

Guidance on cooperative approaches referred to in Article 6, paragraph 2 of the Paris Agreement and decision 2/CMA.3

Functional requirements and associated cost estimates for the international registry

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Acronyms and abbreviations

A6.4ERs	Article 6.4 Emission Reductions
ABAC	Attribute-Based Access Control
AEF	Agreed Electronic Format
API	Application Programming Interface
CARP	Centralized Accounting and Reporting Platform
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CRM	Customer Relationship Management System
DLT	Distributed Ledger Technology
ERP	Enterprise Resource Planning System
ITMO	Internationally Transferable Mitigation Outcome
MO	Mitigation Outcome
NDC	Nationally Determined Contribution
OIMP	Other International Mitigation Purposes
PCI DSS	Payment Card Industry Data Security Standard
RPO	Recovery Point Objective
SBSTA	Subsidiary Body for Scientific and Technological Advice
SLA	Service Level Agreement
UNFCCC	United Nations Framework Convention on Climate Change
WCAG	Web Content Accessibility Guidelines



Glossary

This glossary contains key terms as defined in the context of this document. The terms are specific to this document and may differ from their common definition or definitions provided or used elsewhere within the UNFCCC.

Authorization	Also referred to as authorization of use. A statement by a Party that mitigation outcomes are authorized for certain uses under Article 6 and will be correspondingly adjusted in the Party's reporting. Not to be confused with registry user authorization.
Business rule	A set of conditions that allow or disallow operations and any automatically triggered consequences of an operation to which the business rule is applied.
Common nomenclature	A centrally controlled list or hierarchy of elements (values) maintained by the CARP as per decision 6/CMA.4, annex I, chapter II.B.
Cooperative approach	A cooperative approach is a bilateral or multilateral arrangement between participating Parties that implements mitigation activities from which ITMOs can be authorized for use towards nationally determined contributions or for other international mitigation purposes.
Data object	A data structure that is stored in an IT system and describes a real-world business object, such as an ITMO, an account, a transaction etc.
Descriptor record	A data record, such as the authorization or the first transfer marker, that affects the execution of business rules on actions or transactions with ITMOs to which the descriptor record applies.
First transfer	An event in the life cycle of a ITMO as per decision 2/CMA.3 annex, paragraph 2, i.e., for ITMOs authorized for use towards NDC, the first international transfer; for ITMOs authorized for use for OIMP, (1) the authorization, (2) the issuance or (3) the use or cancellation of the mitigation outcome, as specified by the participating Party. ITMOs on which first transfer is performed will be correspondingly adjusted in the first-transferring Party's reporting.
Fragmentation	An undesirable growth in the number of unit blocks in a registry system.
Higher-tier registry	A registry, a Party-specific section in the international registry or a subset of accounts therein that are used for accounting purposes only and track transactions with units that occur in underlying transactional registries.
Immutability	A property of a data object that excludes change of data over the entire lifetime of the data object.
Interoperability	The ability of two or more systems to interact in order to complete transactions or transfer information.
ITMO	See decision 2/CMA.3, annex, Chapter I.
Metadata	A set of data that describes and gives information about other data. For example, information about the sectors(s) associated with an ITMO or an ITMO's first-transfer status is metadata.
Operation	Any manual or automated intervention that alters the state of data in a registry. Operations may include issuances, transfers of mitigation outcomes, entry of new descriptor records, configuration changes or, for higher-tier registries, the receipt of an update from an underlying



	transactional registry. Actions on ITMOs and transactions with ITMOs are operations.
Participating Party	A Party that participates in voluntary cooperation under Article 6, paragraph 2, of the Paris Agreement and meets the participations requirements of decision 2/CMA.3, annex, chapter II.
Participating Party registry	Also referred to as a national registry. A transactional or a higher-tier registry implemented by a participating Party in accordance with decision 2/CMA.3, annex, paragraph 29.
Point-to-point	An arrangement where two systems agree on a common true state exclusively by communicating between themselves and without involving a third party or an external source of validation of that state.
Propagation	Delivery of data to all registries that require it in order to process the applicable business rules correctly.
Reconciliation	A set of technical and/or administrative arrangements to prevent accounting inconsistencies, correct inconsistencies that have occurred or, as the last resort, report inconsistencies that could not be corrected for manual handling.
Registry	A registry (transactional registry and/or higher-tier registry) is an accounting system. As an accounting system, a registry conforms to general accounting principles for handling and reconciling the information it records and tracks.
Re-playability	A property of a record (log) of a system's business activity that enables precise recovery of the state of all data in the system at any given moment in time.
Splitting	A procedure that converts a unit block into two-unit blocks jointly containing the same units.
Transactional registry	A registry capable of keeping ITMOs or mitigation outcomes in accounts and transferring them in a consistent manner between accounts, or to accounts in another registry.
Underlying cooperative approach registry	Also referred to as underlying registry. A transactional registry implemented at the cooperative approach level. Units tracked in such a registry may be reflected by ITMOs tracked in a higher-tier registry implemented by an Article 6.2 participating Party.
Unit	A standardized amount of ITMO or mitigation outcome, one ton of CO ₂ (carbon dioxide) equivalent for greenhouse gas metrics. A unit may be measured in non-greenhouse gas metric where the participating Party has an NDC containing non-greenhouse gas metrics.
Use case	A usage scenario where an information technology system can create value for the user.
User authorization	A set of functions that are available to the user. "User authorization" is always spelled out in this text in order not to be confused with "authorization" of use of ITMOs.
User role	Formal description of the purposes for which the user can use the registry. User roles are key to defining user authorization to access specific data and initiate specific operations.
Voluntary cancellation platform	Public e-commerce solution for offset purchasing, whereby upon payment units held in the connected registry are cancelled.



I. Introduction

1. Mandate for the international registry

CMA 3¹ agreed the guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement (Article 6.2 guidance).² The Article 6.2 guidance provides the framework for voluntary cooperation between Parties to the Paris Agreement through ITMOs towards the implementation and achievement of NDCs. The Article 6.2 guidance comprises accounting rules for the use of ITMOs towards NDCs and other purposes, reporting requirements for the participating Parties and guidelines for the review of submitted information. Further, the Article 6.2 guidance outlines the digital infrastructure necessary for its operationalization and provisions for ambition in mitigation and adaptation actions.

The digital infrastructure comprises the registries for tracking ITMOs of the participating Parties,³ the international registry⁴ administered by the UNFCCC secretariat for participating Parties that do not have or do not have access to a registry, the Article 6 database⁵ in which to record and compile the quantitative annual information⁶ on ITMOs submitted by participating Parties and the CARP⁷ to provide transparency in relation to cooperative approaches and to support the review processes. Conceptually, the international registry and Article 6 database are integrated parts of the CARP and shall be developed and maintained by the secretariat.

The international registry adheres to the requirements of the Article 6.2 guidance for registries. CMA 4 elaborated the requirements for registries set forth in the Article 6.2 guidance.⁸ These include:

1. Registries' form, functions and processes, including tracking and recording method, as well as principles for actions and records;
2. High-level principles for interoperability between registries.

CMA 4 provided further guidance on the international registry,⁹ including on the general approach to implementation, accounts and actions, administrators and processes and high-level guidance on interoperability with other registries.

¹ Numbers after governing bodies indicate the relevant session of the body (in this case CMA at its thirds session).

² [Decision 2/CMA.3](#), annex. CMA, with [Decision 6/CMA.4](#), annex I-II, elaborated elements of the Article 6.2 guidance. The CMA, through subsequent decisions, may further elaborate elements of the Article 6.2 guidance.

³ Decision 2/CMA.3, annex, paragraph 29.

⁴ Decision 2/CMA.3, annex, paragraph 30.

⁵ Decision 2/CMA.3, annex, paragraph 32.

⁶ Annual information is required as per decision 2/CMA.3, annex, chapters IV.B–C.

⁷ Decision 2/CMA.3, annex, paragraph 35.

⁸ Decision 6/CMA.4, annex I, in chapter I.

⁹ Decision 6/CMA.4, annex I, in chapter I.C.



