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Technical Specification

O-RAN Work Group 2 (Non-RT RIC and A1 Interface WG)

R1 interface: General Aspects and Principles

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Contents

Foreword

This Technical Specification (TS) has been produced by O-RAN Alliance.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the O-RAN Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in O-RAN deliverables except when used in direct citation.

1 Scope

The contents of the present document are subject to continuing work within O-RAN and may change following formal O-RAN approval. Should the O-RAN Alliance modify the contents of the present document, it will be re-released by O-RAN with an identifying change of version date and an increase in version number as follows:

version xx.yy.zz

where:

xx: the first digit-group is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc. (the initial approved document will have xx=01). Always 2 digits with leading zero if needed.

yy: the second digit-group is incremented when editorial only changes have been incorporated in the document. Always 2 digits with leading zero if needed.

zz: the third digit-group included only in working versions of the document indicating incremental changes during the editing process. External versions never include the third digit-group. Always 2 digits with leading zero if needed.

The present document specifies the general aspects and principles of the R1 interface. It is part of a planned TS-family covering the R1 interface specifications.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ORAN TS: "A1 Interface: Application Protocol"("A1AP").

[2] O-RAN TS: "Non-RT RIC & A1 Interface: Use Cases and Requirements"("UCR").

[3] O-RAN TS: "Non-RT RIC Functional Architecture Specification".

[4] O-RAN TS: "Security Protocols Specifications".

[5] O-RAN TS: "Transport protocols for R1 Services"("R1TP").

[6] O-RAN TS: "O2IMS-Interface Specifications" ("O2IMS").

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, O-RAN cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

[i.1] 3GPP TR 21.905: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Vocabulary for 3GPP Specifications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Non-RT RIC: O-RAN non-real-time RAN Intelligent Controller: a logical function in the SMO framework that enables non-real-time control and optimization of RAN elements and resources, AI/ML workflow including model training and updates, and policy-based guidance of applications/features in Near-RT RIC. The Non-RT RIC is comprised of the Non-RT RIC framework and Non-RT RIC applications (rApps).

Non-RT RIC framework: Functionality internal to the SMO framework that logically terminates the A1 interface and provides the R1 services to rApps through the R1 interface.

rApp: Non-RT RIC application: an application designed to consume and/or produce R1 Services.

NOTE: rApps can leverage the functionality provided by the SMO and Non-RT RIC frameworks to deliver value added services related to intelligent RAN optimization and operation.

R1 Interface: Interface between rApps and Non-RT RIC framework via which R1 Services can be produced and consumed.

R1 Services: A collection of services including, but not limited to, service registration and discovery services, authentication and authorization services, AI/ML workflow services, and A1, O1 and O2 related services.

3.2 Symbols

Void

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply.

AI Artificial Intelligence

EI	Enrichment Information
FQDN	Fully Qualified Domain Name
FM	Fault Management
ML	Machine Learning
PM	Performance Management
RAN	Radio Access Network
RBAC	Role Based Access Control
RIC	RAN Intelligent Controller
RT	Real-time
SMO	Service Management and Orchestration
TBAC	Target Based Access Control

4 General Aspects of R1 Interface and R1 Services

4.1 Introduction

This chapter covers the general aspects for R1 interface.

4.2 General principles

The general principles for the specification of the R1 interface are as follows:

- The R1 interface is an open logical interface within the O-RAN architecture between the rApps and the Non-RT RIC framework.
- The R1 interface supports the exchange of control signalling information and the collection and delivery of data between endpoints.
- The R1 interface enables multi-vendor rApps to consume or produce the R1 services and is independent of specific implementations of the SMO and Non-RT RIC framework.
- The R1 interface is defined in an extensible way that enables new services and data types to be added without needing to change the protocols or the procedures.

4.3 Specification objectives

The R1 interface specifications shall:

- Facilitate inter-connection between rApps and Non-RT RIC framework supplied by different vendors.
- Provide a level of abstraction between rApps and SMO/Non-RT RIC framework that can be the consumers and or producers of R1 services.

4.4 Capabilities

As described in UCR[3], the R1 interface shall support:

- Registration and Deregistration of R1 services,
- Authentication of rApps,
- Authorization of requests to access R1 services,
- Facilitation of service discovery and service notifications for the registered R1 Services,
- Registration and Deregistration of data types,
- Subscription and Unsubscription for registered data types and collection and delivery of data for subscribed data types,
- Functionalities related to A1, O1 and O2 interfaces, and AI/ML workflow services.

5 R1 Services

5.1 Service management and exposure services

5.1.1 General

As described in the Non-RT RIC Architecture specification [3], the Service management and exposure services provided by the SMO/Non-RT RIC framework enable:

- rApp registration,
- Registration of services,
- Discovery of services,
- Authentication and authorization,
- Communication support,
- Bootstrap (optional),
- Heartbeat (optional).

Additionally, if the Bootstrap service is provided by the SMO/Non-RT RIC framework, an rApp can use it to discover the endpoints of the Service management and exposure services.

