic capability within the RFSC to assist national and regional MCS efforts
Costs of existing method or capability	Minimal costs for submission Staff costs associated with manually entering data (>$300,000 per annum - 15 x 2 @ $10,000 salary)	Most operational and management costs recovered thru industry (UST and FSMA) Manually entered data	Minimal costs for paper boarding reports	Surface and air patrols provided at no cost	VMS costs recovered from industry AIS costs (~$100,000 per annum)	Surface and air patrols provided at no cost	No additional staff costs for conducting existing efforts of data analysis No staff costs dedicated to full time data analysis

		staff costs – (>$500,000 per annum - includes SPC) Observer and debriefer training costs (~$750,000 per annum)					
New technology capital and initial costs	E-MTUs for longliners (~$2.2 million for 870 @ ~$2,500) Initial use of iFIMS at no cost Enhancement of FFA Vessel Register to EVR (Electronic Vessel Register) (~$30,000)	Vessel hardware equipment costs (~$9-13 million) Office set up costs (~$750,000 for ~$50,000 x 15) Video analysis training costs (~$225,000 for 15 classes of 10 students @ $15,000)	E-Tablets for 22 PPBs (~$230,000 For 3 Tablets per PPB) Software development costs (~$30,000) Initial training costs (~$120,000 for 12 programs @ ~$10,000)	UAV platform (~$250,000 each) 1000 hours operational hours @ ~$900 per hour (~$900,000 per annum)	SAR data feed (~$1.5 - 3 million per annum)	90% less cost than other alternatives High – QUAD asset at ~$10,000 /hour) and Low – UAS at ~$900 /hour) = cost per 24 hour period for one platform (~$2,200 - ~$24,000)	Additional staffing costs for 3-4 analysts (~$350,000)
New technology operating and recurring costs	Minimal	Equipment maintenance costs (~$450,000 @ 5% failure and upkeep rate) Staff costs (salary, training, attrition) (~1.5 million for 15 x 5 staff @ $15,000) Software licensing costs per annum (~350,000 for 15 x 3 licenses at ~$7,500 each)	Equipment maintenance and replacement costs (~$10,000 per annum at 5% failure and replacement rate) Recurring training (~$30,000 for 3 programs per annum)	1000 hours operational hours @ ~$900 per hour (~$900,000 per annum)	SAR data feed (~$1.5 - 3 million per annum)	Cost of one platform for 60 days at sea supporting PPB or QUAD asset (~$130,000 - ~$1.4 million)	Salary costs (~$350,000 per annum)

Role of Multi-Criteria Analysis

In many policy decision-making settings there is a practicality to prepare a supplementary assessment that is either 'stand-alone' or used in conjunction with a strict cost-benefit analysis. This is particularly the case where hard-to-quantify factors need to be captured as part of the analysis provided to interested parties. In order to overcome the view that a strict cost-benefit analysis relies too heavily on monetary valuations, and the alleged omission of factors for which money valuations are difficult or impossible, the use of a multi-criteria analysis as a supplementary assessment is provided.

This multi-criteria approach attempts to examine several qualitative values when assessing potential costly investment decisions related to emerging technology and MCS. There would not have been a necessity to use this multi-criteria approach in this study if it was obvious that the vast majority of costs and benefits of all the emerging technologies could have been satisfactorily identified, quantified and monetised. For this study, a number of key general principles are specified for enhancing MCS efforts through the use of emerging technologies which FFA Members must take into account, namely:

- Does the emerging technology address the highest risks or fill the biggest MCS gaps?
- What is the capability of the emerging technology for easily integrating with and/or complementing existing national or regional MCS tools?
- Are there human capacity constraints in implementing the emerging technology?
- Are there extensive legislative or legal requirements that need to be changed or modified in order to implement the emerging technology?
- Does the emerging technology meet specific FFA Member needs or desires?

