COMMISSION
EIGTEENTH REGULAR SESSION
Electronic Meeting
1 – 7 December 2021

DESKTOP-STUDY INVESTIGATING HIGH-LEVEL OPTIONS FOR THE WCPFC SECRETARIAT'S ROLE IN AT-SEA TRANSHIPMENT ELECTRONIC-MONITORING

WCPFC18-2021-IP10
12 November 2021

Paper by the Secretariat

Purpose

1. The purpose of the paper is to present for information the findings of a desktop-study that the Secretariat commissioned in 2021 investigating high-level options for the WCPFC Secretariat's role in at-sea transhipment Electronic-Monitoring. The report is attached to this paper.

Background

2. The WCPFC established the Electronic Reporting and Electronic Monitoring Working Group (ERandEMWG) in 2015, recognizing that a key risk was a lack of documented policies and standards for electronic technologies. The initial focus was to establish a range of E-reporting processes and tools. Over the last three years, the focus has moved to Electronic Monitoring (EM). The Commission encouraged the development of EM by CCMs in areas where data gaps exist such as longline observer coverage and high seas transhipment (WCPFC12 Summary Report (final_rev2_6 July 2016) Paragraph 543).

3. The Commission, in adopting the ERandEMWG3 report (2018), accepted a recommendation that "the Commission agree to prioritising E-monitoring in areas where independent data collection and verification is currently low and asked SC14 and TCC14 for advice on priority areas". In addition, the WCPFC16 Summary Report (2019) paragraph 556 states "The Commission agreed that the conclusions from Project 93 in relation to data gaps be considered in the implementation of regional EM standards".

4. Progressing the development of an EM programme for WCPFC has become more urgent with the impact of COVID-19 significantly affecting the ability to place observers on vessels for scientific and compliance purposes including the monitoring of transhipments, over an extended and, as yet uncertain, period of time.

5. EM programmes complement observer coverage for example, where there are limited numbers of observers available, where operational conditions, such as during the COVID-19 pandemic, mean the minimum required level of observer coverage cannot be met, and where observers are required to focus efforts on specific tasks not able to be delivered by EM.

6. To assist in progressing this work, the United States provided voluntary funds for an analysis of viable business models for a WCPFC Secretariat role to support EM data collection and management associated with science and compliance monitoring of at-sea transhipments in the WCPF Convention Area.

7. In July 2021, the Secretariat initiated the study to assess options for a WCPFC Secretariat role in Regional Electronic Monitoring, led by Consultant, Mr Kim Duckworth. The input for the terms of reference which guided the study was developed by the Secretariat with input from the Chair of the ERandEMWG, the co-Chairs of the TS-IWG and the United States.

8. The analysis provided in the report complements efforts underway within the ERandEMWG which are intended to inform future Commission discussions on the design of a Conservation and Management Measure for EM. It will also assist the work of the Transhipment Intersessional Working Group (TS-IWG) reviewing the current Conservation and Management Measure on the Regulation of Transhipment. The outcome of this study will benefit the Secretariat and the Commission in further considering options to enhance and strengthen at-sea transhipment in the WCPF Convention Area.

9. The enclosed report is presented for information.

Options for the WCPFC Secretariat's role in at-sea transhipment Electronic Monitoring

Version 1.1

20 September 2021

EXECUTIVE SUMMARY

This document investigates high level options for the ongoing role of the Secretariat in a possible WCPFC at-sea transhipment Electronic Monitoring (ASTEM) programme. The document:

- Identifies fourteen roles that exist in a generic fisheries Electronic Monitoring programme. Of these fourteen roles, ten are candidates for provision by the Secretariat.
- Presents twelve options for the ongoing role of the Secretariat in a possible ASTEM programme. These twelve options are made up of different combinations of the ten candidate roles.
- Concludes that the minimum role for the Secretariat is *Comparing ASTEM data to other transhipment data to identify discrepancies* and *Auditing National ASTEM programmes*. These two roles closely align with the role of the Secretariat role as defined in the Convention text.
- Concludes that it would probably also be most efficient to have the Secretariat fulfilling the roles of *Supplying ASTEM data to other authorised organisations / people* and *Producing reports / analyses, for the Commission, from ASTEM data*.
- Concludes that there are a further six ASTEM roles for which the Secretariat should be considered, but that appropriate alternative organisations should also be considered.
- Concludes that there are many viable alternatives for the path through which ASTEM data could flow to the Secretariat. These include ASTEM data flowing: first to Members / a sub-regional agency then onto the Secretariat, or first to the Secretariat then onto Members / a sub-regional agency, or simultaneously to the Secretariat and Members and possibly a sub-regional agency.
- Concludes that, regarding the Secretariat's role, decisions about the path through which ASTEM data would flow to the Secretariat are less important than decisions about the timeliness with which ASTEM data would reach the Secretariat. Specifically, the Secretariat would be able to provide a wider range of services to the Commission if it received ASTEM data sooner (e.g., in real-time) than if it received ASTEM data later (e.g., quarterly or annually).
- Concludes that, regarding the Secretariat's role, the other important decision is whether the ASTEM programme will collect, store and review video. The case for collecting, storing and reviewing video, in the WCPFC at-sea transhipment monitoring context, is questioned. A non-video based form of Electronic Monitoring programme could be a better alternative. Commission decisions on whether video should be collected, stored, and reviewed; will have a significant impact on options for the role of the Secretariat in a possible ASTEM programme and on the cost of such a programme.

INTRODUCTION

Purpose

The purpose of this document is to describe options for the ongoing role of the WCPFC Secretariat in any future WCPFC at-sea transhipment electronic monitoring programme. Matters that are out-of-scope include:

- Any ship-board roles, as it is considered that there is no likely option under which these would be the responsibility of the Secretariat.
- The Secretariat's, or any other organisations, role in initially setting up a future WCPFC at-sea transhipment electronic monitoring programme. For example, the Secretariat's role in the ongoing administration of an ASTEM programme is considered, but the Secretariat's role in project managing the establishment of an ASTEM programme is not.
- The technology that would be used to implement the Secretariat's role in a future WCPFC at-sea transhipment electronic monitoring programme; except where a discussion of technology is needed to inform the options for the ongoing role of the Secretariat in such a programme.

Note also that this document outlines options but does not make recommendations. This document describes twelve of the most obvious options for the ongoing role of the WCPFC Secretariat in any future WCPFC at-sea transhipment electronic monitoring programme. All twelve of the options presented for the WCPFC Secretariat's role in at-sea transhipment Electronic Monitoring are practical.

Keys to successfully implementing Electronic Monitoring

The literature[1] describing the successful implementation of fisheries EM programmes is clear on the importance of:

- Identifying the monitoring objectives for any EM programme; and
- Identifying how EM fits into wider transhipment monitoring needs.

As stated in *Catalyzing the growth of electronic monitoring in fisheries* (CEA Consulting, 2018) - "Customers need to think about the objectives before they think about the tools."

Monitoring objectives

The WCPFC does not currently have a document that explicitly identifies its objectives for monitoring transhipments.

The introduction to CMM2009-06 contains several references that could be taken to imply the objectives for monitoring transhipments, specifically:

> *Acknowledging* that effective conservation and management of highly migratory fish stocks **is dependent on the provision of accurate reporting of catches** of such stocks in the Convention Area.

[1] Including: Roadmap for electronic monitoring in RFMO's (CEO consulting, 2020), and Fisheries monitoring roadmap (Lowman et al, 2013)

Recalling Article 29(1) of the Convention which provides that in order to support efforts **to ensure accurate reporting of catches**, the members of the Commission shall encourage their fishing vessels, to the extent practicable, to conduct transhipment in port.

Recalling also Article 29(2) and (3) of the Convention that transhipment at a port or in an area within waters under the national jurisdiction of a member of the Commission shall take place in accordance with applicable national laws, and that the Commission shall develop procedures **to obtain and verify data on the quantity and species transhipped** both in port and at sea in the Convention Area and procedures to determine when transhipment covered by the Convention has been completed;

Desiring to establish procedures **to obtain and verify data on the quantity and species transhipped in the Convention Area to ensure accurate reporting of catches**, and enhance stock assessments of highly migratory fish stocks.

Recognizing that transhipment at sea is a common global practice, but that unregulated and unreported transhipment of catches of highly migratory fish stocks at sea, in particular on the high seas, **contributes to distorted reporting of catches of such stocks and supports IUU fishing** in the Convention Area;

While the FAO's Global Study on Transhipment (2018) recognised the need to –

> Adequately monitor and control transhipment to avoid it becoming a gateway for IUU fishing activities.

Additionally, transhipment creates an opportunity for non-fisheries related serious criminal activity (e.g., human trafficking).

This paper assumes that the monitoring objectives for at-sea transhipment EM are:

- to obtain and verify data on the quantity and species transhipped in the Convention Area;
- to facilitate the detection of IUU fishing**;**
- to facilitate the detection of non-fisheries related serious illegal activity (e.g. human trafficking);
- to verify compliance with Conservation and Management Measures.

How EM fits into at-sea transhipment monitoring

The WCPFC has yet to define the role that ASTEM has in achieving transhipment monitoring objectives. Presumably, ASTEM would operate in conjunction with other monitoring tools to deliver on these objectives. Those tools include the regional Vessel Monitoring System (VMS), transhipment notifications and declarations, the regional observer programme, and inspections. Typically, no one tool can deliver all fisheries monitoring objectives. Key to the successful implementation of ASTEM will be identifying how this programme can both complement, and mitigate the weaknesses inherent in, other tools.

The most obvious data needs that a combined suite of monitoring tools could meet for at-sea transhipments is:

1. That a transhipment has occurred
2. Offloading and Carrier Vessel IDs
3. Transhipment location

4. Transhipment date/time
5. Weight of fish product transhipped, for all species combined
6. Weight of fish product transhipped, for each species individually
7. Intended port of landing
8. Non-fisheries related illegal activity.

To be effective, the data collected by this combined suite of tools would overlap each other, as this would allow for better quality control of data and for vessel-dependent data sources to be cross checked against vessel-independent data sources. Such an approach would need to be balanced against cost considerations. The end goal is for the WCPFC to adopt a suite of tools that together, cost-effectively, achieve the Commission's transhipment monitoring objectives. Such an integrated monitoring programme could be depicted as a table, with the range of tools used to monitor at-sea transhipments shown as column headings, and the data needs shown as row headings.

	ASTEM	VMS	Transhipment Notifications / Declarations	Etc, etc
That a transhipment has occurred				
Offloading and Carrier Vessel IDs				
Transhipment location				
Transhipment date/time				
Weight transhipped, for all species combined				
Weight transhipped, for each species individually				
Intended port of landing				
Non-fisheries related illegal activity.				

The body of the table would then describe the role that tool X played in meeting data need Y. The table cells would define:

- Whether tool X collected primary or secondary information for need Y. Primary means the tool would be used directly to collect that type of information. For example – If the ASTEM tool collected the offloading vessel's ID, then that would be primary information. Secondary means the tool would typically be used to either verify, or improve the quality of, information collected using other tools. For example – If the ASTEM tool collected information which could be used to verify the weight transhipped for all species combined, as reported on Transhipment Notifications / Declarations, then that would be secondary information.

- Whether tool X collected vessel independent or vessel-dependent information of type Y.

A very significant aspect of the role of fisheries EM programmes is to improve the quality of vessel-dependent reporting. As described in *Catalyzing the growth of electronic monitoring in fisheries* (CEA Consulting, 2018) – "You could turn the power on and not collect anything and completely change behaviour". It is this trait, more than any other, that best defines the potential of EM within a multi-tool integrated monitoring programme. The paper *Changes in logbook reporting by commercial fishers following the implementation of electronic monitoring in Australian Commonwealth fisheries* (Emery et al, 2019) describes the same outcome.

An excellent guide to developing this form of "monitoring matrix" is provided in the *Fisheries monitoring roadmap* (Lowman et al, 2013). If the WCPFC adopted this type of approach, the result should be a cost-optimised integrated monitoring programme for at-sea transhipments.

The WCPFC document *Outcomes of the review of the Commission's data needs and collection programmes* (SC project 93) makes a start in producing this type of analysis, but treats transhipment data as one generic need without considering the eight specific needs for transhipment data that are identified here.