If the Heartbeat service is provided by the SMO/Non-RT RIC framework, an rApp can use it to maintain its R1 service registration status with the Service management and exposure services Producer.

The Service management and exposure services handle R1 services that are produced and/or consumed by rApps, as well as R1 services that are produced by functions in the SMO/Non-RT RIC framework and consumed by rApps. Additionally, the information related to the registered services is stored and the status of the service registrations is kept updated.

The Service management and exposure services also handle the authorization of Service Consumers. When an R1 service is registered, it is available for discovery and invocation, by authorized Service Consumers.

In the following, the term "Service Producer" refers to the role of an rApp to register and produce a service, and the term "Service Consumer" refers to the role of an rApp to discover and consume a service, using the Service management and exposure service. The term "Service management and exposure services Producer" refers to the logical R1 Service management and exposure functions in the SMO/Non-RT RIC framework acting as Service Producers of one or more of the Service management and exposure services.

NOTE: An rApp can discover services produced by other functions than rApps via the R1 interface, while services registered by rApps cannot be discovered by other functions than rApps via the R1 interface. The R1 interface only specifies how rApp interacts using the Service management and exposure services in the roles of Service Producer and Service Consumer.

5.1.2 Bootstrap service

5.1.2.1 Overview

If the Bootstrap service is provided by the SMO/Non-RT RIC framework, an rApp can use it to discover the endpoints of the Service management and exposure services.

5.1.2.2 Bootstrap

The endpoint on which the Bootstrap service can be reached shall be version independent. It can be provisioned to the rApp or can be obtained e.g., from a fixed well-known address or FQDN.

The following procedure is defined:

Discover bootstrap: This procedure enables determination of the endpoints of the other Service management and exposure services.

5.1.3 Service registration service

5.1.3.1 Overview

This service allows Service Producers to register information about the R1 services they produce.

5.1.3.2 Registration of services

Register service is a procedure where a Service Producer declares its produced services to the Service management and exposure services Producer. Upon successful registration of a service, the information about the services is stored. Deregister service is a procedure where a Service Producer declares which services are no longer provided. The Service Producer can also update the registered information related to a service.

When registering a service, the Service Producer provides the information about the service, and may provide information on, but not limited to, the following:

- profile of the service,
- information on how to access the service,

- information on the API,
- limitations/capabilities of the Service Producer.

The following procedures are defined:

Register service: A Service Producer uses this procedure to register an R1 service that it produces with the capabilities that are being exposed. On receiving the request, the Service management and exposure services Producer determines whether the Service Producer is authorized to produce the service, and whether there are any conflicts. In the response, the Service management and exposure services Producer informs the Service Producer on the capabilities that they are allowed to expose.

Deregister service: A Service Producer can use this procedure to deregister an R1 service that it is registered to provide.

Update service registration: A Service Producer can use this procedure to update the registration of an R1 service that it provides.

5.1.4 Service discovery service

5.1.4.1 Overview

This service allows Service Consumers to discover R1 services they intend to consume.

5.1.4.2 Discovery of services

For service discovery, a set of procedures enables a Service Consumer to retrieve information on available services based on selection criteria.

NOTE: Available services either have been registered by service-producing rApps using the Service registration service (in case these are produced by rApps) or have been made known to the Service discovery service Producer by other means (in case they are produced by Service Producers inside the SMO/Non-RT RIC framework).

Upon receiving the request to discover services, the Service management and exposure services Producer verifies the identity of the Service Consumer (see clause 5.1.6). The Service management and exposure services Producer retrieves the stored service information, applies the authorization policy, and performs filtering of service information based on the selection criteria provided in the request.

The following procedures are defined:

Discover services: A Service Consumer uses this procedure to discover registered services. The Service Consumer can provide selection criteria to inquire about the registered services. The response contains a filtered list of available services based on which services the consumer is authorized to access.

Subscribe service availability: A Service Consumer can subscribe to notifications regarding changes in service(s) that are available and thereby receive a notification when a service has been registered, updated, or deregistered by a Service Producer. The subscription is created for the Service Consumer based on the services and capabilities that it is authorized to access, i.e., the Service Consumer only gets notified about changes in registration status of services that it is

authorized to access. Upon subscription, the Service Consumer can pass selection criteria in order to control the set of services about which it wishes to be notified.

Unsubscribe service availability: A Service Consumer can unsubscribe from notifications regarding changes in the available services.

Notify service availability changes: The Service management and exposure services Producer can use this procedure to notify a subscribed Service Consumer about changes in the set of registered services that the Service Consumer is authorized to access.

5.1.5 Heartbeat service

5.1.5.1 Overview

A Service Producer can use the Heartbeat service to maintain its R1 service registration status with the Service management and exposure services Producer if this service is provided.