CMA 4, among other things, requested the secretariat to:

1. Implement the international registry in accordance with the guidance contained in decision 6/CMA.4, annex I, chapter I.C, while prioritizing the requirements as per annex I, chapter I.A–B, and make it available to participating Parties not later than 2024;
2. Provide an interim solution for participating Parties until the international registry becomes operational;
3. Make available, as part of the implementation, the technical specifications and associated cost estimates for the international registry to Parties before SBSTA 58 for comment via the submission portal within four weeks of their publication.¹⁰

CMA 4 agreed on further work to elaborate the requirements for the international registry, the outcome of which will impact the international registry implementation, including in relation to:

1. The need for additional functionalities and procedures for the international registry to allow for transfer of A6.4ERs to the international registry and to provide services for cooperative approaches if voluntarily requested by Parties participating in a cooperative approach, including, inter alia, additional technical functionalities and administrative arrangements, for authorizing account access, and further guidance on procedures for reporting and review for the cooperative approaches of the participating Parties requesting such services, which may be required in addition to the relevant guidance in decision 2/CMA.3 and annex I to this decision;
2. The accounts of the international registry and the role of the international registry administrator, in accordance with the guidance contained in annex I to decision 6/CMA.4;
3. The submission of information by Parties using the international registry as the basis for tracking ITMOs.¹¹

2. Other relevant mandates

2.1. Implications from relevant further work by the CMA and other work in progress

The international registry implementation will be affected by the outcomes of other elements of the CMA's Article 6.2 work-programme¹² captured by decision 6/CMA.4, chief among those are the outcomes in relation to: the finalization of the AEF,¹³ the process of authorization¹⁴ and common nomenclatures.¹⁵

¹⁰ Decision 6/CMA.4, paragraph 33.

¹¹ Decision 6/CMA.4, paragraph 17(g-i).

¹² The set of mandates agreed by the CMA, the outcomes of which will be integrated in the guidance (further guidance).

¹³ Decision 6/CMA.4, paragraph 4.

¹⁴ Decision 6/CMA.4, paragraph 17(b).

¹⁵ Decision 6/CMA.4, paragraph 17(j).



With regard to interoperability of registry systems, the CMA requested the secretariat to develop, publish and periodically update, for participating Parties opting to apply the guidance related to interoperability,¹⁶ standards and recommended practices for electronic recording of data and information related to ITMOs, and communication standards for interoperability and transactions with ITMOs, including record-keeping arrangements, data security protocols, risk management and disaster recovery procedures, and other practices, as necessary, with input from the forum of Article 6 registry system administrators and technical experts of participating Parties.¹⁷ Progress on this work will be relevant to the development and implementation of the international registry with regard to interoperability arrangements.

With regard to funding, CMA 4 requested the secretariat to prepare a technical paper on options for funding the activities related to the infrastructure and the Article 6 technical expert review under Article 6, paragraph 2, for consideration by the subsidiary bodies at their fifty-eighth sessions. Any progress on this work will also be relevant to the development and implementation of the international registry.

2.1. Article 6.4 mechanism registry

The Article 6.4 mechanism registry is a transactional registry mandated to serve the Article 6.4 mechanism¹⁸ and complies with the Article 6.2 requirements for tracking.¹⁹ CMA 4 elaborated the operation of the mechanism registry, including that it will operate exclusively in greenhouse gas units of one tonne of CO₂ equivalent.²⁰

Similar to the international registry, the Article 6.4 mechanism registry will be subdivided into Party-specific sections and be fully internally consistent. All A6.4ERs will be issued in the Article 6.4 mechanism registry. The Article 6.4 mechanism registry will support the entry of authorizations of use of A6.4ERs. Authorized A6.4ERs will be ITMOs,²¹ and may be transferred to the international registry, as the two registries are required to be connected²² and the CMA has agreed to consider additional functionalities and procedures for the international registry to allow for transfer A6.4ERs. The return of A6.4ERs to the Article 6.4 mechanism registry is currently not envisaged.²³

¹⁶ Decision 6/CMA.4, annex I, chapter I.B.

¹⁷ Decision 6/CMA.4, paragraph 34.

¹⁸ Decision 3/CMA.3, annex, chapter VI.

¹⁹ Decision 2/CMA.3, annex, Chapter VI.A and decision 6/CMA.4, annex I, chapter I.A-B.

²⁰ Decision 7/CMA.4, annex, chapter IV.

²¹ Decision 3/CMA.2, annex, paragraph 1(g).

²² Decision 3/CMA.3, annex, paragraph 63.

²³ Decision 6/CMA.4, paragraph 17(g), refers to allowing for transfer of A6.4ERs to the international registry only.



3. Purpose and structure

3.1. Purpose

As per the mandate outlined above, the purpose of this document is to capture:

1. The functional requirements of the international registry resulting from the Article 6.2 mandates in a prioritized manner in order to make them available to Parties before SBSTA 58 to allow Parties to provide views thereon via the submission portal within four weeks of publication of the requirements;²⁴
2. Information on associated cost estimates for the international registry.

3.2. Structure

Information relevant for understanding this document, including the approach to capturing the functional requirements, basic concepts and high-level implementation considerations are included in Chapter I, Section 4; Chapter III and III below.

The approach to cost estimation for the international registry is outlined in Chapter IV.

The functional requirements are captured in the Chapter V below.

3.3. Information not included

This document does not specify how the requirements will be implemented.

Non-functional requirements for the international registry are not included in this document. As the international registry will be maintained by the secretariat, its non-functional requirements will, to the extent possible, be aligned with the existing UNFCCC architecture standards and established practices for IT systems.

3.4. Other

While the goal of this document is to describe the requirements for the international registry, Parties may find it useful in the preparation of requirements to their national registries, and interoperability arrangements.

²⁴ Decision 6/CMA.4, paragraph 26.



4. Functional requirements documentation approach

Requirements covered in this document are mostly functional,²⁵ with non-functional²⁶ requirements covered to the extent needed to augment and clarify the functional requirements.

Following input from Parties on the functional requirements and their prioritization, the functional requirements document will be revised accordingly prior to solicitation of service provision for the implementation and operation of the international registry. The functional requirements will be further revised in accordance with any relevant further guidance by the CMA.

4.1. Requirements hierarchical structure

The requirements in this document are grouped thematically and constitute a three-level hierarchical structure:

- First level: Basic thematic breakdown;
- Second level: Functions and requirement groups;
- Third level: Individual requirements where further breakdown is justified.

4.2. Requirements prioritization

The interpretation of modal verbs used in this document is according to RFC 2119²⁷, In particular:

- ‘must’ and ‘shall’ signify absolute requirement without which being fulfilled the registry may not be considered functional. The negative forms— ‘must not’ and ‘shall not’—mean that the registry cannot be considered functional if it features what follows;
- ‘should’ signifies a recommendation, where fulfilment of the requirement, or an alternative delivering similar value, is highly desirable but not essential for the registry to be considered functional;
- ‘may’ signifies options for implementation or optional features that the registry may implement to follow the requirements more closely, or to provide a better or more consistent user experience.

Although adjustments and upgrades are possible after the initial deployment of the registry, in particular in the area of business rules, it is expected that the registry will be largely procured as a one-off, all-inclusive project, hence the time prioritization of features is not done in these requirements.

²⁵ A functional requirement is a specification of what a system, in this case a registry, is supposed to accomplish or do. It describes the expected behaviour, features, or services that the system must provide to meet its objectives.

²⁶ Non-functional requirements are the characteristics or qualities of a system, such as a registry, that define how well it performs its functions. Non-functional requirements often relate to performance, usability, security, reliability and maintainability, among other aspects, and describe how well the system meets its functional requirements.

²⁷ See [RFC 2119: Key words for use in RFCs to Indicate Requirement Levels \(rfc-editor.org\)](https://www.rfc-editor.org/rfc/rfc2119) The RFC 8174 update is not used as the modal verbs are not capitalized in this text.



II. Basic concepts of the registry business process

1. Registries

A registry system operates as a quasi-financial system that tracks the ownership of ITMOs and metadata pertaining to their lifecycle and status from the point of view of existing Article 6.2 guidance. Therefore, the registry needs to retain data about ITMOs that provides those ITMOs with unique identification and linkage to the specific activity that has led to their generation.

Some registries may transfer ITMOs between accounts in the same or other registries. Such registries are called transactional registries. Transactional registries are responsible for guaranteeing basic consistency conditions necessary for the robust accounting of ITMOs, including through adhering to the following:

1. No ITMO is created other than via a reportable issuance transaction;
2. A specific ITMO exists in exactly one account.

Other registries may not transfer ITMOs. Instead, they pull information about the current location of MOs from transactional registries that provide services to cooperative approaches (also referred to as underlying cooperative approach registries) and augment this information with Article 6-specific data, such as the information about authorization and the first transfer. Such registries are called higher-tier registries (see the definitions for a registry and its two types in the glossary).

The Article 6.2 guidance is not prescriptive about the type of registry a Party may implement. However, in choosing a registry type, a Party will need to consider the tracking arrangements for different cooperative approaches it participates in.

The Article 6.2 registries, including the international registry, shall produce, maintain and compile records, information and data, consistently with the annual information submitted in the AEF.

2. Registry accounts

Ownership or holding of ITMOs may be expressed through the concept of accounts where ITMOs are kept, and the holder of the account is assumed to be the holder of the ITMOs therein. Accounts are categorized according to account types.