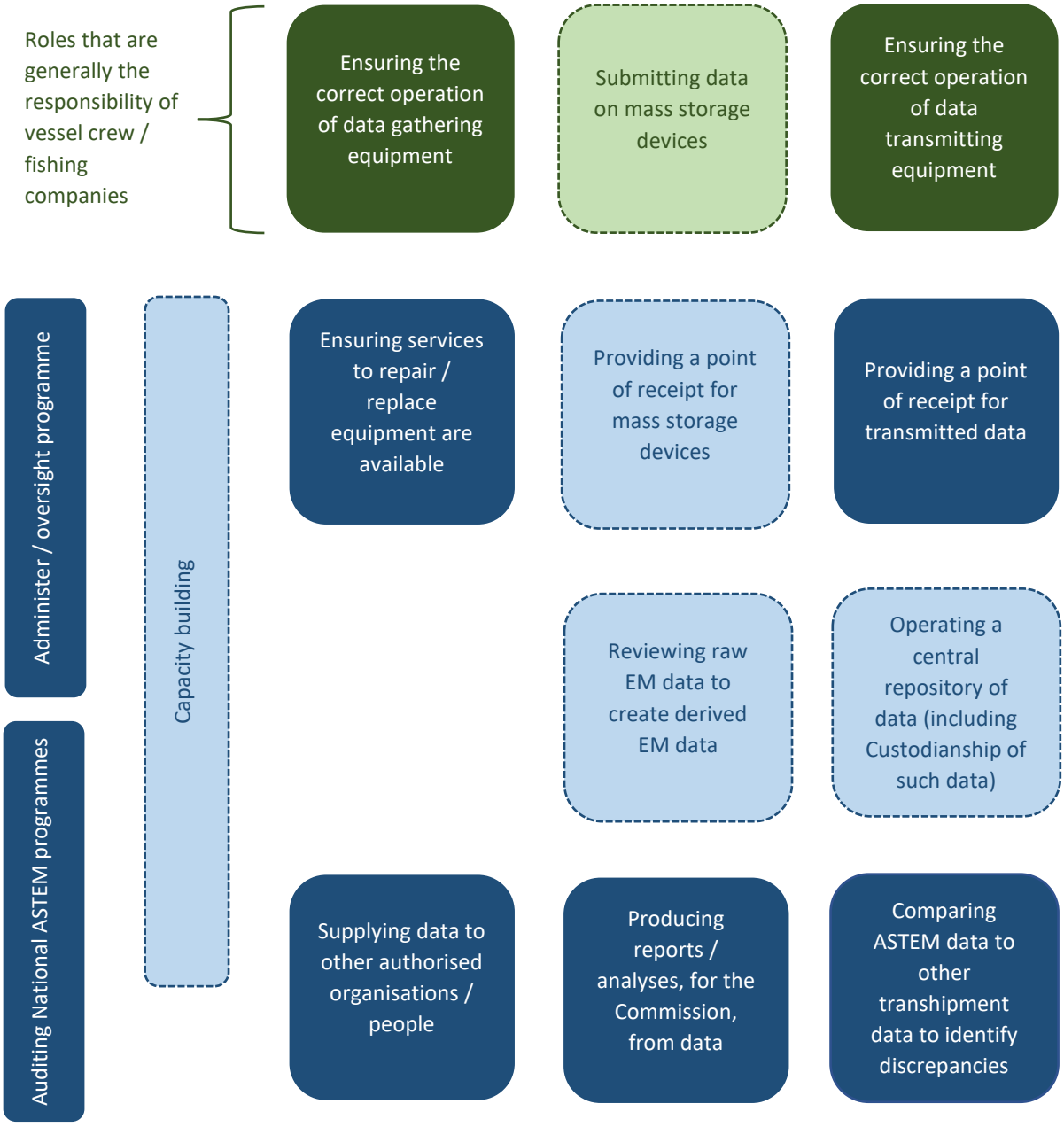
Defining at-sea transhipment data needs

In addition to defining the monitoring objectives for an ASTEM programme and identifying how ASTEM fits into wider transhipment monitoring needs; the Commission, Members and possibly sub-regional agencies will need to define their individual needs for specific fields of data describing at-sea transhipments. Although these needs will be a key part of the design of any future ASTEM programme, in general it is unlikely that they will have a substantial impact on the options for the role of the Secretariat. The exception to this generalization is the potential need to collect data on the species of fish transhipped. Decisions that the Commission makes about using, or not using, EM to collect primary data on the species of fish being transhipped will shape any future ASTEM programme and significantly influence the role of the Secretariat. This is discussed in detail later in the paper.

Roles within a generic fisheries EM programme

The following figure depicts the most common roles within a generic fisheries EM programme.

Figure 1. Roles within a generic fisheries EM programme



Ensuring the correct operation of data gathering equipment – This role occurs at-sea and includes ensuring that sensors, cameras, and data recording equipment are operating in accordance with pre-defined Standards, Specifications and Procedures (SSP). There will be many people undertaking this role, as many vessels will be being monitored at the same time. This role occurs onboard fishing vessels and is generally the responsibility of the vessel's crew or operators.

Ensuring the correct operation of data transmitting equipment – This role occurs at-sea and includes ensuring that the equipment which transmits sensor and camera data to shore is operating in accordance with pre-defined SSPs. There will be many people undertaking this role, as many vessels will be being monitored at the same time. This role occurs onboard fishing vessels and is generally the responsibility of the vessel's crew or operators.

Submitting data on mass storage devices – This role occurs when a vessel reaches port and includes submitting mass storage devices (e.g., those that contain video of the vessel's operations) in accordance with pre-defined SSPs. This role is optional, in so far as there are some models for implementing EM that may not require the submission of video. If required, then there will be many people undertaking this role, as many vessels will be being monitored at the same time. This role occurs onboard fishing vessels and is generally the responsibility of the vessel's crew or operators.

Administering / oversighting the programme – This role occurs ashore. It primarily involves (1) regulating/administering the registration of monitored vessels, and (2) coordinating those aspects of the regional ASTEM programme that require some level of synchronisation. This role will need to be split between organisations. Part of this role will need to be undertaken by Member Governments (probably National Fisheries Management Authorities (NFMAs)). They will need to ensure that vessels flying their flag comply with the requirements established by the Commission for the purposes of the Commission ASTEM programme. An appropriate level of infrastructure and the right equipment are required to be able to run an EM program effectively. Another part of this role may be undertaken by a regional organisation. This organisation might perform administration / oversight functions that require regional synchronisation or are more efficient if centralised. The Secretariat is a candidate to undertake this regional role, but other candidates also exist.

Auditing National ASTEM programmes - This role occurs ashore. It is not found within National ASTEM programmes but may be required in RFMO contexts. It primarily involves checking that Member ASTEM programmes are complying with minimum standards agreed by the Commission. The Secretariat is the obvious candidate to undertake this role.

Capacity building – This role occurs ashore. It primarily involves working with Members to increase their ability to deliver EM services. EM will be new to most Members. The administration of EM programmes and the review of raw EM data are obvious candidates for capacity building. Using the Regional Observer Programme as a model, this capacity building could include comprehensive training modules (to ensure better review and avoid ASTEM data overwhelming National programmes) and well-structured training material. This role is optional, in so far as there are some (highly centralised) models for implementing ASTEM that may not require it. If required, there may be more than one organisation undertaking this role[2]. The Secretariat is a candidate to undertake this role, but other candidates also exist.

[2] There are many aspects to an EM programme that can be supported (e.g., legal frameworks, data management, workflow processes, technology) and a variety of entities that could supply that support.

Ensuring that services to repair / replace equipment are available – Generally,[3] vessel crew or operators will be responsible for ensuring the correct operation of ASTEM equipment located aboard vessels, and this will include maintaining or replacing such equipment when in port. However, given the low levels of infrastructure located at many ports within the Pacific, it cannot be assumed that suitable providers to service / install EM equipment will exist in an appropriate range of ports. There will be a need for an organisation to ensure that such services exist and are functioning. The Secretariat is a candidate to undertake this role, but other candidates also exist.

Providing a point of receipt for transmitted data – This role occurs ashore. Some EM data will be transmitted from vessels to shore. This would be either in real-time via satellite or at end-of-trip via mobile phone network. This data would then be received by a set of programmes built for the purpose (e.g., a web service[4]). There could be one data receipt point or many data receipt points. For each data receipt point, there will need to be an organisation that ensures that data is received and processed in accordance with predefined SSPs. The Secretariat is a candidate to undertake this role for one data receipt point, but other candidates also exist.

Providing a point of receipt for mass storage devices – This role occurs ashore. Some data (e.g., video of the vessels operations) may be accumulated on mass storage devices and submitted once a vessel reaches port. This role is optional, in that there are some models for the implementation of ASTEM that would not require the collection of mass storage devices. If required, there would be many points of receipt for mass storage devices, one in each pre-determined port[5]. For each point of receipt for mass storage devices, there will need to be an organisation that ensures that data is received and processed in accordance with predefined SSPs. The Secretariat is a candidate to undertake this role in Pohnpei, but other candidates also exist. The Secretariat is an unlikely candidate to undertake this role outside of Pohnpei.

Operating a central repository of data (including the Custodianship of such data) – This role occurs ashore. This role is optional, as in some of the models for the flow of EM data the data is consolidated into a central repository (although copies of subsets of the data may simultaneously be held in other repositories), while in other [distributed] models the data is never consolidated into a central repository. If the data is consolidated into a central repository, then one organisation will need to operate this repository and provide Custodianship[6] services for the data in accordance with predefined SSPs. The Secretariat is a candidate to undertake this role, but other candidates also exist.

Reviewing raw EM data to create derived EM data – This role occurs ashore. Raw EM data (e.g., video) may be reviewed to create derived EM data (e.g., that ABC kilogrammes of XYZ species were transhipped). This role is optional, as in some of the models for EM raw data is never reviewed to create derived data. If required, review could occur in either a regional / sub-regional data review

[3] This is not always true as there are some fisheries EM programmes in which the monitoring authority is responsible for the repair / replacement of onboard cameras, sensors, etc. If the WCPFC selected this model, then the *Ensuring that services to repair / replace equipment are available* role would become larger and require more resources.

[4] In a Web service a web technology such as HTTP is used for transferring machine-readable file formats such as XML and JSON. For a full explanation see https://en.wikipedia.org/wiki/Web_service

[5] Typically, the local NFMA would be the point of receipt. The mass storage devices are typically encrypted, but there are issues with the continuity of evidence so an NFMA (or its delegated authority) is the most likely first point of receipt.

[6] Ensuring quality, ensuring appropriate availability, ensuring appropriate confidentiality, where appropriate protecting privacy, protecting data from loss or corruption, etc

centre, or a group of national data review centres, or some combination of both.. For each data review centre, there will need to be an organisation that ensures that data is reviewed in accordance with predefined SSPs. The Secretariat is a candidate to undertake this role for one data review centre, but other candidates also exist.

Supplying data to other authorised organisations / people – This role occurs ashore. There will be a need for an organisation, or organisations, to provide (in accordance with predefined SSPs) subsets of ASTEM data to other organisations / people that have been authorised to have access to the data. If the Secretariat has access to the full set of ASTEM data, then the Secretariat is an obvious candidate to undertake this role, but other candidates may also exist.

Producing reports / analyses, for the Commission, from data – This role occurs ashore. There will be a need for an organisation to provide reports / analyses of ASTEM data for the Commission. If the Secretariat has access to the full set of ASTEM data, then the Secretariat is an obvious candidate to undertake this role, but other candidates may also exist.

Comparing ASTEM data to other transhipment data to identify discrepancies – This role occurs ashore. There will be a need for an organisation to compare ASTEM data to other transhipment data (e.g., VMS or transhipment notifications / declarations) to identify discrepancies. If the Secretariat has access to the full set of ASTEM data, then the Secretariat is the most obvious candidate to undertake this role, especially given that the Secretariat is currently the only organisation that has access to most of the other transhipment data.

Note that there will be sub-roles within some of these roles. For example, operating a central repository of ASTEM data (including the Custodianship of such data) may require both IT and Data Management professionals.

Current roles of the Secretariat

Article 15 of the Convention defines the role of the Secretariat. Article 15.4 states that the Secretariat's role is:

a) [abridged]
b) facilitating the compilation and dissemination of data necessary to accomplish the objective of this Convention;
c) preparing administrative and other reports for the Commission and the Scientific and Technical and Compliance Committees;
d) administering agreed arrangements for monitoring, control and surveillance and the provision of scientific advice;
e) [abridged]

Beyond the convention text itself, the Secretariat is the common denominator between all Members, and it is one of the few bodies that is accountable to all Members. As such, the Secretariat represents both a central hub in the Commission's operations and perhaps the closest thing that the Commission has to a neutral body. The Secretariat's role in administering the WCPFC Compliance Monitoring Scheme (CMS), essentially auditing Member's compliance with obligations, reinforces the importance of this neutral character.

The table below summarises the Secretariat's role with regard to existing types of information that can be used to monitor transhipment events.

	The Secretariat's role includes -
Vessel Monitoring System	• Providing a point of receipt for transmitted VMS data • Operating a central repository of VMS data (including Custodianship of such data) • Supplying VMS data to other authorised organisations / people • Producing reports / analyses, for the Commission, from VMS data • Comparing VMS data to other transhipment data to identify discrepancies • Administering / Oversighting the VMS programme[7] • Capacity building[8]
Transhipment Notifications / Declarations	• Providing a point of receipt for transmitted Transhipment E-Reporting (TSER) data • Operating a central repository of TSER data (including Custodianship of such data) • Supplying TSER data to other authorised organisations / people[9] • Producing reports / analyses, for the Commission, from TSER data • Comparing TSER data to other transhipment data to identify discrepancies • Administering / Oversighting the TSER programme • Capacity building[4]
Regional Observer Programme (ROP) Transhipment	• Administering / Oversighting the programme[10] • Capacity building[4]
Inspections (HSBI or Port)	• Providing a point of receipt for Inspections data • Operating a central repository of Inspections data (including Custodianship of such data) • Supplying Inspections data to other authorised organisations / people • Producing reports / analyses, for the Commission, from Inspections data • Capacity building[4]

Current models for the flow of information to the Secretariat

A wide range of models are currently in use to facilitate the flow of information to the Secretariat. These are documented in full in Appendix 1. A summary of information relevant to transhipment events is provided in the table below.

Information type	Timeliness	Information flow
VMS	In real-time.	From vessels directly to the Secretariat; or

[7] This role is shared with Members.
[8] Currently suspended or done online as a consequence of the Covid pandemic
[9] The Secretariat has created an online tool that allows Member's to retrieve the Transhipment Notifications / Declarations submitted for their vessels.
[10] As part of the WCPFC Regional Observer Programme in general.