Adoption of this multi-criteria assessment technique is to provide a means for interested parties to assess these criteria for each emerging technology outlined within this study. Criteria can be weighted to reflect their relative importance to decision-makers and in the case of this study, were weighted based upon the background, knowledge and expertise of the author. Whereas cost-benefit analysis employs a well- established methodology in specifying and estimating various effects or impacts, the choice of impacts in the multi-criteria approach used in this study is more arbitrary. While the scoring system may be subject to debate, it does have the benefit in that it converts all criteria to a common range of values and preserves relativities for criteria for different options when scores are combined.

Table 2: Multi-Criteria Analysis of Emerging Technologies

CRITERIA	E-Reporting	E-Monitoring	E-Tablet	UAS	Integrated Sensor System	ASV	Data Analysis - Optimizing RFSC
Addresses highest risks and biggest MCS gaps	4	4	3	2	2	2	3
Capability for easily integrating with and/or complementing existing national or regional MCS tools	4	4	4	4	4	4	4
No human capacity constraints	4	2	3	1	3	1	2
No Legislative hurdles or obstacles	2	2	3	2	3	2	4
Meets FFA Member interest and desires	4	4	3	3	3	3	3
TOTAL	18	16	16	12	15	12	16

0 – Negative Effect 1 – Remotely Meets 2 – Partially Meets 3 – Substantially Meets 4 – Fully Meets

Final Analysis and Recommendations

For this broad overview study, the following prioritized list of emerging technologies should be considered for implementation:

E-Reporting/E-Monitoring/E-Tablets:

There are no specific hurdles to implementing these e-technologies. There is a demonstrated need to improve compliance amongst licensed vessels as a strong case can be made that the highest risks of IUU activity in the region is associated with licensed fleets, especially with respect to inadequate reporting by longliners. The implementation of e-technology requirements are concrete examples of how these emerging technologies can improve levels of compliance amongst licensed fleets. Their use will also undoubtedly facilitate FFA Member efforts to further establish a robust Catch Documentation Scheme which can then begin to address IUU risks throughout the entire supply chain. MCS effectiveness in the field can also be enhanced through the use of E-Tablet Job Aids by Fisheries Officers, Port Inspectors and Observers alike. These tools improve data capture and information management which ultimately facilitates improved analytical capability and decision-making.

Data Analysis – Optimizing the RFSC:

A detailed scoping study of the FFA Regional Fisheries Surveillance Centre directed at its current and future capabilities and the service it provides to FFA Members on both a national and regional scale should be considered. This study should include a concentration on staffing components, not just technological needs, especially in terms of increasing the ability of the RFSC to conduct comprehensive data fusion and analysis, an identified emerging MCS deficiency in the region. Multiple sources of fisheries information and data are already available now to accomplish this critical task. These datasets stand ready to be fused and analysed with the intent of developing specific and relevant national and regional IUU threat assessments, including estimated levels of risk that each fleet and vessel poses of conducting IUU fishing. Data analysis will increase national and regional prioritization of surveillance and patrol assets through more targeted and risk-based

approaches towards non-compliance, thereby optimizing effective and efficient use of scarce enforcement resources.

Integrated Sensor Systems:

Collaborative engagement is recommended with both commercial entities and/or other like-minded third parties to develop agreements and/or arrangements that will provide the best "cost per value" service access to additional, previously unavailable, datasets as delivered via integrated sensor systems. Integrating additional data feeds into the existing FFA Regional Surveillance Picture such as Synthetic Aperture Radar data would optimize the remote sensing capabilities of the FFA RFSC in detecting uncooperative or "darkened" vessels operating in the region that would form the basis for initiating more effective and efficient national law enforcement responses. These data sets would increase the overall regional maritime domain awareness of the RFSC, an already existing MCS tool.