Each account type has a specific purpose, and specific rules governing the way ITMOs may be created or issued, added or removed from it. For example, in a transactional registry, an issuance account would allow issuance of new ITMOs and outgoing transfer; a holding account would allow both incoming and outgoing transfers; and a cancellation or a use account would allow incoming transfers only. In a higher-tier registry, accounts track the issuance and transfers happening in underlying cooperative approach registries.

3. Administrators

A registry is a centralized system that requires an administrator or administrators who may have a range of responsibilities, necessarily including the responsibility of granting access to the registry functions to other users. These functions may include the opening of accounts, transacting in ITMOs and other functions.



4. Authorization of the use of ITMOs

The article 6.2 guidance prescribes a specific regime of how MOs become internationally transferred (i.e. become ITMOs) through the act of authorization of the use of the ITMOs.

In order to maintain accounting integrity:

1. ITMO records are created immutable in the registry;
2. Authorizations, along with any future changes thereto, are kept in separate records that are propagated across the registries participating in the given cooperative approach.

Authorizations are entered into the registry of the Party that issues the authorization. It is the responsibility of the registry in which the authorization has been first entered to inform other registries in the cooperative approach (propagate information on authorization), as long as these registries are capable of accepting such information, as well as make this information available to such other registries on demand.²⁸ The propagation of information on authorization across registries should be enabled through interoperability arrangements.

Authorization affects the life cycle of an ITMO and hence needs to be available at the point of making decisions regarding the acceptability of any operations (actions or transactions) being proposed by account holders or administrators.

The conditions that allow or disallow operations, along with the automatically triggered consequences of certain operations, are called 'business rules' in this document.

5. Transfers and first transfer

The information about first transfers²⁹ is maintained using the same technical approach as is used to maintain authorizations.

ITMOs may be transferred within one cooperative approach for which they are authorized. A cooperative approach may span two or more Party registries and/or utilize an underlying cooperative approach registry or registries that provide data on MOs to Party registries implemented as higher-tier registries.

III. Implementation approach

1. International registry high-level design approach

The mission of the international registry is to provide registry functionality to Parties that do not have or do not have access to a registry as per paragraph 29 of the Article 6.2 guidance (Article 6.2 registry). Due to the potential diversity of Parties' needs, the international registry will need to implement a reasonably complete set of common Article 6.2 registry use cases. In particular, the international registry will need to implement both transactional and higher-tier functionalities.

²⁸ In other words, the registry that entered an authorization should attempt to push the information about it to other registries that participate in the relevant cooperative approach, as well as make this information available to be pulled.

²⁹ As per paragraph 2 of the Article 6.2 guidance.



The international registry is envisaged to be administered in a way that allows Parties to administer access and accounts of entities they authorize.³⁰ This will be done via Party-specific sections of the international registry. A Party-specific section will be created in the international registry upon request of a Party with the designation of a section administrator. The section administrator will then be responsible for the provision of accounts and other administrative actions within the Party's section.³¹

The international registry will be built to be fully internally consistent and able to provide the data needed to generate the AEF entries for Parties that use it. If the entire cooperative approach is operated using international registry sections, the AEF information provided will be guaranteed to be consistent.

When used as a transactional registry, the international registry will support ITMOs represented as uniquely identified units,³² equalling amounts of MOs, which for GHG mitigation outcomes will be tracked in tonnes of CO₂ equivalent. In its higher-tier mode, the international registry will work with arbitrarily sized, uniquely identified accounting amounts. Such accounting amounts will be associated with, and consistently reflect transactions with, uniquely identified MOs tracked in an underlying cooperative approach registry in a way that would allow tracing their entire life cycle, including any splitting that may occur, and guarantee robust accounting.

The International registry will publish an interoperability layer to integrate with it for transaction processing, reconciliation or linkage between a transactional registry and a higher-tier registry.

2. Implementation approach

2.1. General considerations

The requirements formulated in this document describe what the desired solution must do, without unnecessarily constraining how it will be implemented, so that procurement and implementation of the registry solution can be undertaken as efficiently and effectively as possible.

Where units are transferred within the international registry (in its transactional mode), consistency will be guaranteed by the internal consistency of the IT system delivering the registry solution.³³ Where the international registry functions as a higher-tier registry to an underlying cooperative approach registry, the international registry will implement APIs that may be used by underlying cooperative approach registries to exchange necessary data.

2.2. Interoperability considerations

The interoperability arrangements for the international registry will be implemented according to the relevant provisions of the Article 6.2 guidance.³⁴

³⁰ The extent of access to entities is subject to outcome in accordance with decision 6/CMA.4, paragraph 17(g).

³¹ As per decision 6/CMA.4, annex I, chapter I.C.

³² As per decision 6/CMA.4, annex I, paragraph 5.

³³ I.e., one transactional database.

³⁴ As per decision 6/CMA.4, annex I, paragraphs 23-24.



The elaboration of the interoperability approach (or approaches) is included in the Article 6.2 work-programme³⁵ and the Article 6.4 work-programme³⁶.

For transactional registries connecting to the international registry for the purpose of inter-registry transfers, in the interest of achieving a prompt start the following approach is envisaged: implementation of a set of APIs for transaction processing and point-to-point reconciliation where only one national or another transactional registry per cooperative approach will be connected.

A reconciliation mechanism akin to a transaction log service may be implemented at a later stage, based on possible further guidance by the CMA in relation to interoperability. This reconciliation mechanism would be responsible for guaranteeing the consistency of transfers within a cooperative approach where multiple registries need to interoperate.

The reconciliation mechanism could be made available to all cooperative approaches, whether they use the international registry or not. Specific arrangements for running and interoperating with the proposed reconciliation mechanism will be elaborated and published subject to possible further guidance by the CMA and once the final implementation arrangements for the international registry are in place.

It should be noted that, unlike the functionality for the registry itself, the functionality needed for the reconciliation mechanism is unlikely to be available in off-the-shelf IT solutions. The reconciliation mechanism would need to be:

1. Custom developed, considering to the extent possible the lessons learned from the implementation and operation of the Kyoto Protocol's international transaction log;
2. Developed in-line with the standards and recommended practices for electronic recording of data and information related to ITMOs, and communication standards for interoperability and transactions with ITMOs, including record-keeping arrangements, data security protocols, risk management and disaster recovery procedures, and other practices, as necessary, to be developed by the secretariat with input from the forum of Article 6 registry system administrators and technical experts of participating Parties.³⁷

IV. Cost considerations

1. Software provisioning

Implementing the international registry system 'from scratch' would be a significant undertaking, particularly where it concerns the safeguarding of the integrity and traceability of quasi-financial information and transaction flows. The alternative approach of implementing it based on an off-the-shelf system might offer considerable cost benefits. However, the latter approach might introduce dependencies on existing features and its suitability would depend on the flexibility of the off-the-shelf system to be adapted to the international registry requirements. In this context, the procurement of

³⁵ Decision 6/CMA.4, paragraph 17(g).

³⁶ Decision 7/CMA.4, paragraph 9(b).

³⁷ As per decision 6/CMA.4, paragraph 21 and paragraph 34.



service provision will be focused on maximizing the out-of-the-box features and the flexibility of existing and commercially available solutions to be configured and/or customized to meet all the international registry requirements.

The cost estimates vary widely depending on the approach to implementation and will need to be further elaborated by the secretariat through market research and a ‘commercial dialogue’³⁸ initiative to find the most optimal and cost-effective solution. Both methods will be undertaken based on these functional requirements and the non-functional requirements to be specified by the secretariat.

As mentioned in chapter III above, the non-functional requirements for the international registry will, to the extent possible, be aligned with the existing UNFCCC architecture standards and established practices for IT systems. This should lead to economies of scale in operating the registry, as well as better out-of-the-box compatibility and interoperability with other systems run by the secretariat, such as the submission portal.³⁹

2. Shared software and operations provisioning for the international registry and for the Article 6.4 mechanism registry

As the international registry and the Article 6.4 mechanism registry are to be implemented and operated by the secretariat, shared software and operations provisioning is the most efficient, effective and economic approach to implementation. Regarding implementing the interoperability between the two registries, the most economic and reliable option is to use one internally consistent IT system to deliver the functionality of both registries.

The implementation approach of shared software and operations provisioning, including the option of implementing the two registries as one internally consistent IT system, is in line with the CMA requirement that the secretariat, in implementing the international registry, shall strive to minimize its development and operational costs while ensuring that the international registry meets the necessary security and quality expectations.⁴⁰ This implementation approach will be accompanied by an appropriate method for cost allocation with respect to the funds made available for the operationalization and implementation of Article 6.2 activities and the trust fund for the Article 6.4 mechanism.

Ranges for cost estimates are not provided in this document due to considerations related to the forthcoming process for solicitation of service provision. Relevant information on estimating costs associated with the international registry implementation, including its development and operation, will be shared with Parties in relation to the work of the subsidiary bodies on funding the Article 6.2 activities related to infrastructure and the Article 6 technical expert review.