		From vessels to the Pacific Islands Forum Fisheries Agency (FFA), then to the Secretariat. In both cases the information is simultaneously reported to the relevant NFMA.
Transhipment Notifications / Declarations	Notifications: at least 36 hours prior to each transhipment. Declarations: within 15 days of completion of each transhipment[11].	From vessels to NFMAs, then to the Secretariat.
Inspection reports (e.g., HSBI or Port)	Within a week.	From inspectors to the Inspecting CCM NFMA, then to the Secretariat.
Reports from ROP for purse seine and longline vessels	For SPC PICT members: quarterly. For others: annually.	From observers to the observer NFMA, then to SPC-OFP, then to the Secretariat.
Reports from ROP for transhipment vessels	Not applicable, as there are no arrangements for the Secretariat to routinely receive ROP Transhipment data.	

Possible models for the flow of ASTEM information to the Secretariat

Many options exist for the flow of ASTEM information to the Secretariat. ASTEM data could flow through serial paths from the vessel to organisation A then onto organisation B; or through parallel paths from the vessel to organisations A and B. The actual path is less important than decisions about:

- The timeliness with which each organisation in the path will receive or have access to ASTEM data that they are authorised to see; and
- The format[12] with which each organisation in the path will receive or have access to ASTEM data that they are authorised to see; and
- Which organisation in the path is responsible for each of the ASTEM Data Governance roles[13]; and
- Handling versions of the same ASTEM data. For example, if organisations A and B both hold a copy of the same ASTEM data, then organisation A updates their copy. Should organisation B automatically receive the same update?

Any model will need to consider the Secretariat's powers. For example, the Secretariat does not have legal authority over vessels so would not be able to require vessels to have and operate ASTEM equipment. The Commission's VMS Conservation and Management Measure (2014-02) gets around

[11] These are the timeliness requirements specified in CMM2009-06. The technology already in use (the Secretariat's Transhipment Electronic Reporting app, TSER) would allow vessels to directly supply transhipment notifications and declarations to the Secretariat in real-time, but to-date CCMs have not elected to allow their vessels to report directly.

[12] Decisions about format will have major implications for the efficiency with which the Secretariat, or any other organisation in the ASTEM information pathway, can access the data.

[13] These are defined in later in this document

this constraint by (1) stating that the Secretariat will administer a VMS and receive data directly from fishing vessels, then (2) requiring each flag CCM to ensure that their vessels comply -

> Clause 7a - *The Commission VMS shall be a stand-alone system:*
> - *developed in and administered by the Secretariat of WCPFC under the guidance of the Commission, which receives data directly from fishing vessels operating on the high seas in the Convention Area; and*
> - *with the added capability that it can accept VMS data forwarded from the FFA VMS, so that the fishing vessels operating on the high seas in the Convention Area will have the option to report data via the FFA VMS.*
>
> Clause 9a - *Each flag CCM shall ensure that fishing vessels on the high seas in the Convention Area comply with the requirements established by the Commission for the purposes of the Commission VMS and are equipped with ALCs that shall communicate such data as determined by the Commission.*

Note that nothing in CMM 2014-02 prevents Members from receiving VMS data from their vessels at the same time that the Secretariat receives it; in fact, the CMM specifically allows for parallel flows of VMS data coming through the FFA then onto the Secretariat.

Regarding the flow of ASTEM information to the Secretariat, it is likely that the deciding factor will be what institutional arrangements Members are most comfortable with, as the costs associated with the various options will probably not differ greatly. There are several existing models that are working, although the timeliness of data arriving at the Secretariat is much faster in some models than in others. Equally, the Commission may want to consider not being bound by previous models for information flow, given that technology now offers the Commission a wide range of viable models.

Timeliness of the flow of ASTEM information to the Secretariat

It is important that the Commission identify how quickly it needs ASTEM information to reach the Secretariat. The current models for timeliness vary greatly, with VMS data reaching the Secretariat in real-time while ROP for purse seine and longline vessels reaches the Secretariat only annually or quarterly (and ROP Transhipment data does not routinely reach the Secretariat at all). Decisions about timeliness should be based on the services that Members want the Secretariat to provide to them.

If ASTEM data reaches the Secretariat annually or quarterly, then the Secretariat will be able to use ASTEM data to:

- Support scientific analyses;
- Support compliance monitoring reviews;
- Provide analyses of transhipment activities months/years after the fact (e.g., TCC annual reports).

Whereas, if ASTEM data reaches the Secretariat in real-time or near-real-time, then the Secretariat will be able to use ASTEM data (together with other MCS data) to achieve all of the above plus:

- Support Member-MCS activities under approved WCPFC non-public domain data requests, including HSBI and surveillance operations;

- Support Member monitoring of activity within the Convention Area, through real-time verification of transhipment notification and declaration reporting, and linking to VMS reporting;
- Allow Member-led investigations into possible offences to be followed up sooner rather than later, and particularly before the fish is offloaded from the receiving vessel.

Nothing in the above would exclude the possibility of Members or sub-regional agencies receiving ASTEM data at the same time as the Secretariat. The decision about the timing of the arrival of ASTEM data at the Secretariat can be viewed as independent of the decision about the path of ASTEM information flow. The technology is easily available to allow multiple organisations to receive data simultaneously.

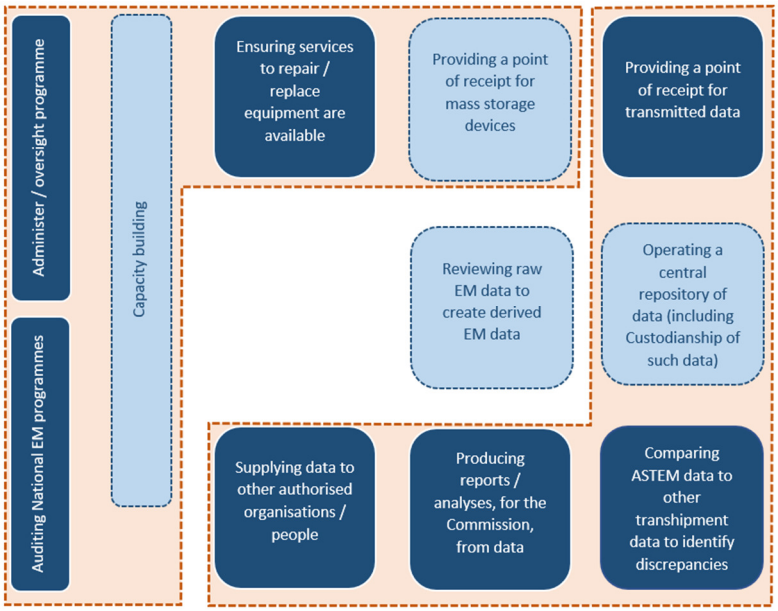
Grouping possible roles of the Secretariat

Figure 1 outlined ten ASTEM related roles, each of which might or might not be assigned to the Secretariat. In theory, that gives 1024 potential combinations of ASTEM roles which the Secretariat might, or might not, undertake. Clearly, it would be impossible to consider all 1024 scenarios within the bounds of this paper. Practically, some of the roles are logically associated with each other. For example:

- Auditing National ASTEM programmes, Administering / oversighting the programme, Capacity building, Ensuring services to repair / replace equipment are available, and Providing a point of receipt for mass storage devices all have a substantial operational / in-the-field component to them; and it may be appropriate for the same organisation to undertake some / all of them;
- Operating a central repository of ASTEM data (including Custodianship of such data), Supplying ASTEM data to other authorised organisations / people, Producing reports / analyses for the Commission from ASTEM data, and Comparing ASTEM data to other transhipment data to identify discrepancies; all have a substantial Data Management / Analysis component to them.

To simplify the combinations of options for the role of the Secretariat that this paper needs to consider, the ten possible roles for the Secretariat have been grouped into three clusters.

- The single role of Reviewing raw EM data to create derived EM data.
- A cluster of port-side services that focuses on coordinating or actioning tasks that need to occur in-port or in conjunction with National Fisheries Management Agencies.
- A cluster of Information Centre services that focus on compiling and disseminating data.



Options for the Secretariat's role in providing these groupings of roles are considered in the pages that follow.

Relationship between Commission decisions and the role of the Secretariat

If the Commission makes certain decisions, then the options for the role of the Secretariat will be substantially constrained. For example, if the Commission decides that there will be no requirement for Members to supply ASTEM data to any organisation, as is currently the case with ROP transhipment, then that would effectively preclude the Secretariat (or any other single organisation) from fulfilling an Information Centre role.

Equally, for the Secretariat to effectively undertake certain roles, then the Commission would need to make certain decisions. For example, if the Secretariat was required to provide a point for the receipt of transmitted ASTEM data, as is currently the case with the VMS programme, then the Commission would need to specify a requirement (either in a CMM or in a Commission decision applied to rules and procedures) for Members to submit data to that point of receipt.

Decisions, or the absence of decisions, of the Commission will largely define the role of the Secretariat in ASTEM. Although at this moment there may be 1024 possible combinations of roles that the Secretariat might fill; as the Commission makes, or does not make, decisions this number will be dramatically reduced.

Within the pages that follow, the relationship between decisions of the Commission and options for the role of the Secretariat are outlined. The intent is that this relationship can be read in either direction:

- If the Commission decides X then options for the role of the Secretariat become Y; or
- If it is desired that the Secretariat's role should be Y then the Commission would need to enable this by deciding X.

Difficulty in estimating costs

As stated in *Catalyzing the growth of electronic monitoring in fisheries* (CEA Consulting, 2018) -

> *Unfortunately, what seems like a relatively straightforward question to answer—how much does an EM program cost — can be difficult to break down. Differences in the goals and designs of EM programs can have a huge influence on the overall cost of the program. Choices impacting cost include the number of cameras on each boat, the percentage of video that will be reviewed, the duration of video storage, the scale of implementation, the data that will be collected, and the compliance being verified (e.g., no discards versus complete enumeration). Likewise, characteristics of the fishery influence the cost of an EM program, including number of vessels, number of fishing days, geographic distribution of the fleet, and the type of gear. Studies also vary in their system boundaries and categorization of costs. For example, some choose to include the startup and ongoing costs for regulatory agencies, while others do not. Finally, cost data can be presented in different units—total cost, cost per vessel, cost per day, cost per fishing day, percent of net revenue—across different studies, which can make it difficult to quickly understand and compare how much EM programs cost for specific fisheries.*

This paper documents the indicative ongoing costs that would be associated with each of the options identified for the role of the Secretariat in a future ASTEM programme. The cost estimates are based on the assumptions documented in Appendix 2.

No attempt has been made to estimate the cost of initially setting up an ASTEM programme[14] or estimate the ongoing on-vessel costs of operating an ASTEM programme.

National EM programmes are costly to implement / operate. It is outside the scope of this paper to examine what these costs are and who should cover them, but it is likely that some of the costs will be meet by vessel owners and because of this it is important that vessel owners understand the reasons behind EM initiatives.

For all of the costs identified, if the role is needed but the Commission decides that some organisation(s) other than the Secretariat should fulfil the role, then the costs will still exist. Not having the Secretariat be responsible for a role will not make the role (or its associated costs) go away.

For each of the options identified, the suitability of having the Secretariat outsource the role to another provider is commented on. Some roles are obvious options for outsourcing, while others should probably remain in-house.

All of the estimated costs presented in this paper are in US dollars.

[14] Excluding on-vessel costs, these are unlikely to exceed one year's operating costs.

HIGH LEVEL OPTIONS FOR THE SECRETARIAT'S ROLE IN ASTEM

The ten roles, in a possible future ASTEM programme, that the Secretariat might undertake have been grouped into three clusters of services. These clusters are defined in more detail in the pages that follow. Within each cluster of services, the most obvious options for the Secretariat's role are identified. The full role of the Secretariat in any future ASTEM programme would be defined by selecting one option from each of the three clusters. For the most part, the three clusters can be viewed in isolation of each other. Where this is not true, this is specifically identified in the pages that follow.

Roles relating to the review of raw EM data (e.g., video, photos, sensor data) to create derived EM data	**Roles relating to Information Centre Services**	**Roles relating to Port-Side Services**
Choose one of:	Choose one of:	Choose one of:
1A. Raw EM data is not reviewed (by anyone) to create derived EM data.	**2A**. The Secretariat has the roles of supplying ASTEM data, producing ASTEM reports / analyses, and comparing ASTEM data.	**3A.** The Secretariat has the role of auditing National ASTEM programmes.
1B. Raw EM data is reviewed to create derived EM data, but the Secretariat is not involved in this role.	**2B**. The Secretariat has the roles of providing a point of receipt for transmitted ASTEM data, operating a central repository of ASTEM data, supplying ASTEM data, producing ASTEM reports / analyses, and comparing ASTEM data.	**3B.** The Secretariat has the roles of auditing National ASTEM programmes, administering / oversighting the ASTEM programme, ensuring that services to repair / replace equipment are available, and capacity building.
1C. The Secretariat has the role of primary reviewer of raw EM data to create derived EM data.		

This approach reduces the number of combinations of roles that the Secretariat might take on from over one thousand to just twelve (3 x 2 x 2). These twelve combinations represent the most obvious options for the role of the Secretariat in any future at-sea transhipment EM programme. No one option is singled out or recommended within this document. All twelve of the options presented for the WCPFC Secretariat's role in at-sea transhipment Electronic Monitoring are practical. As noted earlier, any decisions on the role of the Secretariat can be viewed as substantially independent of decisions on the path of the flow of information to the Secretariat.

OPTIONS FOR THE SECRETARIAT'S ROLE IN REVIEWING RAW EM DATA TO CREATE DERIVED EM DATA

Background

To-date, fisheries EM programmes around the world have focused on the review of video to deliver their monitoring objectives. This review is most commonly done by human reviewers, and less commonly (but increasingly) by Artificial Intelligence programmes. The review of video has been identified as one of the two most expensive aspects of operating an EM programme. This is because of:

- The person-hours involved in reviewing video; and
- The IT infrastructure required to transmit, receive, store, and process the vast amounts of video collected.