5.1.5.2 Heartbeat

The Service Producer sends a heartbeat message periodically, where the period may be specified in the response of the Register service procedure. On receiving the heartbeat message, the Service management and exposure services Producer validates it and sends a response to the Service Producer which may include information modifying the heartbeat message period. If a valid request is not received for a specified duration from a particular Service Producer, the Service management and exposure services Producer marks the Service Producer as no longer active, which may impact the state or discoverability of the produced services. The Service management and exposure services Producer will record the changes of the state or discoverability of the services related to the Service Producer that is no longer active and notify the Service Consumers subscribed to receive notifications of status changes via Notify service availability changes procedure.

The following procedure is defined:

Heartbeart: A Service Producer can use this procedure to maintain its R1 service registrations.

5.1.6 Authentication and authorization

5.1.6.1 Overview

Authentication and authorization are realized as a combination of procedures and services that allow asserting the identity of Service Producers and Service Consumers and ensure that only authorized consumers can access the R1 services.

5.1.6.2 Authentication

Authentication will be performed to authenticate the Service Consumers and/or Service Producers to allow them to provide and/or access R1 Services. Service Consumers and/or Service Producers can initiate secure communication for R1 services that they are authorized to use, after the authentication information is validated.

Authentication procedures shall comply to all the requirements specified in the Security Protocols Specifications [4] .

5.1.6.3 Authorization

Authorization procedures are used to grant Service Consumers access to registered R1 services and to allow Service Producers to produce R1 services.

Authorization may be based on a mechanism to enforce authorization by policies, where exposed R1 services are further subject to authorization policies before granting access to registered services. Authorization policies refer to the attributes that are associated to the Service Consumer. For example, authorization policy can be RBAC or TBAC and the additional details are supplied in the policy attributes.

The following procedures are defined:

Request access: A Service Consumer can use the Request access procedure to request access to the exposed services that it can discover. A token may be granted for subsequent use of any R1 services that require authorization.

Revoke access: A Service Consumer with appropriate privileges (administrator) can use the Revoke access procedure to revoke the access to exposed R1 services.

5.1.7 rApp registration service

5.1.7.1 Overview

The rApp consumes this service to register with the Service management and exposure services Producer.

5.1.7.2 rApp registration management

The rApp consumes this service to register with the Service management and exposure services Producer and may provide the following information such as rApp name, vendor, software version, certificates, role of the rApp (Service Producer and / or Service Consumer), and security credentials. On successful registration, the Service management and exposure services Producer responds with an rApp identifier (rAppID).

NOTE: The procedure for provisioning the security credentials by an rApp with the Service management and exposure services Producer is FFS.

The following procedure is defined:

Registration: An rApp can use this procedure to register with Service management and exposure services Producer.

5.2 Data management and exposure services

5.2.1 General

As described in the Non-RT RIC Architecture specification [3], the Data management and exposure services enable:

- Registration of data types,
- Discovery of data types,

- Request for data,
- Subscription to data,
- Collection of data from Data Producers and consumption of data by Data Consumers,
- Access to optional data processing in the SMO/Non-RT RIC framework.

The Data management and exposure services use data types as descriptions of certain types of data that are available. A data type is defined by a data type identifier and the syntax of the data type is given by an associated schema. A data type is defined by one schema while a schema may be associated with one or multiple data types.

When a data type has been registered, it is available for discovery, and request for / subscription to data, by authorized Data Consumers. Further, the data instances for a data type may be stored or the actual data production may be triggered by the SMO/Non-RT RIC framework on the need for data collection, including based on a request for data by a Data Consumer or a data offer from a Data Producer.

Data Consumer refers to an rApp that can consume data for a data type and Data Producer refers to an rApp that can produce data for a data type.

Based on data type information, to trigger data collection or data consumption, data instances can be requested or subscribed to. While a data request causes the delivery of a data instance as a one-time response, a data subscription potentially causes multiple data delivery actions. Data consumption refers to a Data Consumer requesting for or subscribing to a data instance. Data collection refers to the SMO/Non-RT RIC framework requesting for or subscribing to a data instance.

When initiating a data request or data subscription, the data instance to obtain is defined by the data type information and by additional characteristics as listed below.

NOTE: Data type information can be made available to Data Consumers using the Discover data types procedure (see clause 5.2.3 Data discovery service

5.2.3.1 Overview

Data Consumers consume this service to discover available data types. The Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

5.2.3.2) or from configuration. Data type information can be made available by Data Producers to the Data management and exposure functions using the the Register data procedure (see clause 5.2.2.2).

This information that defines a data instance may contain, but is not limited to, the following parameters:

- data type identifier,
- time interval for the data instance (start and end of the interval during which the data have been or will be collected),
- granularity of collection (how often data are to be collected),
- periodicity of delivery (how often data instances are to be delivered),
- scope (i.e., filter on the data),

- target (i.e., filter on the managed objects that the data is associated with).