³⁸ An event organized prior to an official procurement exercise to prepare and source information from potential bidders.

³⁹ The UNFCCC submission portal that will be used for submissions by Parties in relation to Article 6.2 reporting requirements made to the CARP.

⁴⁰ Decision 6/CMA.4, annex I, paragraph 14.



V. Functional Requirements

1. User Management (A6R-1)

The registry⁴¹ shall provide access to Party representatives and other entities authorized by a Party for the purpose of establishing and using their accounts⁴² and performing administrative functions.

1.1. User identification and authentication (A6R-2)

Users of the registry shall be robustly identified and authenticated by the registry. Access credentials shall be commensurate in their sophistication to the level of risk posed by the respective access.

1.1.1. Users shall be identified by the registry (A6R-3)

There shall be a procedure of how access credentials are issued to users that provides sufficient guarantees of correct initial identification and subsequent authentication. In particular, government ID checks, residence checks, checks in other UN-run systems and/or other checks of comparable assurance shall be used to identify users.

1.1.2. Access credentials shall be issued in a way that guarantees secure transfer to the identified user (A6R-4)

Access credentials shall be issued in a way that guarantees secure transfer to the identified user. This way shall be aligned with UNFCCC standards for similar operations and control for the possibility that email addresses provided by national focal points⁴³ may be out of date or otherwise incorrect.

1.1.3. Access credentials should be easy to revoke (A6R-5)

Access credentials should be easy to revoke in case there is a suspicion that they have been compromised or used by unidentified individuals.

1.1.4. Access credentials shall require more than one authentication factor (A6R-6)

Access credentials shall require more than one authentication factor, while considering additional cost and/or operational burden for either the secretariat or the user.

⁴¹ Within this chapter, registry is understood to be the international registry. Other uses of “registry” will be clarified.

⁴² Within the participating Party’s registry section.

⁴³ [Country representatives](#) for official communications with the UNFCCC.



1.1.5. Require additional authentication factors for elevated user authorization (A6R-7)

For access credentials that allow elevated user authorization, such as the access for Party-specific section administrators, registry administrators, or the system administrators, it shall be possible to require additional authentication factors or more complex procedures for identification.

1.1.6. Authentication for external systems (A6R-8)

External systems shall be identified and authenticated by the registry using a distinct process that involves assessment of the risks caused by connection.

1.2. Profile management (A6R-9)

A user profile comprises all data pertaining to the identification of the user and their relationship with the registry that is not managed by the general authentication mechanism (see [A6R-1](#)). User profile information is generally self-supplied by the user; some data points may be subject to verification by the secretariat, by the respective Party-specific section administrator or by an external service. Multiple verifications may be required for the same data points.

1.2.1. Keep profile history (A6R-49)

Profile history shall be retained by the registry indefinitely and be part of the replayable logging arrangement ([A6R-48](#)). Parts of the profile information that need to be erasable due to privacy regulations, subject to a further decision on which regulations are applicable to the international registry, shall avail themselves to anonymising as a separate action subject to replayable logging. Log entries shall not be affected by anonymising.

1.2.2. Keep basic information about the user (A6R-10)

The registry shall keep basic information about the user (profile information), such as the real name, affiliations, more than one method of communication.

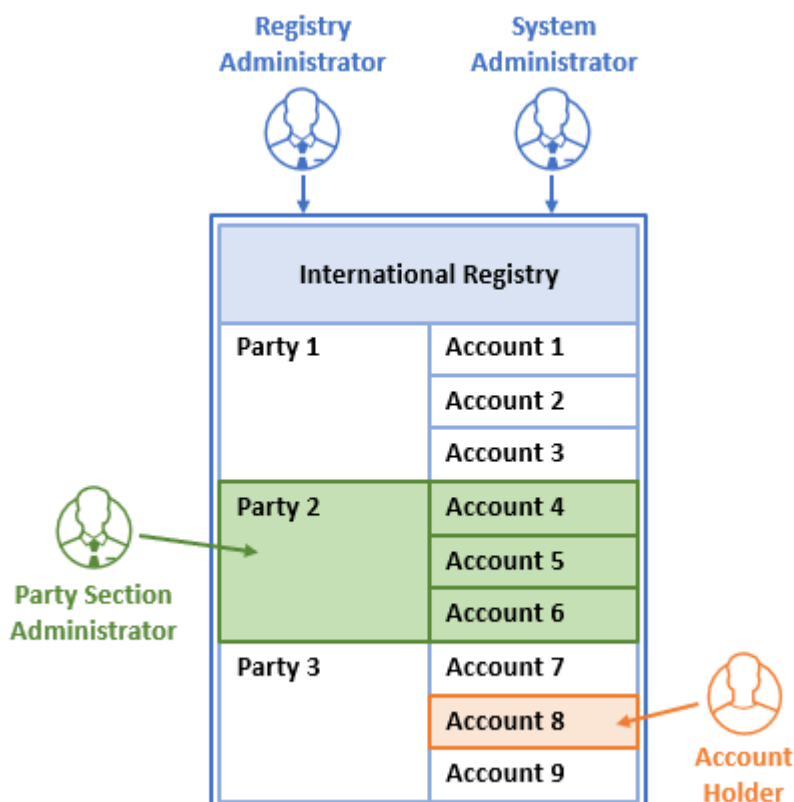
1.2.3. Users shall be able to request changes to their profile information (A6R-11)

Users shall be able to request changes to their profile information. For some information, such requests shall be executed automatically, other changes may require acknowledgement by the Party-specific section registry administrator or the registry administrator.

1.3. User authorization (A6R-12)

‘User authorization’ refers to user roles assigned to a user. It is always spelt out as such in these requirements as it shall not be confused with ‘authorization’ which is a substantive term that is reflected in registries by the existence of a descriptor record of the type ‘authorization’ (A6R-45).

Figure 1. User authorization hierarchy



As presented in Figure 1 above, while basic user roles will be handled by the general authentication mechanism (see [A6R-1](#)), user authorization in specific cases shall be handled by the registry application in the context of Party-specific sections, accounts, and other attributes of the object (ABAC).

1.3.1. Users are created without specific user authorizations in the registry (A6R-13)

It shall be possible to create a user record without specific user authorization. Such users can later be authorized to use specific Party-specific sections (A6R-42) and request the opening of accounts.

1.3.2. Registry administrator (A6R-43)

Users may be authorized to act as registry administrators. Registry administrators supervise the user identification activities. Registry administrators are able to create, grant access to, and suspend Party-specific sections.

Registry administrators are also able to, on an emergency basis, act on behalf of ('impersonate') any registry user so that they can take actions on behalf of a given user of the same registry while ensuring that that user's access rights are not exceeded. Any impersonation shall be logged by the replayable logging arrangements with identities of the impersonated user and the administrator acting on their behalf recorded.



1.3.3. System administrators (A6R-50)

Registry system administrators or just system administrators shall be able to issue and administer registry administrator credentials. They shall have access to the list of registry users, and credential issuance logs, and be able to suspend access of any user to the registry. System administrators shall not have access to registry administrator functions or any other business functions of the registry.

1.3.4. Party-specific sections (A6R-42)

The registry shall be divided into Party-specific sections. Party-specific sections contain accounts held by a Party and entities authorized by the same Party. The Party shall be able to exercise its functions through Party-specific section administrators ([A6R-58](#))

1.3.5. Party-specific section administrators (A6R-58)

When creating a Party-specific section in the international registry, and at any point in its life cycle afterwards, the registry administrators shall be able to appoint users to act as Party-specific section administrators for a given Party-specific section.

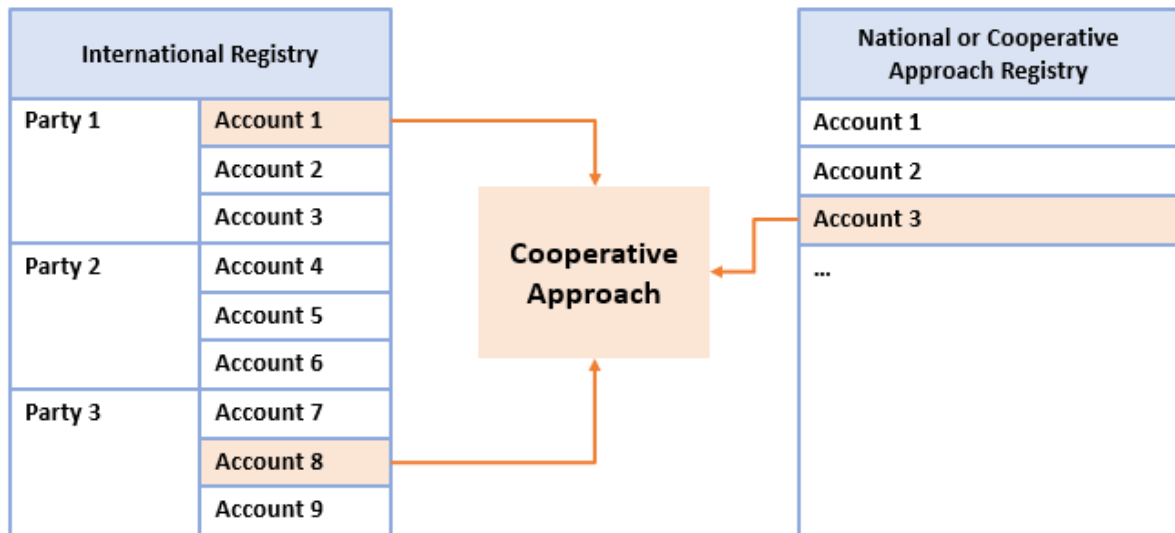
1.3.6. Cooperative approaches (A6R-46)

The international registry shall support multiple cooperative approaches. From the user authorization point of view, a cooperative approach is a subset of accounts (see Figure 2 below) in which units may appear due to their authorization for use.