Unmanned Aerial Systems (UAS)/Autonomous Surface Vehicles (ASV):

Further dialog is encouraged with commercial entities and like-minded third parties to coordinate a pilot project that specifically integrates these technologies as queuing tools in direct support of other aerial and surface enforcement assets. These technologies have a greater ability to enhance regional MCS efforts if used in direct combination with other enforcement assets to provide an integrated law enforcement response approach that could facilitate "end game" scenarios rather than their use as autonomous monitoring tools used solely in the hope of unilaterally detecting and documenting instances of illegal fishing activity. Evaluating results of this project would further inform decision-makers whether these technologies provide a sound return on investment on their widespread use.

Human Capacity and Capabilities

Within the process of evaluating emerging technologies for their usefulness in improving current MCS tools and techniques, one should remember that overall MCS effectiveness can be improved at little expense by enhancing regional cooperation mechanisms and optimizing existing frameworks such as improvements to data sharing agreements, optimizing use of shiprider opportunities, implementing the new multilateral NTSA and using data analysis to facilitate more targeted and risk-based enforcement responses.

Despite all that new and exciting technologies can add to the existing MCS regime, there still remains a demonstrated need to invest in people. While technology, information and hardware all play an important role, arguably the most important assets in any MCS programme are its people. FFA has already commenced efforts to formalize a regionally consistent MCS training and certification program across the broad FFA membership and consideration should always be given to include scope for investing in the building of human MCS capacity and capabilities in the within the region, not just technology.

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Appendix 1 – Acronyms

Acronym	*Full Description*
AIS	Automated Identification System
ALC	Automatic Location Communicator
ASV	Autonomous Surface Vehicle
CBA	Cost Benefit Analysis
CCM	Commission Members, Cooperating non-Members, and participating Territories of the WCPFC
CDS	Catch Documentation Scheme
CMM	Compliance and Management Measure
CMS	Compliance Monitoring Scheme
DWFN	Distant Water Fishing Nation
EEZ	Exclusive Economic Zone
EU	European Union
EVR	Electronic Vessel Registration
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FFA	Pacific Islands Forum Fisheries Agency
FIMS	Fisheries Information Management System
FSM	Federated States of Micronesia
HMTC	Harmonized Minimum Terms and Conditions
HSBI	High Seas Boarding and Inspection
IMS	Information Management System
IUU	Illegal, Unreported and Unregulated Fishing
LRIT	Long Range Information and Tracking
MCS	Monitoring Control and Surveillance
MCSWG	MCS Working Group
MDA	Maritime Domain Awareness
MPA	Marine Protected Area
MRAG	Marine Resources Assessment Group
MSC	Marine Stewardship Council
MTU	Mobile Transmitting Unit
NGO	Non-governmental Organisation
NTSA	Niue Treaty Subsidiary Agreement
OMSI	Oceanic Maritime Security Initiative
OWG	Operational Working Group
PNA	Parties to the Nauru Agreement
PMSP	Pacific Maritime Security Program
PPB	Pacific Patrol Boat
PNG	Papua New Guinea
PSMA	Port State Measures Agreement
QUAD	Quadrilateral Defence Coordinating Group
RFMO	Regional Fisheries Management Organization
RFSC	FFA Regional Fisheries Surveillance Centre
RFV	Record of Fishing Vessels
RIMF	Regional Information Management Facility
RMCSS	Regional MCS Strategy
RMI	Republic of the Marshall Islands
ROP	Regional Observer Programme

RSP	Regional Surveillance Picture
S-AIS	Satellite – Automated Identification System
SPC	Secretariat of the Pacific Community (formerly South Pacific Commission)
TCC	Technical and Compliance Committee of WCPFC
TUFMAN	Tuna Fisheries Database Management System
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UNCLOS	United Nations Convention on the Law of the Sea
UVI	Universal Vessel Identifier
VDS	Vessel Day Scheme
VMS	Vessel Monitoring System
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean

Appendix 2 - Acknowledgements

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Our Smart Fishing Vision and Goals:

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2020 Goals: The responsible management and trade of four key fishery populations results in recovering and resilient marine eco-systems, improved livelihoods for coastal communities and strengthened food security for the Planet.

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For more information

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