The collection of data from the Data Producers can for instance be started based on a trigger from a Data Consumer that requests/subscribes to specified data that needs to be generated and collected, at the discretion of functions in the SMO/Non-RT RIC framework or based on a data offer from a Data Producer. If an additional Data Consumer request for / subscribes to a data instance of a certain data type and scope that is already being collected by the Data Management and Exposure functions, no additional data collection will be started with the Data Producer if the collected data meets the criteria of additional request.

Data management and exposure services include services that are produced by the Data management and exposure functions, as well as services to be produced by the Data Producers or Data Consumers and consumed by the Data management and exposure functions.

NOTE: In the Non-RT RIC Architecture specification [3], it is described that the Data management and exposure services can enable an rApp to discover and consume data types produced by functions other than rApps, and that data types produced by rApps can be consumed by functions other than rApps. The R1 interface only specifies how rApps interact with the Data management and exposure service in the roles of Data Producer and Data Consumer.

5.2.2 Data registration service

5.2.2.1 Overview

Data Producers consume this service to register data types. The Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

5.2.2.2 Registration of data types

Register data type is a procedure where a Data Producer declares a data type it can provide to the Data registration and discovery service Producer. Deregister data type is a procedure where a Data Producer declares a data type to be no longer available.

As part of the Register data type procedure, the Data Producer provides the data type identifier and further information about the data type, such as if it is stored e.g., in an object store or can be continuously produced and delivered and may provide information on, including but not limited to, the following:

- information on how to collect the data, e.g., a reference to a message bus or a location in an object store,
- periodicity of the data, in case it is generated periodically,
- information on the data syntax (schema),
- limitations/capabilities of the Data Producer to filter the data (e.g., to provide only certain types of events if requested so by the Data Consumers),
- the supported data delivery methods (i.e., push and pull) by the Data Producer,
- information whether the Data Producer supports data request or data subscription or both.

The following procedures are defined:

Register data type: A Data Producer uses this procedure to register a data type for which it can produce data instances. On receiving the request, the Data registration and discovery service Producer determines whether the Data Producer is authorized to produce the data type, and whether there are any conflicts, e.g., if the data type is already registered. In the response, the Data registration and discovery service Producer informs the Data Producer if it is allowed to produce the data type.

Deregister data type: A Data Producer can use this procedure to deregister a data type that it has previously registered for which it is no longer able to produce data instances.

5.2.3 Data discovery service

5.2.3.1 Overview

Data Consumers consume this service to discover available data types. The Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

5.2.3.2 Discovery of data types

This set of procedures enables a Data Consumer to retrieve information on the registered data types.

Discovery of a data type does not imply availability of data instances of that data type. It is just an indication that Data Consumers can request or subscribe to data for that data type. It can happen that the actual data production is only triggered by the request or subscription actions of the Data Consumers.

The following procedures are defined:

Discover data types: A Data Consumer can discover the data types that are available. For each data type, a data type identifier and additional metadata are provided.

Query data type information: A Data Consumer can retrieve information on a specific data type identified by a data type identifier. Such information enables the Data Consumer to formulate a request or subscription for data instances of that data type.

Subscribe data types changes: A Data Consumer can subscribe to notifications regarding changes in the set of available data types and thereby receive notifications when data types have been registered or deregistered. The subscription is created for the Data Consumer based on the data types that it is authorized to access, i.e., the Data Consumer can only subscribe to get notified about changes in availability status of data types that it is authorized to access.

Unsubscribe data types changes: A Data Consumer can unsubscribe from notifications regarding changes in the set of available data types.

Notify data types changes: The Data registration and discovery service Producer uses this procedure to notify a subscribed Data Consumer about changes in the set of available data types.

5.2.4 Data request service

5.2.4.1 Overview

For data consumption, Data Consumers consume this service to request data instances, and the Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

For data collection, the Data management and exposure functions in the SMO/Non-RT RIC framework consume this service to request data instances, and Data Producers produce this service.

5.2.4.2 Requesting data

This set of procedures allows a Data request service Consumer to specify a data instance (for a registered data type) to be delivered to it. The data instance is defined by information specified in clause 5.2.1

Data request is a one-time request and is performed via Request data procedure.

A data request can be stopped using the Cancel data request procedure.

The following procedures are defined:

Request data: The Service Consumer provides, to the Data request and subscription service Producer, information on the data it requests based on the data type information.

Cancel data request: The Service Consumer cancels a data request.

5.2.5 Data subscription service

5.2.5.1 Overview

For data consumption, Data Consumers consume this service to subscribe to data instances, and the Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

For data collection, the Data management and exposure functions in the SMO/Non-RT RIC framework consume this service to subscribe to data instances, and Data Producers produce this service.

5.2.5.2 Subscribing to data

This set of procedures allows a Data subscription service Consumer to specify a data instance (for a registered data type) to be delivered to it, and to choose the delivery service to use (push or pull). The data instance is defined by information specified in clause5.2.1.

Subscribe data is a procedure that initiates the delivery of a data instance in potentially multiple chunks of data. A data subscription can be stopped using the Unsubscribe data procedure.