A cooperative approach may be supported by accounts in Party-specific sections of the international registry (when in transactional mode) and accounts in other transactional national registries. Alternatively, a cooperative approach may be supported by accounts in Party-specific sections of the international registry (when in higher-tier mode) and accounts in underlying cooperative approach registries (figure 2).



Figure 2. A cooperative approach supported by accounts in the international registry and accounts in other national registries or underlying cooperative approach registries



1.3.7. User authorization granting hierarchy (A6R-14)

User authorizations are granted by the registry administrator to the Party-specific section administrator and by a Party-specific section administrator to a Party-specific section user.

1.3.8. One user may be authorized in multiple Party-specific sections of the registry. (A6R-15)

It is possible for one user to have different roles in multiple Party-specific sections or combine a regular user role in one Party-specific section with a role of a registry administrator in another Party-specific section. All efforts should be made to avoid duplication of user records.

1.3.9. Suspension and revocation of user authorizations (A6R-51)

Suspension of user authorization is temporary in nature. Any settings pertaining to the user authorization are retained for the period of suspension. Suspension may be done by all administrators with respect to users administered by them, the users may be further resuspended by the same or a higher-level administrator. Revocation leads to the loss of settings pertaining to user authorization. A user authorization that needs to be reinstated after revocation shall be issued as a new user authorization by the administrator of the respective level.

It shall be possible to suspend or revoke user authorizations on a granular basis. For example, if a user has access to accounts in different Party-specific sections, it shall be possible to suspend or revoke their authorization to access just one of them.



2. Transaction Management (A6R-16)

Transactions shall be processed by the international registry in a way to provide flexibility and versatility for business models that underpin different cooperative approaches and shall be based on robust accounting to ensure compliance with all applicable rules.

2.1. Transaction processing and business rules (A6R-17)

Transactions shall be processed by the registry according to configurable rules. There shall be a way for registry administrators to suspend the rules in a traceable and auditable way in order to recover from operational errors.

2.1.1. Fast processing of transactions (A6R-36)

Transactions shall be processed expeditiously. While the registry may depend on other systems and slow-running processes to determine the course of action on a proposed transaction, the overhead that the registry itself adds to the transaction processing time should not exceed one second.

2.1.2. Minimal set of built-in business rules (A6R-37)

A business rule defines the way a transaction is handled. It is a piece of functionality that receives the data context of the transaction and rules on whether the transaction can go ahead, and/or initiates other transactions that need to atomically accompany the transaction being proposed.

The registry shall implement a minimal set of simple business rules:

- (a) Conditional transfer and acquisition on the basis of the account type;
- (b) Generation of units based on the account type;
- (c) Conditional transaction initiation on the basis of initiating or impersonated ([A6R-43](#)) user authorizations.

Built-in rules shall be readily available in the registry solution to support its transactional functionality without regard to descriptor objects.

2.1.3. Pluggable business rules (A6R-38)

It should be possible to add business rules to the registry without major change management processes; re-programming, or other risky activities. For any software changes that may be necessary to add new business rules, the roll-out and change management processes should allow for a very rapid (preferably under one week) roll-out without significant additional risk.

Pluggable business rules may be used for enhanced transaction handling purposes, such as:

- (a) Constraints that take into account the applicable descriptor objects;
- (b) Initiation of supplementary transactions that need to be initiated atomically with the transaction being proposed, such as the calculation and transfer of any commissions;



(c) Other customised constraints.

Applicability of specific business rules to cooperative approaches, Party-specific sections and accounts shall be defined from the administrative interface by registry administrators (or, in cases to be specified in business rule configuration, Party-specific section administrators) through a configuration change operation.

2.1.4. Versioning of business rules (A6R-39)

Business rules shall be versioned. There may be an evolution of a business rule logic under the same name. Replayable logging arrangements shall record which versions of business rules have been applied to each transaction handled by the registry. Older versions of business rules shall be retired from use at a specified future date and time.

2.1.5. Corrective actions (A6R-55)

All data objects created in the registry are immutable; they cannot be modified after being created. Any mistakes made in operating a transactional registry shall be rectified using corrective transfers. Corrective transfers are transfers that may be initiated by registry administrators and may partially or fully disregard applicable business rules, including:

- (a) Where the transfer of units was initiated by mistake, a corrective transfer can 'cancel' the transfer by moving the units back to the originating account;
- (b) Where the issuance of units was initiated by mistake, the units may be taken permanently out of use by transferring them to an administrative cancellation account;
- (c) Where specific units need to be withheld temporarily from the current holder due to unspecified legal reasons, the units may be temporarily transferred to an administrative holding account.

All corrective transfers shall be logged as such, including the transaction they are expected to reverse, if any, and the list of business rules that such transfers have broken, if any.

Descriptor objects, once issued, cannot be recalled. A new descriptor object, typically issued by the Party-specific section administrator, shall be issued to replace the currently active one.

For first transfer markers, the latest first transfer marker by date is applicable. It shall only be possible to re-issue the first transfer marker for units that have not been transferred externally since the original first transfer marker was issued. It shall be possible to re-issue the first transfer marker for such units if the subsequent international transfers have been reversed with a corrective transfer as described above.

For authorizations, corrections are made via the issuance of a new authorization.

2.2. Units, accounts, tracking and reporting of transactions (A6R-18)

The international registry may be used as a transactional registry or a higher-tier registry (A6R-53).



It shall be possible to use accounts in the international registry to facilitate Parties' participation in cooperative approaches that include Parties using national registries.

Mitigation outcomes in the international registry shall be accounted for using the concept of units ([A6R-40](#)). All records that affect the transaction flow shall be immutable; where business rules affecting specific units should change, such as in the case of authorization, an additional descriptor record shall be created ([A6R-45](#)).

The international registry shall feature robust logging and auditability comparable to financial systems.

2.2.1. Records, units and unit blocks (A6R-40)

ITMOs held in the international registry may be accounted for in uniquely identifiable amounts of mitigation outcomes that reflect mitigation outcomes accounted for in an underlying registry, referred to as 'accounting amounts'.

ITMOs held in the international registry may be accounted for in uniquely identifiable standardized amounts of mitigation outcomes, referred to as 'units'. For GHG metrics, a unit equals one tonne of CO₂ equivalent. Other metrics may use other unit definitions.

ITMOs recorded as accounting amounts that reflect underlying registry unit blocks have serial numbers.

ITMOs issued as units have serial numbers. For the ease of handling in human-readable reports, and in order to save potential storage space, processing time and amount of resources necessary to find and select units that are eligible to participate in a transaction (see also the definition of the 'registry fragmentation' problem in [A6R-52](#)), units with consecutive serial numbers are stored in 'unit blocks' identified by the serial numbers of the first and the last unit in the block.

The human-readable version of the serial number should be presented in a dash-connected composite form and comprise:

- (a) The identifier of the cooperative approach from the respective common nomenclature;
- (b) The identifier of the originating Party registry from the respective common nomenclature;
- (c) The ISO 3166-1 alpha-3 code of the first transferring Party;
- (d) The serial number of the unit for the given country, project identity and vintage;
- (e) The calendar year in which the mitigation outcome had occurred (the vintage year);

Other components of unit metadata may be included in the human-readable version of the unit serial number.

2.2.2. Descriptor records: authorization and first transfer (A6R-45)

Descriptor records, such as an authorization or a first transfer marker are immutable objects that influence the processing of transactions concerning units or accounting amounts. Descriptor records are timestamped and have an applicability date in the future to let propagation mechanisms deliver the descriptor records to all registries participating in the same cooperative approach, and whose business rules may depend on them (see example in the description of higher-tier accounts [A6R-53](#)).