The *Roadmap for electronic monitoring in RFMO's* (CEO consulting, 2020) states -

> *Video review is typically the costliest component of an EM programme – often about 50 per cent of overall programme costs – and decisions about how much video to review and what data to extract need to be guided by and aligned with the overall EM programme's objectives.*

Identifying species in a WCPFC transhipment context

One of the objectives of WCPFC transhipment monitoring is to obtain and verify data on the quantity and species transhipped in the Convention Area. The paper *Catalyzing the growth of electronic monitoring in fisheries* (CEA Consulting, 2018) notes -

> *A University of Washington and NOAA collaboration has achieved greater than 95 percent species identification accuracy and length estimates with 2-3 percent margin of error for a Pacific multispecies fishery using a prototype chute-based system. This same team is also developing software to identify species as they come aboard during rail fishing operations and software that can flag behaviour anomalies (e.g., if a fish comes on board and is not taken directly to the fish chute for species identification and length measurement).*
>
> *The Nature Conservancy organized a Kaggle Competition to solicit algorithms that could automatically detect and classify species caught in tuna longline fisheries. The winning submission was close to 100 percent accurate in fish count and 75 percent accurate in species identification.*

At-Sea transhipment in the Convention Area shares little in common with the conditions in which EM has been used to successfully identify species. Specifically, in the WCPFC context:

1. Fish is typically transhipped in a processed state, and in this processed state many of the features which can be used to identify the species have been removed.
2. Fish is transhipped in a frozen state, and the layer of frost will reduce the accuracy with which species can be identified.
3. In the case of fish transhipped in a sling, the netting of the sling obstructs the identification of the species.

4. Fish is transhipped in a mass (sling or bunch). In some transhipment operations fish product is offloaded one species at a time, but mixed-species offloads are common in the region. When more than one species is transhipped, only the fish on the outside of the mass are visible. The fish inside the mass are either substantially or entirely obscured. This issue is particularly problematic, as it would be common for more than half of the fish being transhipped, in either a bunch or a sling, to be obscured. If you are willing to assume that the non-visible species in a mass are present in the same ratios as the visible species in a mass, then it may be possible to estimate the weight/count for each species in each mass; but in the context of monitoring for possible infringements this would seem to be an unsafe assumption, as it is easy to conceive of a situation in which vessels changed their transhipping behaviour in order to conceal certain species in the centre of a mass of transhipped fish.

In the WCPFC at-sea transhipment context, four additional levels of difficulty are applied over a task that is already difficult. Unless transhipping practices were profoundly changed in order to facilitate ASTEM, it is very difficult to foresee a situation in which a WCPFC ASTEM programme could deliver accurate vessel-independent data on the species transhipped in the Convention Area.

The case for an ASTEM programme collecting, storing, and reviewing video

While this has been the norm in other fisheries EM programmes, in a WCPFC ASTEM context the case for collecting, storing, and reviewing video is fragile, because:

- There is a large cost associated with collecting, storing, and reviewing video; and
- Collecting, storing, and reviewing video is unlikely to meet the data need for *weight of fish product transhipped, for each species individually*; and
- It is easy to conceive of a non-video based EM programme which could meet the Commission's other at-sea transhipment data needs at a much lower cost.

The WCPFC document *Outcomes of the review of the Commission's data needs and collection programmes* (SC project 93) concludes that the main function of ASTEM would be the verification of vessel-reported data, but project 93 considers at-sea transhipments as being one "data need" and this is an over simplification. This document identifies eight data needs for at-sea transhipments, with the *weight of fish product transhipped, for each species individually* being one of these eight. In the case of *weight of fish product transhipped for each species individually*, the conclusion of project 93 (that the best use of EM is to validate vessel-reported data) may be correct, but EM offers significantly more potential for six[15] of the other seven other at-sea transhipment data needs.

The alternative to collecting, storing, and reviewing video

If it is determined that EM is not a good tool for collecting accurate vessel-independent data on the species of fish being transhipped at-sea in the Convention Area or the intended port of landing, then that leaves six other data needs that an ASTEM programme might reasonably collect in relation to any transhipment; specifically:

1) That a transhipment has occurred
2) Offloading and Carrier Vessel IDs
3) Transhipment location
4) Transhipment date/time
5) Weight for all species combined
6) Non-fisheries related illegal activity.

Note that this is a list of data needs and not a list of how an ASTEM programme might collect such data. An ASTEM programme utilising some combination of sensors mounted on equipment (cranes, freezers, etc), motion compensated scales, still photographs, Artificial Intelligence, and possibly minimal amounts of on-shore review of still photographs; should be able to meet these six data needs at a much lower cost than a video based ASTEM programme. Assessing the total quantity of fish (all species combined) being moved between vessels would contribute to achieving the monitoring objectives of facilitating the detection of IUU fishing and verifying compliance with Conservation and Management Measures[16]. It is outside the scope of this paper to go into detail about what technology might be used to implement a non-video based ASTEM programme, other

[15] The *Intended port of landing* is excluded from the list, as it is difficult to see how this information could be practically collected by an ASTEM programme. Note that Intended port of landing could practically be collected by other transhipment monitoring tools (e.g., an updated form of Receiving Vessel Transhipment Declaration).

[16] As noted earlier, the mere presence of EM often substantially improves vessel-dependent reporting and would presumably reduce the risk that transhipments will be used to launder fish product.

than to say that models for a non-video based ASTEM programme are conceivable, and the implications for the role of the Secretariat are:

- The *Submitting ASTEM data on mass storage devices* role – may not be required to be supplied by the vessel's crew / operators or any other organisation.
- The *Providing a point of receipt for ASTEM mass storage devices* – may not be required to be supplied by the Secretariat, NFMAs, or any other organisation.
- The *Reviewing raw ASTEM data to create derived ASTEM data* – may not be required to be supplied by the Secretariat, NFMAs, or any other organisation. If this role is still required, then it would need much less effort than under the video-based ASTEM programme model. This low effort model would be based around the review of ASTEM sensor data (winches, freezers, etc), motion compensated scale data, and/or small numbers of still photographs; in order to derive that a transhipment had occurred, and the offloading vessel ID, and the weight of each sling/bunch transhipped. The Secretariat, NFMAs, or another organisation, would undertake the low-effort review role. A variant on this model would have the review being done by AI. If AI review could be achieved, then the ongoing cost/effort involved in reviewing ASTEM data could be tiny.

In summary - depending on Commission decisions around the collection, storage, and review of video; the Review role could vary from requiring zero effort to requiring more effort than all of the other roles in the ASTEM programme combined. This is true regardless of whether the Secretariat or another organisation fulfils the Review role.

Options for the role of the Secretariat in reviewing raw EM data to create derived EM data

There most obvious options for the role of the Secretariat in reviewing raw EM data to create derived EM data are:

1A. Raw EM data is not reviewed, by anyone, to create derived EM data
1B. Raw EM data is reviewed to create derived EM data, but the Secretariat is not involved in this role.
1C. The Secretariat has the role of primary reviewer of raw EM data to create derived EM data. Note that the description of this option is split to cover scenarios where video is, or is not, being reviewed.

Option	**1A. Raw EM data is not reviewed, by anyone, to create derived EM data**
Explanation	Under this option the Secretariat would not have any role in reviewing raw EM data (video, photo, sensor, motion-compensated scale) to create derived EM data (e.g., that ABC kilogrammes of fish product were transhipped).
Compatible Commission decisions	A Commission decision not to review raw EM data (video, photo, sensor, motion-compensated scale) as part of an ASTEM programme.
Additional resources required for the Secretariat (annually)	Nil
Interactions with other options	Selecting this option would: • Mean that there was no need for the *Providing a point of receipt for mass storage devices* role, and • Significantly reduce the resources required to fulfil the *Operating a central repository of ASTEM data* role.
Suitability for outsourcing by the Secretariat	Not applicable
How would this option compliment national / sub-regional ASTEM programmes?	Not applicable
How would this option support a regionally harmonised ASTEM programme?	Not applicable

Option	**1B. Raw EM data is reviewed to create derived EM data, but the Secretariat is not involved in this role**
Explanation	Under this option the Secretariat would not have any role in reviewing raw EM data (video, photo, sensor, motion-compensated scale) to create derived EM data (e.g., that ABC kilogrammes of fish product were transhipped), but some other organisation(s) would do this.
Compatible Commission decisions	Would require all of: • A Commission decision that raw EM data (video, photo, sensor, motion-compensated scale) should be collected, stored, and reviewed as part of an ASTEM programme; and • A Commission decision that some other organisation(s) should be responsible for creating derived EM data from raw EM data.
Additional resources required for the Secretariat (annually)	Nil, although something similar to the resources specified for option 1c would need to be allocated to the other organisation(s) that were conducting the review.
Interactions with other options	If video was being reviewed, selecting this option would: • Require that some organisation was performing the *Providing a point of receipt for mass storage devices* role, and • Significantly increase the resources required to fulfil the *Operating a central repository of ASTEM data* role (regardless of whether the Secretariat or some other organisation was undertaking this role).
Suitability for outsourcing by the Secretariat	Not applicable
How would this option compliment national / sub-regional ASTEM programmes?	Not applicable
How would this option support a regionally harmonised ASTEM programme?	Not applicable

Option	**1C. The Secretariat had the role of primary reviewer of raw EM data to create derived EM data**
Explanation	Under this option the Secretariat would review raw EM data (video, photo, sensor, motion-compensated scale) to create derived EM data (e.g., that ABC kilogrammes of fish product were transhipped) for most / all of the ASTEM programme.
Compatible Commission decisions	Would require all of: • A Commission decision that raw EM data should be reviewed as part of an ASTEM programme; and • A Commission decision that raw EM data should be supplied to the Secretariat, in an appropriate format and within an appropriate timeframe; and • A Commission decision that the Secretariat should be the primary organisation responsible for creating derived EM data from raw EM data.
Additional resources required for the Secretariat (annually)	If video was being reviewed with the objective of estimating the weight of each species transhipped, then $30K for review software licenses plus $20K for the courier/postage of mass storage devices[17] plus: • If 10% of transhipments are video reviewed, then $48K. • If 20% of transhipments are video reviewed, then $96K. • If 50% of transhipments are video reviewed, then $238K. • If 100% of transhipments are video reviewed, then $475K. If video was not being reviewed with the objective of estimating the weight of each species transhipped; but instead photos, sensor, or motion compensated scale data were being reviewed for 100% of transhipments with the objective of determining: that a transhipment had occurred, and the offloading vessel ID[18], and the weight of each sling/bunch transhipped; then: • $30K if the review was being done by humans • Potentially zero if the review was being done by AI[19].
Interactions with other options	If video was being reviewed, selecting this option would: • Require that some organisation(s) was performing the *Providing a point of receipt for mass storage devices* role, and • Significantly increase the resources required to fulfil the *Operating a central repository of ASTEM data* role (regardless of

[17] If the Commission had decided that video would be collected, stored and reviewed, and had allocated this role to the Secretariat, then the Secretariat would need to provide a service supplying video to authorised organisations / people (e.g., so that Member's could use raw video for their investigations / prosecutions).
[18] The system would automatically know the carrier vessel ID, because it would know which vessel it had been installed on.
[19] In the ideal scenario the AI software doing the review would be located onboard each carrier vessel, as this would substantially reduce volume of photographs that needed to be sent (probably via satellite) back to the review centre.

	whether the Secretariat or some other organisation was undertaking this role).
Suitability for outsourcing by the Secretariat	High, if appropriate commercial providers can be found.
How would this option compliment national / sub-regional ASTEM programmes?	By offering a data review service for the ASTEM data that had been collected by national / sub-regional programmes, this would remove a cost burden from these programmes.
How would this option support a regionally harmonised ASTEM programme?	Having one organisation, the Secretariat, undertaking all of the review of raw EM data to create derived EM data would ensure that there was regional consistency in the way in which data was reviewed.

OPTIONS FOR THE SECRETARIAT'S ROLE IN INFORMATION CENTRE SERVICES

Information Centre services includes the following roles:

- Providing a point of receipt for transmitted raw ASTEM data
- Possibly[20] - Operating a central repository of ASTEM data (including Custodianship of such data)
- Supplying ASTEM data[21] to other authorised organisations / people
- Producing reports / analyses, for the Commission, from data
- Comparing ASTEM data to other Commission data used to monitor transhipments, for the purpose of identifying discrepancies.

Options for these roles can largely be considered independently of options for:

- The Secretariats role in reviewing raw EM data to create derived EM data; and
- The Secretariats role in providing Port-Side services that focus on coordinating or actioning tasks that need to occur in ports or within National Fisheries Management Agencies –

although there is some overlap in that a decision to collect / store / review video would increase the resources required to implement some of the options for the Secretariat's role in Information Centre services.

Of the Information Centre roles, *comparing ASTEM data to other transhipment data to identify discrepancies* stands out as being a role for the Secretariat. A strong case could be made that this role is essential for the Secretariat to fulfil its Article 15.4(d) role of - *administering agreed arrangements for monitoring, control and surveillance*. Good cases could also be made that *supplying ASTEM data to other authorised organisations / people* and *producing reports / analyses, for the Commission, from ASTEM data* are prerequisite roles for the Secretariat's Convention mandated *administering agreed arrangements for monitoring, control and surveillance* and *facilitating the compilation and dissemination of data necessary to accomplish the objective of this Convention* roles. Additionally, it would be efficient to group the *supplying data*, *producing reports*, and *comparing ASTEM data* roles within one organisation.

For these reasons, two options are obvious for the Secretariat's role in providing Information Centre Services:

2A. The Secretariat has the roles of supplying ASTEM data, producing ASTEM reports, and comparing ASTEM data. Note, although it is possible to think of options in which the Secretariat provided only one or two of these roles, it is difficult to think of advantages for such options. In this model the Secretariat would source the ASTEM data either from a central repository operated by another organisation or from distributed repositories operated by Members.