The following procedures are defined:

Subscribe data: The Service Consumer provides, to the Data request and subscription service Producer, information on the data it wants to subscribe to based on the data type information retrieved using the Discover data types procedure.

Notify data availability: The Service Consumer is provided information on the availability and retrieval scheme of the subscribed data instance. As a precondition, the Service Consumer must have used the Subscribe data procedure to create a subscription.

Unsubscribe data: The Service Consumer cancels a data subscription.

The procedures for delivery of data instances are described in clause (5.2.6).

5.2.6 Data delivery services

5.2.6.1 Overview

Data delivery is handled through a set of services as defined below which deliver data as requested using the Request data or the Subscribe data procedure (see clause 5.2.4) or indicated using the Create data offer procedure (see clause5.2.6).

Data delivery messages relate to a particular data request, data subscription or data offer. The data can be delivered in different ways, e.g.:

- as part of the payload of a data delivery message,
- as a data stream,
- a REST endpoint, a message bus or object store location.

The means where and how the data can be retrieved can be made known to the recipient of the data by different means as part of the Request data, Subscribe data, Notify data availability or Create data offer procedure.

NOTE: Additional procedures for data delivery can be added in later releases.

5.2.6.2 Pull data service

The pull data service allows the Service Consumer to obtain data via a pull mechanism from the Service Producer. Retrieval of data can occur once or multiple times (polling).

For data consumption, Data Consumers consume this service and the Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

For data collection, the Data management and exposure functions in the SMO/Non-RT RIC framework consume this service and Data Producers produce this service.

The following procedure is defined:

Retrieve data: The Service Consumer retrieves, from the Service Producer, data instances about whose existence the Service Consumer has been informed as part of the Request data, Notify data availability or Create data offer procedure, using a pull communication mechanism.

5.2.6.3 Push data service

The push data service allows the Service Consumer to push data to the Service Producer,

For data consumption, the Data management and exposure functions in the SMO/Non-RT RIC framework consume this service and Data Consumers produce this service.

For data collection, Data Producers consume this service and the Data management and exposure functions in the SMO/Non-RT RIC framework produces this service.

The following procedure is defined:

Push data: The Service Consumer provides, to the Service Producer a data instance using a push communication mechanism as arranged as part of the Request data, Subscribe data or Create data offer procedure.

5.2.7 Data offer service

5.2.7.1 Overview

Data Producers consume this service to request producing data to the Data offer service Producer for immediate collection and storage. The Data management and exposure functions in the SMO/Non-RT RIC framework produce this service.

5.2.7.2 Managing a data offer

This service allows a Data Producer to declare to the Data offer service Producer that it intends to produce data instances for immediate collection and storage by the latter. Prior to creating a data offer, the Data Producer has registered the related data type.

The Data Producer provides information on the data that it intends to provide based on the data type information it has provided during data registration (see clause5.2.2.2) and specifies additional characteristics of the data instance it intends to provide, similar to the information passed in the data request or data subscription (see clause 5.2.4 and 5.2.5).

The Data Producer can further indicate that it no longer intends to produce data for a data offer by deleting the offer.

The Data offer service Producer can indicate to the Data Producer that it does no longer wishes to receive data related to the offer by sending a data offer termination notification to the Data Producer, subsequently stopping collecting data related to the offer and terminating the offer.

The following procedures are defined:

Create data offer: A Data Producer provides, to the Data offer service Producer, information on the data it intends to deliver based on the data type information passed during the Register data type procedure. In case the push data service is intended to be used for data delivery, the Data offer service Producer provides to the Service Consumer information regarding the endpoint on which to receive the pushed data. In case the pull data service is intended to be used for data delivery, the Data offer service Producer provides to the Service Consumer information regarding the endpoint on which to receive the data availability notifications.

Terminate data offer: A Data Producer terminates a data offer it has created.

Notify data offer termination: The Data offer service Producer provides, to the Data Producer, a notification that it intends to stop collecting data from the data offer and terminating the offer. Following the reception of such notification, the Data Producer shall not deliver further data related to the data offer. The procedures for the delivery of data instances are described in clause (5.2.6)

5.3 A1-related Services

5.3.1 General

As described in the Non-RT RIC Architecture specification [3], the A1-related services produced by the SMO/Non-RT RIC framework enable the following functionalities related to the management of A1 policies and A1 enrichment information:

- Creation, modification, deletion, and query of A1 policies.
- Discovery of supported A1 policy types.
- Querying the status of A1 policies.
- Subscribe to event notifications related to A1 policies.
- Registration and deregistration of EI types.

5.3.2 A1 policy management service

5.3.2.1 Overview

The A1 Policy management service is an R1 service that enables an rApp (the consumer of that service) to

- discover available A1 policy types and subscribe to notifications on added or removed A1 policy types,
- query for details of A1 policy types and details of A1 policy and status,
- create, update, and delete an A1 policy.

