

# ETSI TS 103 655-2 V1.1.1 (2021-02)



TECHNICAL SPECIFICATION

## **Reconfigurable Radio Systems (RRS); Radio Interface Engine (RIE); Part 2: Architecture**

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**Reference**

DTS/RRS-0149-2

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**Keywords**

architecture, radio, system

**ETSI**

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# Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS).

The present document is part 2 of a multi-part deliverable covering the Radio Interface Engine (RIE), as identified below:

Part 1: "Technical requirements";

**Part 2: "Architecture".**

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# 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 [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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# Introduction

The radio interface engine gathers and manages access to context information in a technology neutral way with the objective to optimize the configuration of any radio interface.

In ETSI TR 103 587 [i.1] several use cases are identified and described that are used as base for the requirements of the radio interface engine.

In ETSI TS 103 655-1 [1], the performance requirements are defined which comprise communication as well as context information indicators. Context information includes positioning performance indicators and is proposed in 3GPP R16 where positioning relevant KPIs are identified [i.2]. The context information performance KPIs steer the potential of the radio interface engine to improve and reach the communication performance requirements of the network.

The present document builds on ETSI TR 103 587 [i.1], as well as ETSI TS 103 655-1 [1], defines the corresponding Radio Interface Engine system architecture.

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# 1 Scope

The scope of the present document is to define the Radio Interface Engine related system architecture. The work is based on the system requirements defined in ETSI TS 103 655-1 [1], and the feasibility study including Use Cases defined in ETSI TR 103 587 [i.1].

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## 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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference>.

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

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

- [1] ETSI TS 103 655-1: "Reconfigurable Radio Systems (RRS); Radio Interface Engine (RIE); Part 1: Technical requirements".

### 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, ETSI 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] ETSI TR 103 587: "Reconfigurable Radio Systems (RRS); Feasibility study of a Radio Interface Engine (RIE)".
- [i.2] 3GPP TR 22.872 (V16.1.0): "Study on positioning use cases (Release 16)", SA WG1.
- [i.3] IEEE 802.2™: "ISO/IEEE International Standard - Information processing systems - Local area networks - Part 2: Logic Link Control".

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

Void.

### 3.2 Symbols

Void.

### 3.3 Abbreviations

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

GNSS	Global Navigation Satellite System
LLC	Logical Link Control
MAC	Medium Access Control
PER	Packet Error Rates
PHY	Physical Layer
QoS	Quality of Service
RAT	Radio Access Technology
RIE	Radio Interface Engine
RIEF	Radio Interface Engine Function
RLC	Radio Link Control
RSS	Radio Signal Strength
SAP	Service Access Point
WD	Wireless Device

## 4 Architectural Reference Model for Radio Interface Engine

### 4.1 Introduction

The present clause introduces three options for the architectural reference model for the Radio Interface Engine. One of the three options shall be selected for implementation:

- Option 1: A general basic approach of an architecture reference model is proposed including the Radio Interface Engine Function (RIEF), Information Functions and the lower layers of the related communication systems which are accessing to the RIEF. No Information Validation Function is introduced.
- Option 2: The general basic approach of an architecture reference model is complemented by an Information Validation Function which allows to verify the validity of acquired context information.
- Option 3: A variant of option 2 is introduced. The Information Validation Function is part of the RIEF.

### 4.2 Architecture Reference Model (Option 1)

The Radio Interface engine is interacting with Layer-1 (physical layer), and Layer-2 (medium access control layer) as well as logical link control (LLC) layers such as IEEE 802.2 [i.3] LLC or 3GPP Radio Link Control (RLC).