2B. The Secretariat has the roles of providing a point of receipt for transmitted ASTEM data, operating a central repository of ASTEM data, supplying ASTEM data, producing ASTEM

[20] There are distributed models, similar to the current WCPFC ROP Transhipment programme, for an ASTEM programme in which no central repository of ASTEM data would exist. However, these models could be expected to have the same problems that are currently being experienced with the use / sharing of ROP Transhipment data. At the least, a distributed model of Data Custodianship would be less efficient than a centralised model.

[21] Probably derived ASTEM data, although raw ASTEM data might also be a possibility

reports, and comparing ASTEM data. Note, although it is possible to think of options in which the Secretariat did not provide a point of receipt for transmitted data, but did fulfil the other four roles, it is difficult to think of advantages for such an option.

Option	**2A. The Secretariat has the roles of supplying ASTEM data, producing ASTEM reports, and comparing ASTEM data**
Explanation	Under this option the Secretariat would have the role of: • Supplying ASTEM data[22] to other authorised organisations / people • Producing reports / analyses, for the Commission, from ASTEM data • Comparing ASTEM data to other Commission data used to monitor transhipments, for the purpose of identifying discrepancies. Plus either: • Another organisation would operate a central repository of ASTEM data. Members may simultaneously operate their own repositories of their ASTEM data. This has similarities to the current ROP Purse Seine and Longline model. The Secretariat would source the ASTEM data that it needed from the central repository; or • There would be no central repository of ASTEM data, but Members would operate their own repositories of their ASTEM data. This has similarities to the current ROP Transhipment model. The Secretariat would source the ASTEM data that it needed from Members.
Compatible Commission decisions	Would require all of: • A Commission decision granting the Secretariat access to ASTEM derived data, as held in a central repository operated by another organisation or by Members; and • A specification of the timeliness (e.g., in real-time, daily, weekly, etc) for such access. This is important to allow the Secretariat to respond to time-sensitive data needs (e.g., supplying data to Members for the purpose of planning surveillance operations); and • A detailed specification of the manner in which the Secretariat would access the ASTEM data. This is important to allow the Secretariat's access to data to occur efficiently. To-date the Commission has typically operated processes whereby Members or sub-regional agencies "push" data to the Secretariat. For ASTEM the Commission should also consider the alternative whereby

[22] This would not include video, unless the Secretariat had separately been assigned the role of video reviewer. If video was being collected, stored and reviewed; then the obvious organisation to supply video would be whichever Member / sub-regional agency was doing the review.

	the Secretariat "pulls" data, ideally via a Web Service[23], from Members or a central repository operated by another organisation. Both models are feasible. To be implemented efficiently, either model would require appropriate Commission decisions and detailed standards.
Additional resources required for the Secretariat (annually)	$133K to employ a suitably qualified staff member to fill a Transhipment Data Analyst role. If access to the central repository of all ASTEM data was not via a high quality web service, then some additional IT server resource to allow the Secretariat to store large amounts of ASTEM data ($10K).
Interactions with other options	Nil
Suitability for outsourcing by the Secretariat	Low. See notes 1 and 2 below.
How would this option compliment national / sub-regional ASTEM programmes?	By offering a supply / reporting / analysis service for the ASTEM data that had been collected by national / sub-regional programmes, this would remove a cost burden from these programmes.
How would this option support a regionally harmonised ASTEM programme?	This would be of minor benefit in achieving a harmonised regional ASTEM programme. The main benefit would be that, in comparing ASTEM data to other transhipment data to identify discrepancies, issues with the inconsistent collection of ASTEM data across the region could be identified and feed back to national / sub-regional programmes.
Notes	1) These roles align closely with the Secretariat's role as defined in the Convention; and 2) The Secretariat is currently the only organisation that could fulfil the *Comparing ASTEM data to other transhipment data to identify discrepancies* role, as no other organisation has access to the full set of VMS and Transhipment Notification / Declaration data. 3) Nothing in this option precludes other organisations from simultaneously producing reports / analyses from ASTEM data for themselves.

[23] In a Web service a web technology such as HTTP is used for transferring machine-readable file formats such as XML and JSON. For a full explanation see https://en.wikipedia.org/wiki/Web_service

Option	**2B. The Secretariat has the roles of providing a point of receipt for transmitted data, operating a central repository of ASTEM data, supplying ASTEM data, producing ASTEM reports, and comparing ASTEM data**
Explanation	Under this option the Secretariat would have the role of: • Providing a point of receipt for transmitted ASTEM data • Operating a central repository of ASTEM data (including Custodianship of such data) • Supplying ASTEM data to other authorised organisations / people[24] • Producing reports / analyses, for the Commission, from data • Comparing ASTEM data to other Commission data used to monitor transhipments, for the purpose of identifying discrepancies. This option has similarities to the current VMS and Transhipment Notification / Declaration models.
Compatible Commission decisions	Would require all of: • A Commission decision requiring Members to supply ASTEM data to the Secretariat[25]; and • A specification of the timeliness (ideally, "real-time" or "immediately") for such supply. This is important to allow the Secretariat to respond to time-sensitive data needs (e.g., supplying ASTEM data to Members for the purpose of planning surveillance operations); and • A detailed specification of the manner in which vessels or Members would provide the data[26]. This is important to allow the Secretariat's loading of data to occur efficiently; and • A specification (probably in the form of an SSP) of how the Secretariat would perform its ASTEM Data Custodianship role.
Additional resources required for the Secretariat (annually)	$20K to operate the IT infrastructure required to provide a point of receipt for transmitted ASTEM data. Plus, the IT infrastructure required to receive and store ASTEM data. If the Commission selects an option that requires the Secretariat to store and review video (options 1c) then $52K. If the Commission selects an option that does not require the Secretariat to store and review video (options 1a or 1b) then $20K. Plus, $133K to employ a suitably qualified staff member to fill a Transhipment Data Analyst role.

[24] Consideration should be given to adopting the Secretariat's current model for Transhipment Notification / Declaration data and allowing each Member to see the data that it has submitted online. Consideration should also be given to extending this model and allowing each member web service access to the data that it had submitted (which would allow members to download a copy of their data at will).
[25] Clauses 7 and 9 of the VMS CMM (2014-02) provide a possible model for such a requirement.
[26] If Members were supplying the data, then ideally this would be a specification of a Web Service.

Interactions with other options	As described above, if the ASTEM programme was video based then more resources would be required to store data.
Suitability for outsourcing by the Secretariat	Mixed. *Comparing ASTEM data to other transhipment data to identify discrepancies* would seem to be a core role of the Secretariat as defined in the Convention. This and the *producing ASTEM reports / supplying ASTEM data* roles have a low suitability for outsourcing. *Providing a point of receipt for transmitted ASTEM data* and *operating a central repository of ASTEM data (including Custodianship of such data)* have a higher suitability for outsourcing and this should be considered (while noting the sensitive nature of ASTEM data).
How would this option compliment national / sub-regional ASTEM programmes?	By offering a supply / reporting / analysis / Custodianship service for the ASTEM data that had been collected by national / sub-regional programmes, this would remove a cost burden from these programmes.
How would this option support a regionally harmonised ASTEM programme?	In comparing ASTEM data to other transhipment data to identify discrepancies, issues with the inconsistent collection of ASTEM data across the region could be identified and feed back to national / sub-regional programmes. By ensuring that all ASTEM data collected throughout the region was subject to the same Data Custodianship practices.
Note	1) The Secretariat is currently the only organisation that could fulfil the *Comparing ASTEM data to other transhipment data to identify discrepancies* role, as no other organisation has access to the full set of VMS and Transhipment Notification / Declaration data. 2) Nothing in this option precludes other organisations from simultaneously operating repositories of subsets of ASTEM data. For example, a sub-regional agency could operate a repository containing copies of the ASTEM data from its Members, and Members could operate repositories containing copies of their ASTEM data. Although, it may be more efficient for the Secretariat to provide a service whereby each Member (or sub-regional agency) had online access to that portion of the data in the central repository that it was authorised to see[27]. 3) The path through which ASTEM data flowed into the central repository operated by the Secretariat would need to be decided on. Obvious options include: a. ASTEM data flows directly from the vessels to a point of receipt for transmitted ASTEM data that is operated by the Secretariat. From the Secretariat, subsets of this data might then automatically be made available to Members / sub-regional agencies.

[27] As the Secretariat currently does with its online portal for Member submitted Transhipment Notification / Declaration data.

	b. ASTEM data flows directly from the vessels to points of receipt for transmitted ASTEM data that are operated by Members / sub-regional agencies. From the Members / sub-regional agencies, ASTEM data is then automatically made available to the Secretariat. c. ASTEM data flows directly from the vessels to a point of receipt for transmitted ASTEM data that is operated by a commercial provider. From the commercial provider, ASTEM data is then made available simultaneously to the Secretariat and a sub-regional agency and Members; each receiving that subset of the ASTEM data that they are authorised to access. 4) If this option was selected, then something similar to clauses 7 and 9 of the Vessel Monitoring System CMM (2014-02) could be used to impose an ASTEM data supply obligation on vessels.

Ownership of ASTEM data

Any attempt to create a central repository of ASTEM data will result in a discussion of "Data Ownership". The ownership of data is often a topic of considerable interest, but it is less common for what it means to be a Data Owner to be carefully considered. While the idea of owning something may have an intuitive appeal, what does it mean to own a resource that can be infinitely replicated at near-zero cost? There are few widely agreed terms in the field of Data Management / Information Management[28], and there is no widely agreed definition of the powers and responsibilities of a Data Owner. The most common approach is for data governance roles to be divided into Data Owner, Data Steward, and Data Custodian. The Custodian typically does the day-to-day work required to ensure that data is fit for purpose and appropriately used. The Steward typically establishes Standards for this day-to-day work. The Owner typically ensures that the other two roles are functioning appropriately and makes decisions in cases where the SSPs allow for discretion. However, a Google search on these terms will surface many other interpretations. Rather than be drawn into abstract debates about what it means to be a Data Owner, it would be more productive if the WCPFC concentrated on (1) which organisation is responsible for each of the range of data governance tasks that will need to be actioned in order for ASTEM data to be useful to the Commission and its Members, and (2) what decisions Members want to be able to make regarding ASTEM data. Ultimately this approach will serve the Commission better than relying on individual interpretations of undefined terms.

	Who defines the Standards, Specifications and Processes?	Who does the day-to-day work?
Ensure the quality (accuracy, completeness, precision, etc) of ASTEM data		
Ensure the availability of ASTEM data, within appropriate timeframes and in an appropriate format, for authorised use		
Ensure the confidentiality of classified / sensitive ASTEM data		
Protect the privacy of individuals identified in ASTEM data is appropriately protected		

[28] There is far from universal agreement on what the discipline should be called, with the same role being called Data Management in some contexts and Information Management in others. Note that Data Management is a distinct discipline from Database Management, and Information Management is a distinct discipline from Records Management, and then there is Knowledge Management…

Protect ASTEM data from loss or corruption		
Ensure that versions of ASTEM data are correctly maintained		
Ensure that an audit trail, of changes to ASTEM data, exists and is correct		
Ensure the appropriate disposal of ASTEM data at the end of its lifecycle		

Example table of data governance tasks

Retention / disposal of video

Any video based fisheries EM programme will collect very large volumes of data. The total volume of data stored will compound each year. For example, if 1000 units of video data are collected each year, then:

- At the end of year one the Data Custodian will be storing 1000 units of video data.
- At the end of year two the Data Custodian will be storing 2000 units of video data.
- At the end of year three the Data Custodian will be storing 3000 units of video data.

This process will cause the costs associated with storing video data to increase each year. The significant and compounding costs associated with storing video data is one of the unusual aspects of most EM programmes. While the temptation is always to retain fisheries data because it "might be useful one day", the significant and compounding costs of retaining video (in particular) will create a need to establish a disposal regime for ASTEM video data. This disposal regime will need to balance the benefits of retaining video data against the associated cost. Some Members will have domestic legislation that requires Government agencies to retain data for specific periods of time or to meet evidential standards. These will need to be considered. It may be an option for individual Members to retain a copy of the ASTEM video that they collected. It may also be an option for the Custodian of a central repository of ASTEM data to have different disposal regimes for different Members ASTEM video.

OPTIONS FOR THE SECRETARIAT'S ROLE IN PORT-SIDE SERVICES

Port-Side services includes the following roles:

- Auditing National ASTEM programmes
- Administering / oversighting the regional ASTEM programme
- Ensuring that services to repair / replace ASTEM equipment are available
- Possibly[29] - Providing a point of receipt for mass storage devices
- Capacity building.

Options for these roles can largely be considered independently of options for:

- The Secretariats role in reviewing raw EM data to create derived EM data; and
- The Secretariats role in providing Information Centre services –

although there is some overlap in that a decision to collect / store / review video would result in a need to provide a point of receipt for mass storage devices.

Of the Port-Side roles, *Auditing National EM programmes* stands out as being a role for the Secretariat. A strong case could be made that this role is essential for the Secretariat to fulfil its Article 15.4(d) role of - *administering agreed arrangements for monitoring, control and surveillance*.

Of the other Port-side roles:

- *Administering / oversighting the ASTEM programme* – is a role that will need to be split between NFMAs, with a central organisation (possibly the Secretariat) performing those parts of the role that require regional coordination or are more efficient if centralised.
- *Providing a point of receipt for mass storage devices* – if required at all - is not a role to which the Secretariat would be well suited. This role should be undertaken by either commercial providers or port-side Member Government agencies.