The term "A1 policy management service Producer" refers to the A1-related functions in the SMO/Non-RT RIC framework acting as Service Producer of the A1 policy management service. The term "A1 policy management service Consumer" refers to an rApp acting as Service Consumer of the A1 policy management service.

NOTE 1: Another name for this service that does not depend on southbound interface naming is FFS.

NOTE 2: The terms A1 policy type, A1 policy type identifier, A1 policy and A1 policy identifier refer to definitions made for the A1-P service over the A1 interface, see A1 Application Protocol [[1]], and are used unchanged in the procedures of the A1 policy management service over the R1 interface.

5.3.2.2 A1 Policy management

The following procedures are defined:

Query Near-RT RIC identifiers: An A1 policy management service Consumer can use this procedure to query the Near-RT RIC identifiers. The A1 policy management service Producer will respond with a list of Near-RT RIC identifiers.

Query A1 policy type identifiers: An A1 policy management service Consumer can use this procedure to query for the available A1 policy types. The A1 policy management service Producer will respond with the list of identifiers for all the available A1 policy types.

Subscribe to policy type availability changes: An A1 policy management service Consumer can use this procedure to subscribe to notifications on policy type availability changes, i.e. when an A1 policy type becomes available or when an A1 policy type becomes unavailable.

Query A1 policy type: An A1 policy management service Consumer can use this procedure to query the details of an A1 policy type by providing the A1 policy type identifier. The A1 policy management service Producer will respond with information about the A1 policy type.

Query A1 policy identifiers: An A1 policy management service Consumer can use this procedure to query for the A1 policies, or a subset of the A1 policies by providing query parameters such as A1 policy type identifier or Near-RT RIC identifier. The A1 policy management service Producer will return the list of A1 policy identifiers that matches with the query criteria.

Query A1 policy: An A1 policy management service Consumer can use this procedure to query for the details of an A1 policy by providing the A1 policy identifier. The A1 policy management service Producer will respond with information about the A1 policy.

Create A1 policy: An A1 policy management service Consumer can use this procedure to create an A1 policy by providing the below parameters:

- Information about the A1 policy,
- A1 policy type identifier,
- Near-RT RIC identifier.

On receiving the request, the A1 policy management service Producer determines whether the A1 policy type is supported by the Near-RT RIC, assigns an A1 policy identifier for the new A1 policy, and informs the A1 policy management service Consumer on the outcome of the A1 policy creation.

Update A1 Policy: An A1 policy management service Consumer can use this procedure to update an A1 policy by providing the below parameters:

- information about the A1 policy,
- A1 policy identifier.

On receiving the request, the A1 policy management service Producer determines whether the A1 policy is available in the Near-RT RIC and informs the A1 policy management service Consumer on the outcome of the A1 policy update.

Query A1 policy status: An A1 policy management service Consumer can use this procedure to query the status of a single A1 policy by providing the A1 policy identifier. The A1 policy management service Producer will respond with the status of the A1 policy.

Subscribe to A1 policy status changes: An A1 policy management service Consumer can use this procedure to subscribe to notifications on status changes of A1 policy. i.e., when an A1 policy status becomes enforced or not enforced.

Delete A1 policy: An A1 policy management service Consumer can use this procedure to delete an existing A1 policy. The A1 policy management service Producer will respond with the outcome of the A1 policy deletion.

NOTE: In the responses of the above procedures, the A1 policy management service Producer can either use stored information that has already been received via the A1 interface (e.g., information on available A1 policy types), or information directly resulting from an A1 procedure performed due to the R1 procedure (e.g., creation of an A1 policy).

5.3.3 A1 enrichment information related services

5.3.3.1 Overview

A1 enrichment information related services enable rApp to register and deregister of EI types of which data it can produce as the source for the EI job results delivered over the A1 interface.

5.3.3.2 A1 enrichment information

The following procedures are defined:

Register EI type: An rApp uses this procedure to register an EI type that it can produce as the source for the EI job results delivered over the A1 interface to the A1 enrichment information functions. In the registration request, the rApp includes the EI source data type registered in the DME functions. On receiving the request, the A1 enrichment information functions can subscribe EI source data from DME functions using the EI source data type. In the response, the A1 enrichment information functions inform the rApp on the EI type capabilities that it is registered to provide.

Deregister EI type: An rApp can use this procedure to deregister EI types that it has previously registered, but that it is no longer able to produce.

5.4 RAN OAM-related Services

5.4.1 General

As described in the Non-RT RIC Architecture specification [3], the RAN OAM-related services produced by the SMO/Non-RT RIC framework provide access to OAM functionality that enables the Service Consumer:

- To obtain information about alarms.
- To change their acknowledgment status.
- To obtain performance information related to the network.
- To obtain the current configuration of the network.
- To provision changes of the configuration of the network.
- To obtain additional information related to the network.

5.4.2 Network Information service

5.4.2.1 Overview

The Network Information service provides to the Service Consumer information related to the network, in particular the RAN, that has been aggregated from multiple information sources that the SMO has access to, e.g., configuration, topology, network element state, geolocation, inventory, etc.