Transaction processing and business rules may be affected by the existence of authorization records that are related to the units being transacted. Authorization records may be issued in respect of specific units if such units already exist in one of the registries participating in the given cooperative approach, or define a set of conditions that the units should meet in order to be considered authorized. Authorization records are created in the system manually, typically by Party-specific section administrators, or via an API by project lifecycle and other information systems authorized to do so (typically, information systems of specific cooperative approaches).

Authorization records shall contain the dedication of the authorized use (NDC, OIMP, or both).

The first transfer marker is automatically created in the registry in which the event that constitutes the first transfer has happened. The first transfer marker is always related to specific units that shall exist at the moment of creation of the first transfer marker.

2.2.3. Transnational accounts (A6R-41)

Units are held in accounts. In a transactional registry, units are transacted directly between accounts. In a higher-tier registry, account holdings reflect movements of units in underlying registries as described in [A6R-53](#).

The kinds of units that may be generated in an account or be allowed to be acquired into or transferred from an account, is defined by business rules. Accounts may be bound to a Party-specific section or be under the responsibility of Registry administrators. An account may be bound to a maximum of one cooperative approach.

Opening of accounts for account holders in Party-specific sections is application process-based. An authenticated registry user may apply for an account that is then approved by the Party-specific section administrator or the registry administrator. For service accounts that do not belong to any Party-specific section, registry administrators open the account directly.

Accounts have an account type. The nomenclature of account types is a common nomenclature; at the minimum, it contains the following types:

- (a) Issuance account.
- (b) Holding account.
- (c) Use account.
- (d) Cancellation account.
- (e) Administrative cancellation account.
- (f) Proxy account of units transacted in another registry.

Accounts are created in the Initial status which is similar to the Suspended status described below. They may later be transitioned to further statuses by the Party-specific section or registry administrator:

- (a) Active - the account is fully operational.
- (b) Restricted - the account is fully operational, but only registry administrators can initiate transactions involving the account.



- (c) Suspended - nobody can initiate transactions involving the account until a registry administrator or a Party-specific section administrator reactivates it (a Party-specific section administrator or a registry administrator can select this status for the account).
- (d) Frozen - nobody can initiate transactions involving the account until a registry administrator reactivates it (only a registry administrator can select this status for the account).
- (e) Terminated - the account is permanently terminated and may no longer be used.

Accounts may be generic or specific to a cooperative approach ([A6R-46](#)).

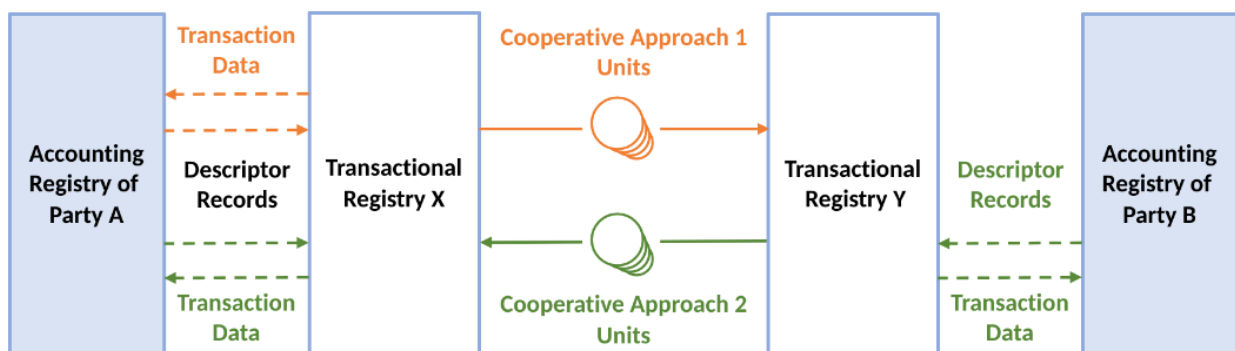
2.2.4. Higher-tier accounts ([A6R-53](#))

Accounting amounts are recorded in accounts.

A higher-tier account is an account that reflects balances and turnover of units in another account, which may be located in another transactional registry that is an underlying registry. Higher-tier accounts may be used as national registry representations of accounts in underlying cooperative approach registries that may be authorized by the Party. The international registry may serve as both the transactional and higher-tier registry.

ITMOs recorded in higher-tier accounts may not be transacted directly. In order for such amounts to change hands, the transaction needs to happen in the underlying registry (see Figure 3 below), which is, in this case, responsible for the correct accounting and application of all necessary business rules, compliance checks and ensuring consistency.

Figure 3. Data exchange between transactional and higher tier registries for multiple cooperative approaches



If the higher-tier account is not located in the same registry as the transactional account, transactions and balances that happened in the underlying registry shall be notified to the higher-tier registry via an API. The underlying registry shall cryptographically authenticate the content of transactions and balances transmitted to the higher-tier registry.

Descriptor records ([A6R-45](#)) may be issued either into the transactional or the higher-tier registries. If the higher-tier registry is not the same registry as the transactional registry, descriptor records shall be



communicated to the respective other registries via an API. The originating registry shall cryptographically authenticate the content of descriptor records transmitted to the destination registry.

Due to the asynchronous nature of communication between the higher-tier registry and the underlying registry, applicability periods shall apply to allow for the necessary communications between registries to take place. For example:

- (a) The higher-tier registry may be expected to reflect transactions and balances as of 00:00 UTC of the previous day as of 12:00 UTC.
- (b) Descriptor records shall apply no earlier than 00:00 UTC of the next day, but no earlier than 12 hours after creation.

2.2.5. Elementary operations (A6R-44)

When tracking the lifecycle of units, the international registry implements four elementary operations:

- (a) Generation or issuance of new units;
- (b) Transfer of units between accounts;
- (c) Creation of descriptor records (authorizations and first transfers);
- (d) Configuration changes.

All transactions in the registry can be expressed through an elementary operation or an atomic combination thereof.

The generation or issuance of new units is the operation that creates a unit block in a generation/issuance account.

Transfer of units is the operation that removes units from one account and places them in another account. Transfers may occur within a registry or between registries. Transfers within a registry shall guarantee consistency through the means of transaction atomicity and consistency of all database operations involved. If the transfer is initiated between registries, interoperability arrangements ([A6R-34](#)) are used to ensure correct transfer and maintenance of overall consistency of accounting within a cooperative approach.

Descriptor objects modify the behaviour of business rules with regard to the units or accounting amounts affected by them. Descriptor objects are issued into one registry and are delivered to all registries that participate in the affected cooperative approach.

Configuration changes are done by registry administrators and system administrators and affect the functionality and processing of transactions in the registry. Configuration changes may involve the creation of new Party-specific sections, modification of business rules, and other administrative changes. Configuration changes are regarded as operations mainly in order for them to be covered by log replayability arrangements.



2.2.6. Transaction proposals and transactions (A6R-47)

Transactions are sets of elementary operations that atomically change the registry database state. Some transactions may be executed immediately and some may require longer-running processes to complete, hence the need to have a multi-stage transaction lifecycle:

1. Generation of a transaction proposal;
2. Execution of all necessary business rules and external processes required to execute the transaction;
3. Decision on whether the transaction is allowed to be recorded;
4. Recording or rejection of the transaction;
5. [Optional] Notification of other systems involved of the recording or rejection of the transaction.

If a transaction is rejected, the conditions that did not allow the transaction to go ahead shall be logged with full data on the basis of which the rejection had been issued.

2.2.7. Implicit and explicit splitting, avoidance of registry fragmentation (A6R-52)

Units in the registry are stored in unit blocks ([A6R-40](#)). When a transaction affects units with a serial number range that does not exactly match that of an existing block, implicit or explicit splitting of blocks shall be executed by the registry.

Explicit splitting of a block happens when a user specifies the exact serial number range to be affected by the transaction (e.g. transferred to another account). If the entire affected serial number range belongs to one unit block, the block is split into two (if one of the edges of the specified serial number range is equal to the edge of the block) or three blocks.

The newly-created block is then used in the proposed transaction. Explicit splitting is only possible if all units from the specified serial number range are available in the originating account.

Implicit splitting happens when the user is not specifying the exact serial number range of units to be transacted, but rather the constraints on the unit characteristics (such as the host country, the project and the vintage) and the number of units to be transacted. In this case, the registry shall use an algorithm to select the units to be transacted.

Registry fragmentation is an unnecessary proliferation of the number of unit blocks recorded by registry system(s). Registry fragmentation may lead to excessive transaction data volumes, potential performance issues, an increase in unnecessary burden on consistency checks and review, and, eventually, complete loss of function due to the inability to complete transactions in time for them to be useful for the intended purpose. Registries shall minimise fragmentation by avoiding the splitting of unit blocks.

Finding the optimal solution for the implicit splitting is an NP-complete task (a variant of 'The Knapsack Problem'). With sufficient accrued fragmentation, it may not be feasible to achieve the optimal implicit splitting. Therefore, a simplified algorithm, which still resists registry fragmentation, shall be implemented by the international registry.