However, it may be that, for at least some of the Port-Side roles identified, no better organisation exists; in which case the Secretariat may have to take on these roles by default.

Two options are obvious for the Secretariat's role in providing Port-Side services:

3A. The Secretariat has the role of auditing National ASTEM programmes.
3B. The Secretariat has the roles of auditing National ASTEM programmes, administering / oversighting the programme (along with NFMAs), ensuring that services to repair / replace equipment are available, and capacity building. Note, although it is possible to think of options in which the Secretariat provided only a few of these roles, having one organisation do all of them is likely to be more efficient.

[29] There are models for an ASTEM programme in which mass storage devices would not be collected from vessels. In these models either (1) all ASTEM data would be transmitted electronically via satellite or in-port phone network, or (2) data requiring mass storage would be collected but retained onboard the vessel and only made available during audits/inspections.

Option	**3A.** The Secretariat has the role of auditing National ASTEM programmes.
Explanation	Under this option the Secretariat would have the role of auditing National ASTEM programmes, but other organisations would have the role of: • Administering / oversighting the regional ASTEM programme • Ensuring that services to repair / replace equipment are available • Possibly - Providing a point of receipt for mass storage devices • Capacity building.
Compatible Commission decisions	Commission decisions that: • the Secretariat would be responsible for auditing National EM programmes; but • organisations other than the Secretariat would be responsible for other Port-Side services.
Additional resources required for the Secretariat (annually)	$50K[30]
Interactions with other options	Nil
Suitability for outsourcing by the Secretariat	High. If suitably qualified independent auditors could be found, then this would be an obvious candidate for outsourcing.
How would this option compliment national / sub-regional ASTEM programmes?	By providing a means of independent quality control.
How would this option support a regionally harmonised ASTEM programme?	By ensuring that all National ASTEM programmes complied with pre-agreed regional standards.
Notes	Members will need to each administer their part of a regional ASTEM programme, but some level of central oversight will be needed to ensure consistency and regional integration.

[30] Being approximately one quarter of the amount currently spent to administer / oversight the VMS programme each year.

Option	**3B.** The Secretariat has the roles of auditing National ASTEM programmes, administering / oversighting the regional ASTEM programme, ensuring that services to repair / replace equipment are available, and capacity building.
Explanation	Under this option commercial providers or port-side Member Government agencies would have the role of providing a point of receipt for mass storage devices (if such a role was required at all). The Secretariat's role would include: • Auditing National ASTEM programmes • Ensuring integration / synchronisation, between the different organisations providing different aspects of the ASTEM programme. • Accreditation of suppliers of EM equipment / services. • Maintaining the register of vessels required to operate ASTEM equipment. • Ensuring that key ASTEM infrastructure, such as points of receipt for transmitted data and for mass storage devices (if required), were functioning in accordance with agreed standards. • Ensuring that services to repair / replace ASTEM equipment were available in key ports. • Training and capacity building. NFMA's role would include ensuring that vessels flying their flag complied with the requirements established by the Commission for the purposes of the Commission ASTEM programme.
Compatible Commission decisions	A Commission decision that than the Secretariat would be responsible for most Port-Side services.
Additional resources required for the Secretariat (annually)	$300K, being (1) $50K to audit National EM programmes, plus (2) $150K to administer / oversight the ASTEM programme, plus (3) $25K for capacity building / training, plus (4) $75K to ensure that services to repair / replace ASTEM equipment were available in 10 key ports.
Interactions with other options	If option 1B had been selected, and raw ASTEM data was being reviewed in bulk by organisations other than the Secretariat, then this would increase the amount of effort that the Secretariat needed to put into administering / oversighting programme and training / capacity building. This would be needed to help ensure that review was being done consistently throughout the ASTEM programme.
Suitability for outsourcing by the Secretariat	Mixed. It may be difficult to find non-conflicted commercial providers who could deliver these roles at an appropriate level of quality.
How would this option compliment national / sub-	By providing a means of independent quality control.

regional ASTEM programmes?	By offering administration / oversight services for the ASTEM programmes operated by national / sub-regional agencies, this would remove a cost burden from these agencies. By offering ASTEM capacity building services to national / sub-regional programmes.
How would this option support a regionally harmonised ASTEM programme?	By increasing consistency in the implementation of national / sub-regional ASTEM programmes.
Note	As with the existing VMS programme, the full range of administration tasks will need to be split between Members and the Secretariat; as there are some interactions with vessels / fishing companies that are clearly the responsibility of Members. Consideration would need to be put into defining this split of roles so as to avoid duplicated or missing effort.

CONCLUSION

Scalability

It is highly desirable that any Secretariat role in an at-sea transhipment EM programme has the potential to be scaled up and re-used in a subsequent longline or purse-seine EM programme. None of the options for the role of the Secretariat in an ASTEM programme would take the Secretariat down any "dead ends". All of the infrastructure that would be created within the Secretariat could be re-used in a subsequent longline or purse-seine EM programme. However, some of the options would provide the Secretariat with more EM infrastructure / experience than other options. The greatest point of difference between an at-sea transhipment EM programme and a longline EM programme would be with regard to the collection, storage, and review of video. While the case for video based EM is fragile in the transhipment context, it is much stronger in the longline context (where there is a much greater expectation of being able to identify species from video). As such it might be that an ASTEM programme provided the Secretariat with the infrastructure and experience relevant to all aspects of subsequently operating a longline EM programme, with the exception of those related to the collection, storage, and review of video.

Proof-of-concept

Most of the technology associated with fisheries EM programmes is now well proven. Additionally, in its VMS and Transhipment Notification / Declaration programmes, the Secretariat has significant infrastructure and experience with receiving real-time data electronically. In general, there is no reason to suspect that the technologies associated with an ASTEM programme would be more than an incremental step for the Secretariat. However, there are two areas of technology which would benefit from further investigation. These are:

1) Do motion compensated scales that are suitable for use in a WCPFC ASTEM programme exist? Motion compensated scales which can measure the appropriate load and transmit this to a nearby computer already exist; but are they cheap enough to be practical, tough enough to handle transhipment operations in the Pacific[31], while also being appropriately tamper resistant[32]? Trials of candidate motion compensated scales could initially take place during in-port transhipments, with short-listed scales then being subject to trials at sea. For the purpose of these trials, it would be very helpful to have cooperation from a far-sighted carrier vessel operator. The paper *Electronic Monitoring on Transhipment Vessels Operating in the Western and Central Pacific Ocean Longline Tuna Fishery* (Heberer, 2020) might identify a useful starting point.
2) Can data review Artificial Intelligence, which is suitable for use in a WCPFC ASTEM programme, be developed for an appropriate cost? Such AI would need to take as its inputs some combination of video, photos, sensor, or motion compensated scale data; and from

[31] A study documented in the paper *Standardised Monitoring Procedures for Longline Transhipments in the WCPFC* (Brogan, 2020) attempted to use a digital scale while monitoring 13 at-sea transhipments in the Convention Area. The scale malfunctioned during the first transhipment and during the third transhipment "the crane scale broke and its bright orange castings flew across the deck". The paper also notes that the scale "could not handle the harsh environment which included continuously moving from plus 30 degrees to minus 20 degrees in the space of 3-4 minutes, as well as being hit against rock hard surfaces (albacore!)".

[32] For example, would the vessel crew be able to incorrectly tare the scale so that it under-reported the weight of fish product transhipped?

these determine that a transhipment had occurred, and the offloading vessel ID, and the weight of each sling/bunch transhipped. Of particular interest would be to see if AI could accurately estimate the weight of fish product transhipped using only photographs of transhipment operations[33], as this would create an information source that could supplement (and verify) readings from on-board motion compensated scales. This seems achievable given the current state of AI technology, but the WCPFC would need to commission its development. Ideally this AI would be based onboard the carrier vessel, to minimise the amount of data that needed to be transferred (via satellite) from the vessel to the review centre. This would mean that the AI needed to be able to run on a low-spec computer. AI applications which run on low spec computers (including mobile phones) are becoming increasingly common. AI review may or may not be cost effective, and further investigation will be needed to determine this.

There is every reason to be optimistic that, following investigation, appropriate solutions for both of these technology questions would be identified. Once these solutions had been identified, the Commission could consider conducting a pilot ASTEM programme; but, by that stage all of the individual technologies would have been proven and it is difficult to see why putting them together would be problematic. Rather than a pilot, a better option (after appropriate motion compensated scale and AI review technology had been found) may be to opt for a phased implementation of an ASTEM programme across the fleet of carrier vessels, starting with a modest number of vessels.

[33] With practice humans can do this fairly accurately. This seems like an obvious candidate for AI trials.

Conclusions

1) Of the range of roles that would be required to implement a WCPFC at-sea transhipment electronic monitoring (ASTEM) programme, the roles that are most suited for provision by the Secretariat are:
    a. Supplying ASTEM data to other authorised organisations / people
    b. Producing reports / analyses, for the Commission, from ASTEM data
    c. Comparing ASTEM data to other Commission data used to monitor transhipments, for the purpose of identifying discrepancies
    d. Auditing National ASTEM programmes.
2) Beyond the four roles identified above, there are a further six roles that the Secretariat is an obvious candidate to provide, but other candidates should also be considered. These are:
    a. Providing a point of receipt for transmitted ASTEM data
    b. Operating a central repository of ASTEM data (including Custodianship of such data)
    c. Reviewing raw EM data (video, photo, sensor, motion-compensated scale) to create derived EM data (e.g., that ABC kilogrammes of fish product were transhipped)
    d. Administering / oversighting the programme (along with NFMAs)
    e. Capacity building
    f. Ensuring that services to repair / replace equipment are available in the appropriate ports.
3) A key issue in defining the Secretariat's role in a future ASTEM programme is Member's expectations regarding the Secretariat's ability to provide them with time-sensitive ASTEM data (e.g., supplying ASTEM data to Members for the purpose of planning surveillance operations). If the Secretariat is expected to be able to provide time-sensitive ASTEM data to Members, then the Measures used to establish the ASTEM programme would need to be similar to those used to establish the current VMS programme. If the Secretariat is not expected to be able to provide time-sensitive ASTEM data to Members, then the Measures used to establish the ASTEM programme could be more similar to those used to establish the current Regional Observer Programme.
4) The path for the flow of ASTEM information to the Secretariat is not a critical consideration at this stage. Many models for the flow of information could be made to work. Utilising modern technology, ASTEM data could flow through serial paths from the vessel to organisation A and then onto organisation B; or through parallel paths from the vessel to organisations A and B. At this stage, timing and format (of information supply) are more important than path.
5) An area of uncertainty in defining the Secretariat's role in a future ASTEM programme is the issue of video review. The case for the review of video in an ASTEM programme is fragile. If the review of video is required, then the resources that the Secretariat (or any other organisation) would require to fulfil an *Operating a central repository of ASTEM data* and *Reviewing raw EM data to create derived EM data* role would be greatly increased. The alternative to the review of video would be an ASTEM programme utilising some combination of sensors mounted on equipment (cranes, freezers, etc), motion compensated scales, still photographs, Artificial Intelligence, and possibly minimal amounts of on-shore review of still photographs.

Possible future work to clarify issues of uncertainty

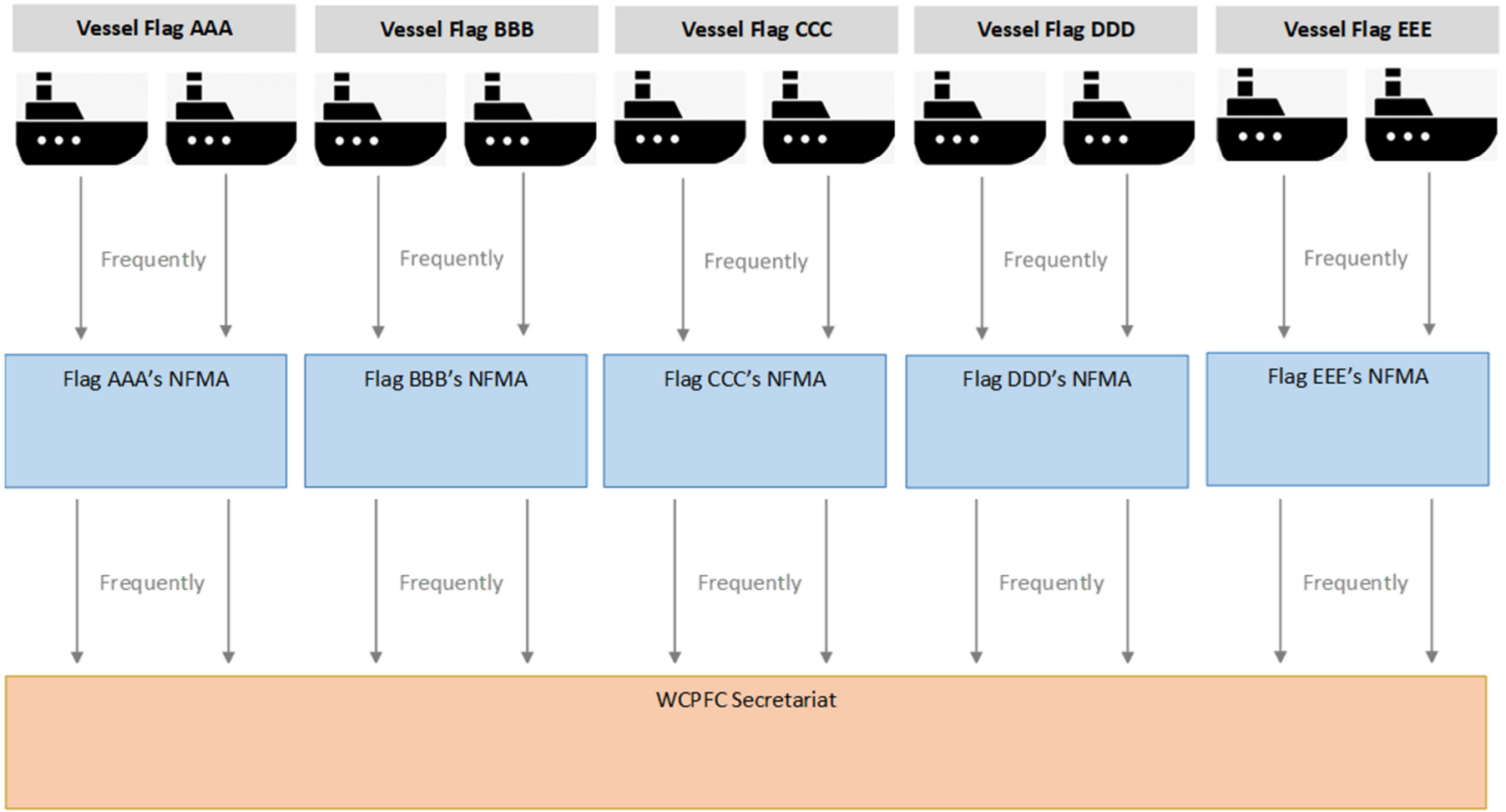
With regard to clarifying options for the WCPFC Secretariat's role in a possible future regional at-sea transhipment electronic monitoring programme, the future work which would be of most immediate benefit is:

1) Verifying the Commission's interest, in principle, in having a regional at-sea transhipment electronic monitoring programme.
2) Achieving clarity regarding how a future ASTEM programme would fit into a multi-tool integrated monitoring programme for at-sea transhipments[34].
3) Undertaking work to determine whether motion compensated scales that are suitable for use in a future ASTEM programme exist or can be easily developed.
4) Undertaking work to determine whether Artificial Intelligence which is suitable for reviewing data in a future ASTEM programme can be easily developed.
5) Conducting an initial assessment of whether the Commission's interest, in principle, is in a video based or non-video based future ASTEM programme.
6) Conducting an initial assessment of whether the Commission's interest, in principle, is in having the Secretariat be able to supply Members with time-sensitive ASTEM data.
7) Using the output of the tasks listed above, documenting viable options for the flow of ASTEM information from vessels to the Secretariat.
8) Using the output of the tasks listed above, improve the estimates of ASTEM resource requirements for the potential role of the Secretariat.

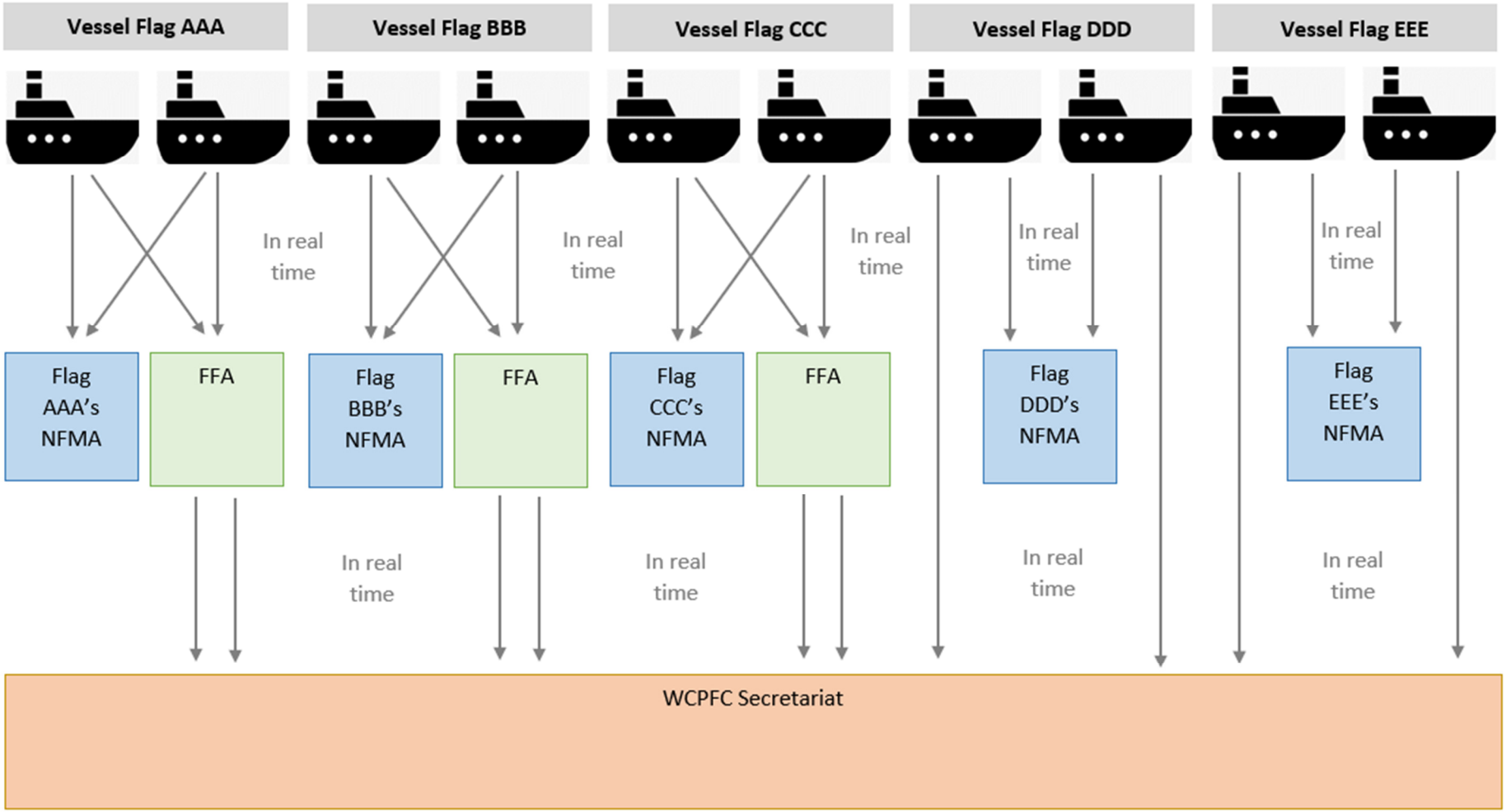
[34] Considering ASTEM in isolation creates the risk that EM will be viewed as a silver bullet, an approach which ignores both its strengths and weaknesses. To achieve the best use of ASTEM the Commission needs to know (a) what its transhipment monitoring objectives are, and (b) how its existing monitoring tools contribute to these objectives, and (c) how ASTEM can assist with filling the gaps. This analysis should give appropriate consideration to EM's ability to improve vessel-dependent reporting.

ANNEX 1 – CURRENT INFORMATION FLOWS

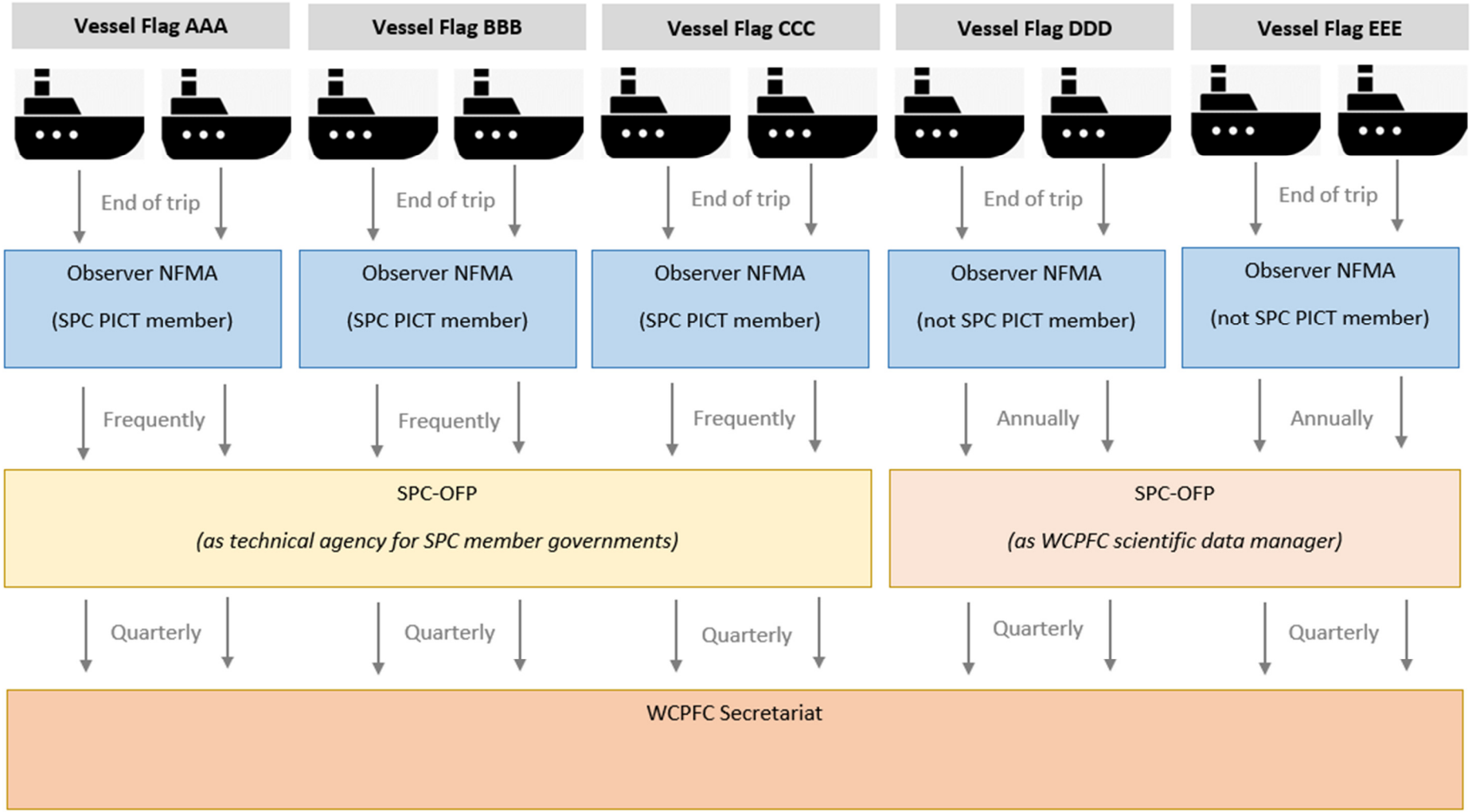
FLOW OF INFORMATION INTO THE SECRETARIAT – High Seas Transhipment Notifications and Declarations



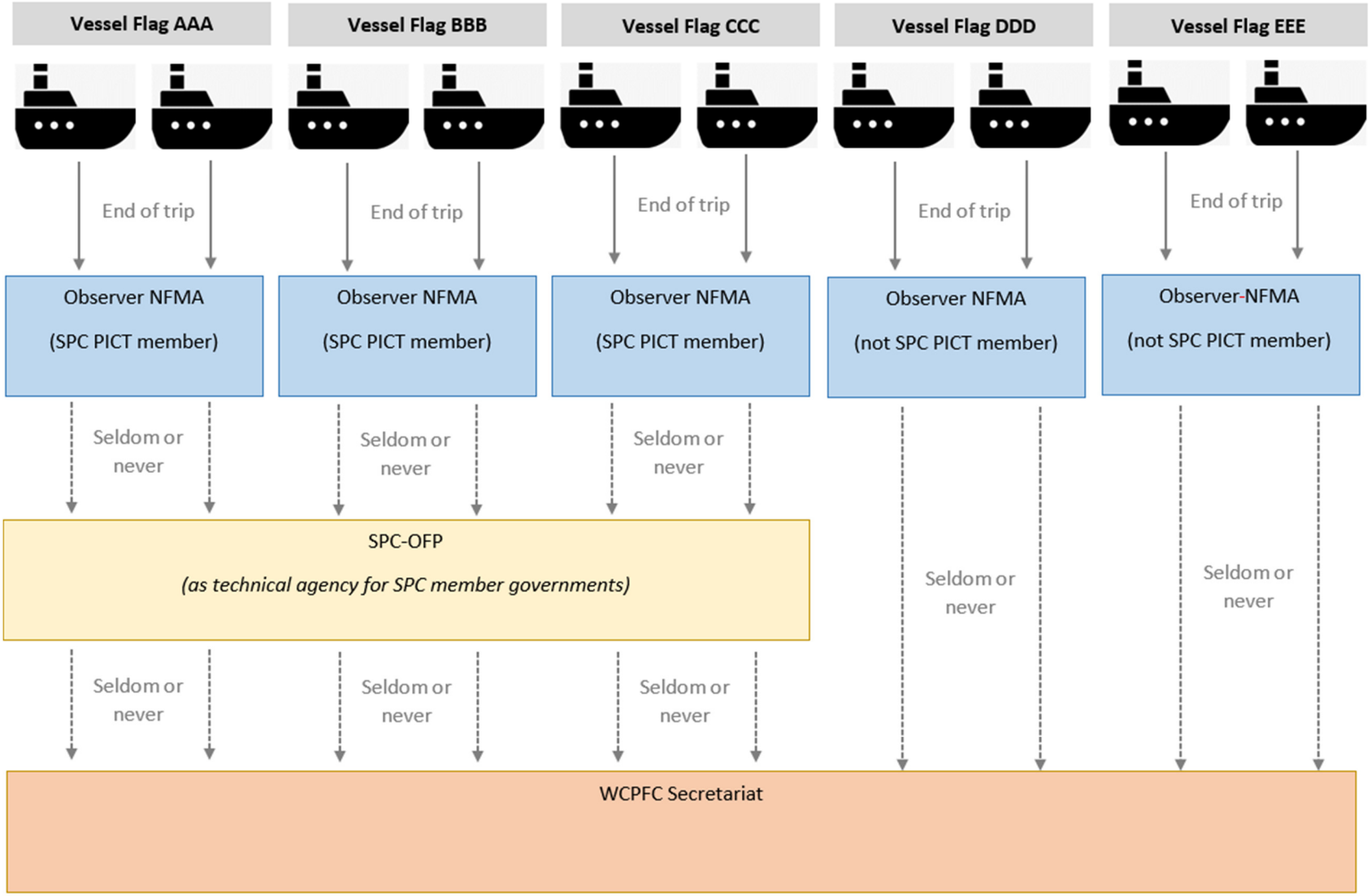
FLOW OF INFORMATION INTO THE SECRETARIAT – Vessel Monitoring System