5.4.2.2 Queries related to information about cells

The Network Information service supports various information queries that give the rApps access to information aggregated from multiple sources.

The following procedure is defined:

Query cells-related information: This service operation allows to query aggregated information related to RAN cells.

NOTE: How to query the information, and how this relates to the Data management and exposure services, is FFS.

5.4.3 Fault management (FM) service

5.4.3.1 Overview

The Fault management service allows the Service Consumer to obtain information about alarms.

The RAN OAM-related functions in the SMO/Non-RT RIC framework produce this service.

5.4.3.2 Querying alarm information

The FM service shall allow the Service Consumer to query alarm information.

The following procedure is defined:

Query alarms: This procedure allows the Service Consumer to query the alarm list to obtain the whole list, a subset of the alarms in the list, or an individual alarm. The Service Consumer may specify a set of filtering criteria to control what is returned as result.

5.4.3.3 Changing the alarm acknowledgement state

The FM service shall allow the Service Consumer to change the acknowledgement state of individual alarms (i.e., to acknowledge or unacknowledge them).

The following procedure is defined:

Change alarm acknowledgement state: This procedure allows the Service Consumer to change the acknowledgement state of an alarm (i.e., to acknowledge or unacknowledge it).

5.4.4 Performance management (PM) service

5.4.4.1 Overview

The performance management service allows the Service Consumer to access performance information that was collected from the network elements by the Service Producer.

The RAN OAM-related functions in the SMO/Non-RT RIC framework produce this service.

5.4.4.2 Querying performance information

The PM service shall allow to query performance information using a set of filtering criteria.

The following procedure is defined:

Query performance information: This procedure allows to query performance information that has been collected from the network elements. The Service Consumer specifies a set of filtering criteria to determine the set of information returned.

NOTE: How to query the information, and how this relates to the Data management and exposure services, is FFS.

5.4.5 Configuration management (CM) service

5.4.5.1 Overview

In the following, the term "Service Consumer" refers to the role of an rApp that consumes the Configuration management (CM) service. The term "Configuration management service Producer" refers to the role of the logical RAN OAM-related functions in the SMO/Non-RT RIC framework rk producing the CM service.

The CM service allows the Service Consumer to access configuration information pertaining to the managed entities, as obtained by the CM service Producer. The CM service further allows the Service Consumer to request configuration changes related to the managed entities.

NOTE: As a preliminary definition in the context of R1, the term "managed entities" represents (i) the RAN nodes and RAN functions managed by the SMO via O1 or M-plane interfaces, and (ii) the group of these known as RAN-specific network slice subnets. The exact definition of the term "managed entity" is FFS.

The following capabilities are provided by the CM service Producer over the R1 interface:

- Retrieving configuration schemas
- Reading configuration data
- Writing configuration changes

5.4.5.2 Retrieving configuration schemas

The CM service allows the Service Consumer to retrieve information pertaining to the configuration schemas of one or more managed entities.

The following procedure is defined:

Get schemas: A Service Consumer can use this procedure to retrieve configuration schemas for the managed entities. The CM service Producer will respond with the requested schemas. The schemas provide information about which configuration attributes are supported by the managed entities.

5.4.5.3 Reading configuration data

The CM service allows the Service Consumer to read the configuration data, related to one or moremanaged entities.

The following procedure is defined:

Read Configuration: This procedure enables the Service Consumer to obtain configuration data (including the configuration attributes) related to one or more managed entities from the CM service Producer, subject to optional filtering criteria. The CM service Producer responds to the Service Consumer by providing the requested configuration data or indicates a failure with an appropriate cause.

5.4.5.4 Writing configuration changes

The CM service allows the Service Consumer to write configuration changes, related to one or more managed entities.

The following procedure is defined:

Write Configuration: This procedure enables the Service Consumer to request the CM service Producer for writing configuration changes related to one or more managed entities. The CM service Producer responds to the Service Consumer with the status of the write operation for the configuration changes requested by the Service Consumer or indicates a failure with an appropriate cause.

5.5 O2-related Services

5.5.1 General

As described in the Non-RT RIC Architecture specification [3], the O2-related services produced by the SMO/Non-RT RIC framework provide access to O-Cloud management functionality that enables the Service Consumer:

- To obtain information related to O-Cloud infrastructure management such as,
  - Infrastructure Inventory.
  - Infrastructure Monitoring.
  - Infrastructure Provisioning.
  - Infrastructure Lifecycle Management.
  - Infrastructure Software Management.
- To obtain information related to O-Cloud deployment management such as,

- Deployment Inventory.
- Deployment Monitoring.
- Deployment Lifecycle Management.

- To provision changes of the configuration of the O-Cloud.
- To obtain additional information related to the O-Cloud.

NOTE: Details about O-Cloud deployment management services, provision of configuration changes, additional information related to the O-Cloud are FFS.