Out of all unit blocks that satisfy the constraints on the unit characteristics set by the user:



1. If there is a range that matches the transfer amount by length, transfer this range.
2. If there is no such range:
 - (a) Sort applicable ranges by size starting from the shortest;
 - (b) Going through the list of ranges, accumulate enough to obtain the transfer amount;
 - (c) If the last range in the resulting list is shorter than the transfer amount, transfer this range and all smaller ranges, splitting the smallest one, if necessary;
 - (d) If the last range in the resulting list is longer than the transfer amount, transfer all the ranges beginning from the smallest one and split the largest one.

2.2.8. External transfers (A6R-54)

When a transfer is made to another registry by a transactional registry, the units transferred are placed into a special proxy account ([A6R-41](#)). The balances in this proxy account may be used in order to establish consistency of data in the registry.

If the units are ever returned to the same registry, the units are transferred from the proxy account into the destination account.

When units that have not been issued or generated in the registry first arrive to the registry, they are generated in the proxy account and transferred to the destination account.

The proxy account is common for the entire registry; its use is transparent to the account holders who see that their transfers are directed to an account to another registry and that the registry has recognised that the transfer is external. Similarly, for incoming transfers, account holders see that their incoming transfer originates from an account in another registry and the transfer is external.

All external transfers shall be cryptographically authenticated by the originating registry and contain full data about the units that is required under the respective cooperative approach ([A6R-40](#)).

2.2.9. Logging, reportability and replayability (A6R-48)

All transactions shall be logged along with all elementary operations and data pertaining to them in order to achieve replayability.

Replayability includes the ability to recover the total state of the registry database at any point in time by applying ('replaying') the log entries against the business rules and the core registry business logic. In order to achieve replayability, the registry shall retain:

- (a) The timestamp of the transaction
- (b) The identity of the user or the system that initiated the transaction;
- (c) The identity of the user on whose behalf the transition is recorded, if any;
- (d) Complete data used for transaction initiation;
- (e) The version of business rules applied or a revision of the business rules repository;
- (f) Complete data received from external systems in the course of processing the transaction for imitation ('mocking') during the replay.



Similar data sets should be logged for rejected transitions, with an indication of the business(s) rule that prevented posting the transaction.

Notwithstanding the above, the recorded transactions shall contain enough data to form the AEF reports.

Replayable logs are the most valuable data asset created by the registry. In order to minimize the possibility of data loss, they should be streamed, as early as possible after the creation of any new record, to a geographically distinct, eventually offline location ([A6R-22](#)).

Whether the same replayable logs are used for display and other UI purposes in the registry interface, or a separate, simplified logging arrangement is used for this purpose, is left to implementation.

2.3. Compliance (A6R-19)

It shall be possible to check transactions for compliance to configurable compliance rules. Compliance rules are different from business rules in that they define the permissible end state of data rather than transaction processing rules.

As a UN-run system, the international registry is not required to comply with legislation or directives of any particular country. At the same time, internal regulations are aligned with internationally accepted way of conducting transactions. Furthermore, checks for compliance with national legislation for Party-specific section accounts may be required by specific Parties in their sections of the registry.

3. Data Management (A6R-20)

As a quasi-financial system, the international registry has elevated requirements to data management. Data management shall be done in a secure way, data safety shall be assured through robust reservation and backup arrangements; the systems shall enable discovery and detailed investigation of actions.

3.1. Secure storage and transit (A6R-21)

The registry shall implement robust encryption techniques, considered safe to encrypt the most sensitive financial data, both for data at rest and in transit.

The integrity of any record shall be cryptographically provable (e.g. by generation and logging of a cryptographically signed hash record) and traceable to its source. Regular integrity checks shall be performed to verify data integrity and identify any inconsistencies or unauthorized changes.

3.2. Backup, business continuity and disaster recovery planning (A6R-22)

As a quasi-financial system that is involved in potentially irreversible transactions, the registry has extremely high requirements for the recovery point objective (RPO). Every reasonable effort shall be made to make sure that the registry does not lose transactions under any circumstances.

Online data shall be stored redundantly over geographically diverse locations, with hot or warm replication.



Replayable logs ([A6R-48](#)) shall be streamed to an off-site location, securely backed up, and put offline as soon as practical after creation, in order to protect them from tampering.

Regular encrypted backups of data shall be performed and stored offline in at least two secure and geographically diverse locations.

3.3. Data analytics ([A6R-23](#))

Outside online statistical data and aggregations in dashboards and oversight reports ([A6R-30](#)), the international registry does not implement analytical tools of its own. Instead, the registry shall provide functionalities to download transactions, balances, units, and descriptor object data to authorized users, including:

- (a) Specially authorized account holders shall be able to download data pertaining to their current or historical holdings only;
- (b) Specially authorized Party-specific section administrators shall be able to download data pertaining to all accounts in their Party-specific section;
- (c) Specially authorized registry administrators shall be able to download data for the entire registry.

For the Party-specific section administrators and registry administrators, there should be a way to directly transmit or stream data to an analytical system without downloading it to the user's computer.

Downloaded datasets shall be in a format that allows users to further manipulate and analyse them using the majority of common office applications and specialised analytical tools.

4. Customer Relationship Management ([A6R-24](#))

The international registry shall provide a way for all users to communicate in an unstructured manner with the registry administrator's support service established by the secretariat. The common 'customer relationship management' (CRM) paradigm shall be used, where cases are created by the user or the administrator request.

Cases are assigned unique identifiers that are communicated to the initiator (and the user concerned, if case was initiated by the registry administrator) and then mentioned every time a communication with reference to the case is made.

Cases may contain confidential information, including personal and financial data, which shall be protected accordingly.

It should be possible to create cases from within the registry interface, in which case the registry should record a context that may be helpful in assisting the user, such as the user identity, the current impersonation, the currently open account identifier, log ids of the latest transaction attempted by the user etc.



Further communication between the user and the registry administrator may go through an authenticated web portal with email notifications or directly by email, depending on the level of confidentiality that the case at hand requires.

5. Security and Compliance (A6R-25)

Although UN-run systems are not subject to formal compliance to particular standards, industry best practices for security commensurate to the level of financial and other types of risks they present shall be applied in their implementation and operation. Of particular relevance is the PCI DSS at the respective compliance level. The following areas should be evaluated for compliance, in accordance with the PCI DSS requirements where 'cardholder' may be replaced with 'Party or account holder':

- (a) Install and maintain a firewall system to protect cardholder data: the network provider shall provide adequate perimeter and host protection for registry-related systems;
- (b) Avoid vendor-supplied defaults for system passwords and other security parameters: a strong password policy shall be maintained for all access to the registry, with elevated requirements for users with elevated rights;
- (c) Protect stored cardholder data: encryption shall be used for registry data and backups at rest ([A6R-21](#)). It shall be possible to review and replace the encryption methods and cyphers with time in order to keep up with technological advancements in the area; in particular, to switch to quantum-safe encryption;
- (d) Encrypt transmission of cardholder data on open, public networks: encrypted communications, with protocols such as TLS, shall be used to communicate with registry users, between registry systems, and between the registry and other systems;
- (e) Protect all systems against malware, and update anti-virus software or programs: necessary protection systems shall be set up and constantly updated on all hosts running the registry software; for all controlled user environments, such as the computers of registry administrators, tight control shall be practised for installed software, restricted use of the Internet other than for direct purposes of using the registry, and hardened operating system installations;
- (f) Develop and maintain secure systems and applications: security best practices shall be adhered to in the development of registry systems and their deployment scenarios. Maintenance manuals shall have security as their primary focus and logging of application of security protocols in maintenance shall be established and periodically verified;
- (g) Restrict access to cardholder data by business need to know: registry users with elevated privileges shall have as little access to data as possible to enable them to perform their functions;
- (h) Identify and authenticate access to system components: all human users of the registry shall have their own identity that is authenticated on each access; system-to-system communications are also authenticated and logged;
- (i) Restrict physical access to cardholder data: the registry shall be hosted in a physically protected environment commensurate to the level of risk associated with the system; for the international registry, this means that it is hosted at a location that is PCI DSS-compliant but can at the same time respect privileges and immunities of the United Nations;
- (j) Track and monitor access to network resources and cardholder data: non-modifying access at the application level shall also be tracked and logged; standard logging arrangements shall be implemented for all system components, with logs protected and stored using similar level of security arrangements as the ones implemented for application logs ([A6R-48](#));



- (k) Regularly test security systems and processes: operational and security manuals for the registry shall contain descriptions of security test and drill procedures for all systems and processes;
- (l) Maintain an information security policy which addresses information security for all personnel: registry solutions shall be equipped with security policies that apply to all registry administrators, system administrators, software and operational vendors and suppliers; recommendations for security arrangements shall also be provided for Party-specific section administrators.