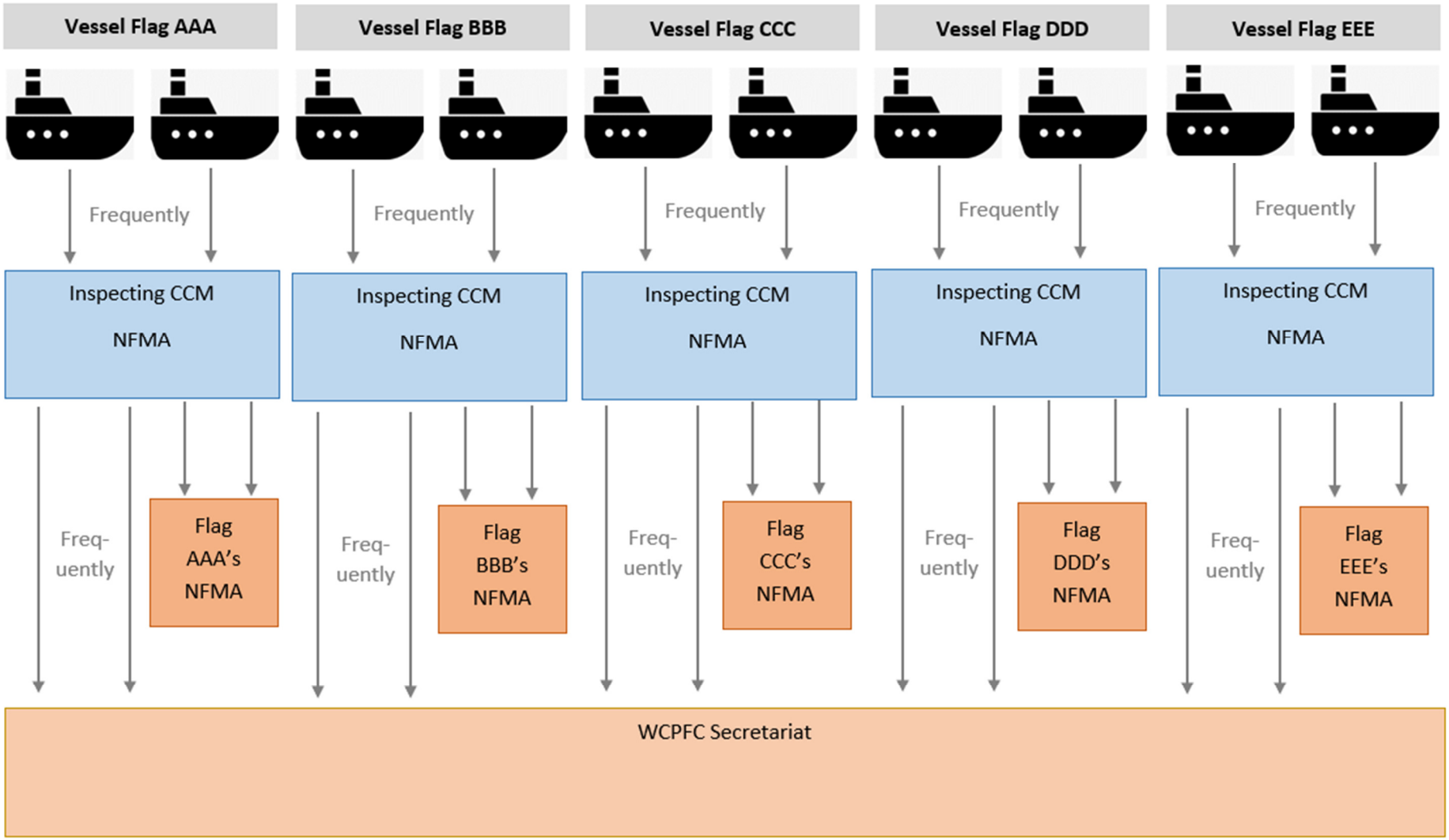
FLOW OF INFORMATION INTO THE SECRETARIAT – Regional Observer Programme for purse seine and longline vessels



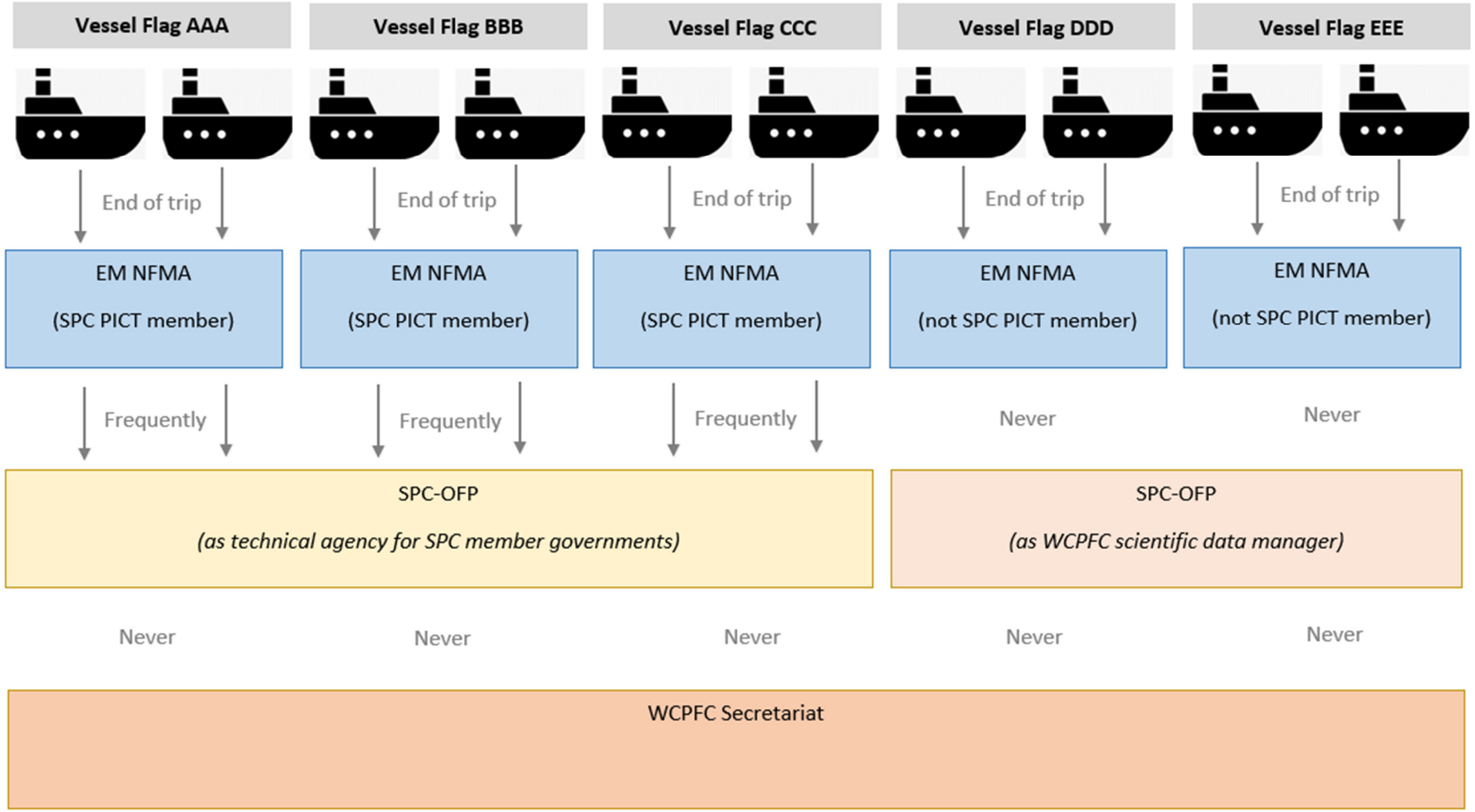
FLOW OF INFORMATION INTO THE SECRETARIAT – Regional Observer Programme for transhipment vessels



FLOW OF INFORMATION INTO THE SECRETARIAT – Inspections (e.g. HSBI or Port)



FLOW OF INFORMATION INTO THE SECRETARIAT – Pilot Regional Electronic Monitoring Programmes



APPENDIX 2 – COST ASSUMPTIONS

It is outside the scope of this paper to identify accurate costing for a possible future WCPFC ASTEM programme. An effort has been made to identify indicative costs that can be used when comparing high level options for the role of the Secretariat. All of the costs below are for the ongoing operation of a possible future ASTEM programme. Although many studies focus on setup costs, the costs for ongoing operation will ultimately be much more significant. All of the costs discussed are for shore-side roles, and exclude the costs associated with (1) Ensuring the correct operation of ASTEM data gathering equipment on vessels, and (2) Ensuring the correct operation of ASTEM data transmitting equipment, and (3) Submitting ASTEM data on mass storage devices.

Where published studies of the cost of fisheries EM programmes exist, the ongoing shore-side costs typically fall within the range $150 to $450 per vessel per monitored day.

Video review is often described as the most expensive aspect of fisheries EM programmes. The covering letter to the paper *Projected cost of providing electronic monitoring to 100 vessels in New England's Groundfish fishery* (The Nature Conservatory, 2019) states that the estimated cost of reviewing 100% of video collected to be in the range $270 to $335 per vessel per monitored day. As such, differences in approaches to video review account for a lot of the variation in the per vessel per monitored day

WCPFC Members reported 1472 high seas transhipments and 111 in-zone transhipments for 2019. The paper *Transhipment in the Western and Central Pacific* (Pew Charitable Trust, 2019) estimates 1538 high seas transhipments and 703 in-zone transhipments for 2016. For the purpose of estimating ongoing operating costs of a possible future ASTEM programme, this paper assumes 2,000 at-sea transhipments per year. The paper *Standardised Monitoring Procedures for Longline Transhipments* in the WCPFC (Brogan, 2020) found that the average duration of the thirteen transhipments observed was approximately 19 hours. For the purpose of estimating ongoing operating costs of a possible future ASTEM programme, this paper assumes 1600 days of at-sea transhipments per year need to be monitored.

Supplying ASTEM data to other authorised organisations / people; and Producing reports / analyses, for the Commission, from ASTEM data; and Comparing ASTEM data to other transhipment data to identify discrepancies	I assume $133K, being the full cost of a Transhipment Data Analyst (WCPFC professional grade J).
Operating a central repository of data (including Custodianship of such data)	I assume that the IT infrastructure to support an ASTEM programme which did not store large amounts of video would cost approximately $20K per annum. This is approximately the amount that the Secretariat currently pays for the IT infrastructure to support the VMS programme.

	I assume that the IT infrastructure to support an ASTEM programme which did store large amounts of video would cost approximately $52K per annum. The paper *Cost efficiency analysis of fisheries monitoring for catch accounting in the NE multispecies groundfish fishery* (Demarest,2019) estimated video storage would cost $208,000 per annum for a fishery with approx. 8300 monitored vessel days. This suggests that it costs approx. $25 to store video, for one year, from one monitored vessel day. This figure assumed that video was retained for three years. The paper *Projected cost of providing electronic monitoring to 100 vessels in New England's Groundfish fishery* (The Nature Conservatory, 2019) states that on average the vessels in this fishery have three cameras. I have assumed that transhipment vessels will have an average of four cameras, and therefore it will cost $33 to store video, for one year, from one monitored vessel day. Note that the $52K per annum estimate assumes that there is technology onboard the carrier vessel that ensures that video is only collected during transhipment operations, and not all of the time.
Reviewing raw EM data to create derived EM data	Video review is often described as the most expensive aspect of fisheries EM programmes. The covering letter to the paper *Projected cost of providing electronic monitoring to 100 vessels in New England's Groundfish fishery* (The Nature Conservatory, 2019) states that the estimated cost of reviewing 100% of video collected to be in the range $270 to $335 per vessel per monitored day. I assume that 100% review of video of at-sea transhipments would cost approximately $475K per annum, being $300 per vessel per monitored day multiplied by 1,600 days of transhipments that need to be monitored. In addition to the cost of reviewing video is the annual license cost for video review software. The paper Projected cost of providing electronic monitoring to 100 vessels in New England's Groundfish fishery estimates this to be $30K. --- For non-video based monitoring – I assume $30K. The paper *Standardised Monitoring Procedures for Longline Transhipments in the WCPFC* (Brogan, 2020) found that the average number of slings transferred per transhipment was 150. If 30,000 slings needed to be reviewed each year, and each sling took 2 minutes to review, that would suggest that reviewing all slings would take approx. 1,000 hours per year.
Administer / oversight programme	I assume $200K, being the same amount that is currently set aside for administering the VMS programme.
Capacity building	I assume $25K, being the same amount that is currently set aside for training / capacity building for the VMS programme.
Providing a point of receipt for transmitted data	I assume $20K.

Ensuring services to repair / replace equipment are available	I assume $75K, being $7.5K per port that transhipment vessels regularly call at, and 10 ports being allowed for.