5.5.2 O2 Infrastructure management service

5.5.2.1 Overview

O2 Infrastructure management service allows the Service Consumer to obtain information related to O-Cloud infrastructure management services.

O2 related functions in the SMO/Non-RT RIC framework produce this service as specified in O2IMS [6].

5.5.2.2 Query O2-IMS Information

O2 Infrastructure management service shall support various information queries that give the rApps access to information related O-Cloud infrastructure management services.

The following procedures are defined:

Query O2ims_Infrastructure Inventory related information: This service procedure allows to query information related to infrastructure resource inventory and event notification service of O-Cloud.

Query O2ims_InfrastructureMonitoring related information: This service procedure allows to query information related to telemetry reporting.

Query O2ims_InfrastructureProvisioning information: This service procedure allows to query information related to O-Cloud provisioning services.

Query O2ims_InfrastructureLifecycleManagement information: This service procedure allows to query information related to support of procedures for the automation of O-Clouds lifecycle events.

5.6 AI/ML Workflow Services

NOTE: AI/ML Workflow services are FFS.

6 R1 Interface Protocol Structure

The “R1TP" specification [5] defines the R1 transport protocol stack.

Revision history

Date	Revision	Description
2021-11-23	01.00.05	• First version as approved by WG2 • introduing the Service management and exposure services and Data management and exposure services
2021-12-09	01.00.08	Implemented CR: NOK-2021-12-07-WG2-CR-0029-R1GAP-DME leftover comment #42 from review_v02
2022-02-10	01.00.09	Implemented CR: NOK.AO-2021-12-07-WG2-CR-0028-R1GAP-DME refactoring to make data delivery service-based_v04
2022-02-17	01.00.10	Implemented CR: RMI-2022.01.26-WG2-CR-0002.R1GAP.O2 Related services-v04 on O2 Related Services
2022-02-24	01.00.11	Implemnted CR: ERI-2021.12.01.WG2-CR-0051.R1GAP. A1 Related Services -v06.docx
2022-03-24	01.00.12	Editorial updates to 01.00.11.
2022-05-02	02.00.01	Implemented CR NOK-CR-0031-R1GAP-Document structure review comment NOK05_v03, NOK -CR-0033-R1GAP-Missing general clauses_v01, NOK-CR-0034-R1GAP-Review leftovers policy identifier_v01, ERI-CR-0074-R1GAP Updates to A1 Policy management service-v02, NOK-2022-04-12-WG2-CR-0032-R1GAP-Review leftovers small issues_v02.
2022-05-12	02.00.02	Implemented INT -CR-00034-authorization in SME services-v01 and NOK.AO-CR-0040-R1GAP-DME Data Offer_v03.
2022-06-28	02.00.03	Implemented ERI-CR-0075-R1GAP Updates to Service management and Exposure service-v04 and NEC-CR-0015-R1GAP change of the status of the A1 policy-v02, NOK-2022-06-21-WG2-CR-0042-R1GAP-Alarm Ack_v02.
2022-07-08	02.00.04	Implemented NOK-2022-06-21-WG2-CR-0044-R1UCR-Alarm Ack-v02.
2022-07-14	02.00.05	Implemented CMCC-2022.06.24-WG2-CR-0010-Add A1 EI related services in R1GAP-v02 and CMCC-2022.06.16-WG2-CR-0009-R1GAP updates on service management and exposure service-v01.
2022-07-20	02.00.06	Implemented NOK.AO-2022-06-28-WG2-CR-0047-R1GAP-Fixing_data_type_discovery_v02,MAV.AO-2022-06-22-WG2-CR-0003, CR004,CR006, and CR007-R1GAP Configuration management service Overview R1draftFinal-v08.
2022-09-22	03.00.01	Implemented NOK.AO-2022-08-05-WG2-CR-0055-R1GAP-DME services modularization and refactoring_v03 and NOK.AO-2022-08-05-WG2-CR-0054-R1GAP-SME services modularization_v02.
2022-09-27	03.00.02	Implemented NOK-2022-09-22-WG2-CR-0060-R1GAP-Fixes to DME service followup of CR 0055_v02 and NEC-2022.09.12-WG2-CR-0023-R1GAP supported data delivery method in Register data type procedure-v01
2022-10-27	03.00.03	Implemented NOK.AO-2022-09-29-WG2-CR-0062-R1GAP-Support of request and subscription in DME data type registration_v02 and ERI-2022.10.19-WG2-CR-0130-R1 GAP update to New TS template-v01 to update the templete to New O-RAN TS template
2022-11-10	03.00.04	Implemented NEC-2022.10.13-WG2-CR-0025-R1GAP Clarification on heartbeat service -v01 and changed the font(from Times new roamn to Calibri) to aling with O-RAN template
2022-11-18	03.00.05	Implemented comments from Nokia, Jio, Ericsson ,QCM and Intel

History

Date	Revision	Description
2022-11-18	04.00	Published as Final version 04.00
2022-07-27	03.00	Published as Final version 03.00.
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