6. User Experience (A6R-26)

The international registry shall provide a user-friendly interface on devices that are likely to be utilized by their users, feature sufficient accessibility, and provide convenient access to all functions that respective users are authorized to use.

6.1. Intuitive, user and expert friendly interface (A6R-27)

The international registry shall provide a user-friendly interface for administrators and account holders. Upon login, a registry shall present the user with a menu of functions that are available for their use according to their role.

The interface shall be both user- and expert-friendly. For users with basic needs, such as the need to review the state of their own account, access the transaction history of their own account, and initiate a transaction from their own account, the interface shall appear in the simplest possible form, with the minimum number of options, and avoiding any complexity that such a user may not use beneficially. At the same time, for the users with advanced roles, such as the Party-specific section administrators and registry administrators, the registry shall provide a feature-rich menu with advanced access and administrative functions readily accessible.

6.2. Responsiveness (A6R-28)

The registry interface shall be convenient for use on desktop and view on mobile devices with screen widths above 1024 pixels and 10 inches. A change of the viewport size shall lead to responsive layout adjustment.

The international registry may be used from small mobile devices.

6.3. Accessibility (A6R-29)

The user interface of the registry shall comply with the requirements of WCAG 2.1, level A and should comply with level AA. Any efforts to increase accessibility should not decrease the usability of systems by able-bodied users.

6.4. Dashboards, oversight interfaces and reports (A6R-30)

The registry shall implement convenient presentation of operational data that are required for effective and efficient use by all user groups. At the minimum, the registry shall implement the following dashboards and oversight reports available through the user interface:



For account holders:

- (a) A welcome dashboard with an account overview, balances in all accounts, incoming notifications and support cases;
- (b) An account review interface, with a list of transactions;
- (c) A transaction review interface;
- (d) A descriptor object review interface.

For Party-specific section administrators:

- (a) Everything available to account holders. The welcome dashboard shall contain a regulated entity overview;
- (b) An entity review interface with a list of accounts;
- (c) A Party holding review interface;
- (d) An authorizations review interface;
- (e) An interface to generate and export registry data that are relevant for AEF reporting.

For registry administrators:

- (a) A welcome dashboard with an overview of cooperative approaches (for the international registry), Party-specific sections, and administrative accounts.
- (b) A daily summary interface with the possibility to generate a daily operation report.
- (c) A user support SLA report and access to ongoing cases.

6.5. Registry function access (A6R-56)

The registry shall implement a convenient way for all its users to initiate actions they are authorized to initiate. At the minimum, the registry shall implement the following interfaces:

For account holders:

- (a) Request account opening, suspension, reactivation, or closure;
- (b) Initiate transfer of units (here and ahead, initiation of a transfer includes transfers for cancellation or use purposes where the transfer is to an account of the respective type);
- (c) Request support ([A6R-24](#)).

For Party-specific section administrators:

- (a) Open Party-specific administrative issuance, holding and cancellation accounts;
- (b) Request granting and suspension of an entity access to the registry;
- (c) Grant and reject requests for account creation by entities;
- (d) Suspend, reactivate and close accounts in the Party-specific section;
- (e) Issue units into a Party-specific issuance account;
- (f) Issue authorizations;
- (g) Initiate transfer of units;
- (h) Request support ([A6R-24](#)).



For registry administrators:

- (a) Create and suspend Party-specific sections.
- (b) Grant and suspend Party-specific section administrator and entity access to the registry.
- (c) Impersonate Party-specific section administrators and account holders.
- (d) Initiate corrective transfers ([A6R-55](#)).
- (e) Provide support ([A6R-24](#)).

For system administrators:

- (a) Create, suspend, and reactivate registry administrator accounts.

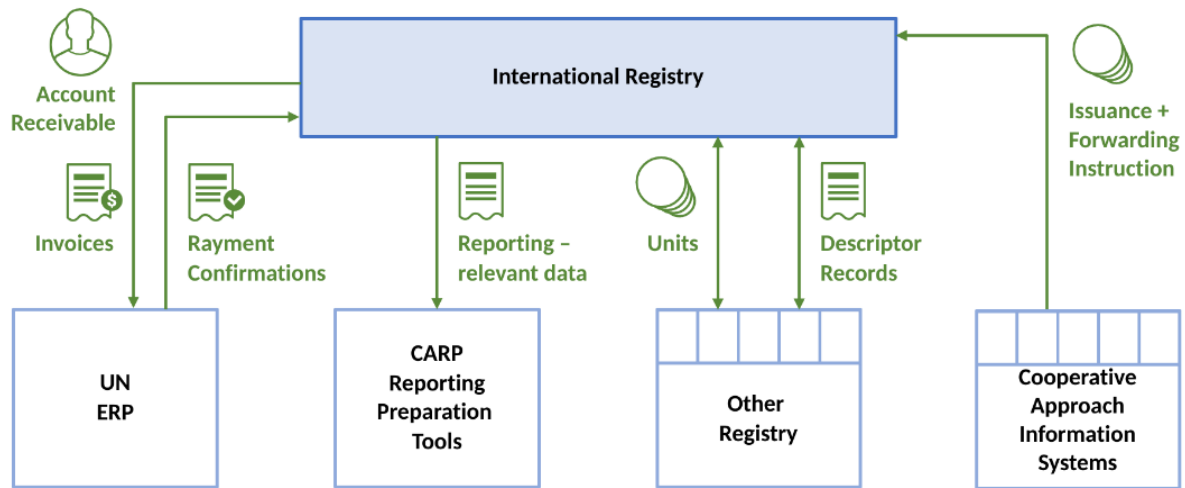
7. Interoperability and Integration (A6R-31)

Interoperability and integration mandates have not been defined yet. It is clear though that the international registry will need to interoperate with various types of external systems (see also Figure 4 below):

- (a) Should the registry charge fees for certain operations, such operations would need to generate invoices for payment and control incoming payments; integration with UN-run ERP and financial accounting systems may be required;
- (b) The registry shall provide data for the generation of AEF reporting automatically ([A6R-48](#)), including outside reporting periods to facilitate pre-checks to be performed on the centralized accounting and reporting platform;⁴⁴
- (c) The registry shall interoperate with other registries and/or any future reconciliation mechanism or other arrangements, for the purposes of external transfers ([A6R-54](#)) and propagation of descriptor records;
- (d) The registry should be able to interoperate with voluntary cancellation platform(s) for the purposes of making available information on units that are available for voluntary cancellation and initiation of transfer of such units to a predefined cancellation account.

Figure 4. Possible interoperability needs of registries

⁴⁴ <https://unfccc.int/documents/628727> - see section 3.7.



Interoperability may be implemented in a variety of technical and/or manual ways that are out of scope for these requirements document.

7.1. Financial accounting (A6R-32)

The registry may charge fees for specific operations. Where the fees are not handled by the respective information systems, the registry should be able to communicate with the UN ERP system for the purposes of:

- (a) Requesting creation of a business counterpart (entity) record;
- (b) Requesting issuance of an invoice to an entity;
- (c) Review of outstanding and paid invoices;
- (d) Requesting a refund to an entity (with a manual confirmation in the ERP system).

7.2. Article 6 database and CARP submission portal (A6R-57)

The international registry shall be able to communicate to:

- (a) The CARP in order to access and update the view of common nomenclatures necessary to run the registry;
- (b) The Article 6 database to facilitate pre-checks;
- (c) The CARP reporting preparation tool in order to provide information relevant for the generation of the AEF.

7.3. Other registries (A6R-34)

The international registry shall be able to interoperate with other registries in order to transfer units within a cooperative approach and propagate descriptor records. The modalities of such interoperability



for the purpose of transferring units are not defined at present. Four potential modalities may be envisaged:

- (a) Manual interoperability (readily provided by the arrangements described in [A6R-54](#));
- (b) Point-to-point interoperability: registries may be expected to have a set of APIs to transfer units to other registries and verify that transfers have been accounted for adequately/reconcile transfers with *one* other registry system;
- (c) Reconciliation mechanism: registries may be expected to connect to a reconciliation mechanism that would facilitate consistency in transferring of units between multiple registries and consistent application of the business rules.
- (d) DLT: registries may be expected to record external transfers using a distributed ledger that would facilitate the transfer of units between multiple registries and smart contracts for the consistent application of the business rules.

Registries shall be able to make descriptor records available to other registries via APIs or other means capable of delivering descriptor records to all registries operating accounts that belong to the given cooperative approach by the time these descriptor records become applicable.

7.4. Voluntary cancellation platforms (A6R-35)

The international registry should implement APIs for a voluntary cancellation platform to be able to:

- (a) Request information on the units that are available for voluntary cancellation;
- (b) Request transfer of such units to a predefined cancellation account
- (c) Verification that the units previously requested for cancellation have been cancelled.

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