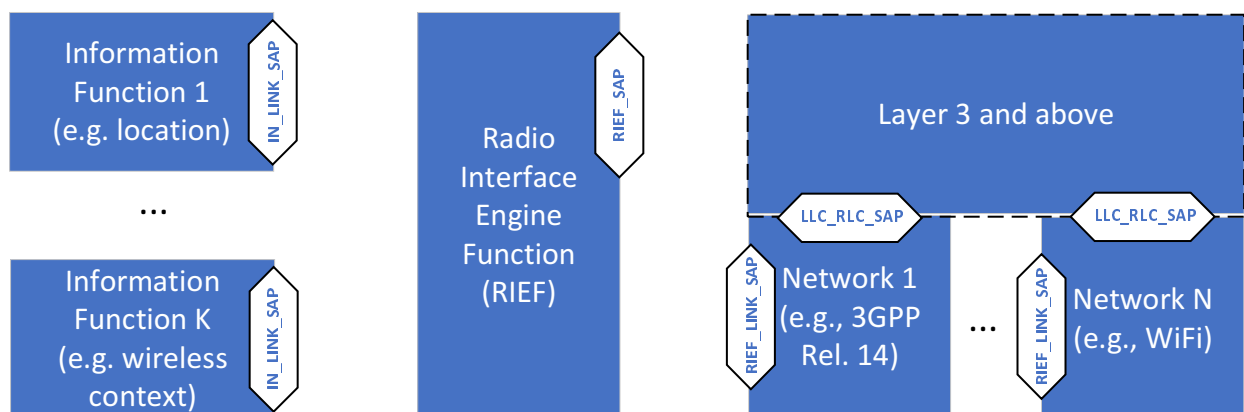
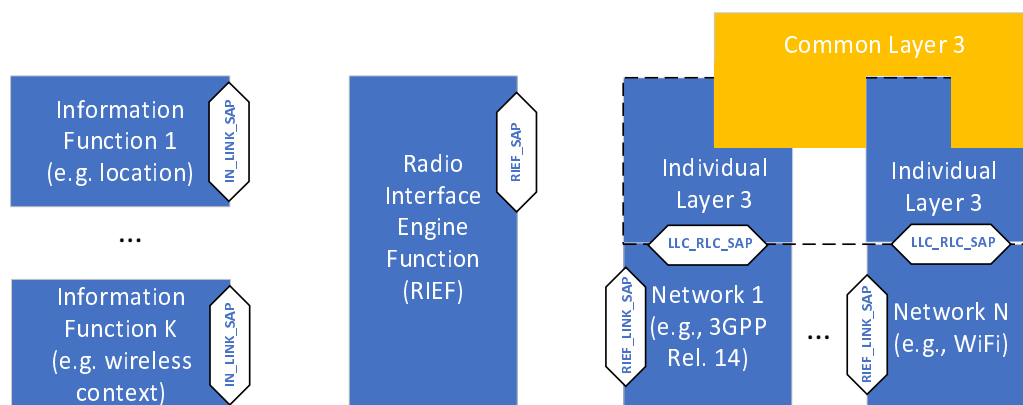


Figure 1: Option 1 - general basic approach

The various building blocks and Service Access Points (SAP) are as follows:

- The "Information Function" components 1, 2, ..., K gather cognitive context information of potential interest to a communication component. The information may include information such as localization information (e.g. GNSS information), information of wireless context (e.g. which Radio Access Technologies (RATs) are present (LTE™, WiFi™, 5G™, etc.), which Quality-of-Service is provided by specific RATs (e.g. Radio Signal Strength (RSS) measurements, observed Packet Error Rates (PER), observed round-trip latencies, etc.).
- The "Radio Interface Engine Function" (RIEF) component is interacting with the "Information Function" components through the "IN\_LNK\_SAP" Service Access Point. RIEF typically requests information (pull mode) from a specific "Information Function" component and then obtains the result. Alternatively, the information may be provided by the respective "Information Function" component without a specific request (push mode), for example when a specific event is happening (e.g. observed QoS metrics such as RSS/PER/latency is changing, etc.). The RIEF is processing the information received from "Information Function" components (e.g. reformatting the information to fit a standardized format) and provides it to higher layers (typically Layer 3 and above) communication components through the "RIEF\_SAP" Service Access Point.
- The Lower Layers (typically Physical Layer ("PHY Layer" and Medium Access Control Layer (MAC Layer)) of any type of Communication systems (including LTE™, 5G™, WiFi™, WiGig™, Bluetooth™, etc.) typically interact with the RIEF through the "RIEF\_LINK\_SAP" Service Access Point. The information exchange is bidirectional; for example, a specific communication component may provide information about the performance of a specific radio link (such as Radio Signal Strength (RSS) measurements, observed Packet Error Rates (PER), observed round-trip latencies, etc.) to the RIEF. In return, a specific communication component may obtain information which is currently not accessible, e.g. information about typical link performance expected in the future (for example, historic information can be exploited which was observed by the user in the past and is processed by the RIEF). The Lower Layers interact with a higher Layer (typically Layer 3) component through the "LLC\_RLC\_SAP" Service Access Point (Logical Link Control (LLC) layers such as IEEE 802.2 LLC or 3GPP radio link control (RLC)).

NOTE: The Layer 3 (and above) is indicated to be spanning across all communication components. This should be considered as an exemplary implementation. Alternatively, each communication component may have its independent Layer 3 (and above); in addition to the individual Layer 3 (and above) there may be an extension of Layer 3 (and above) spanning across multiple (or all) of the available communication components for coordination between the communication components, e.g. selection of one RAT among multiple RATs, etc. The basic principle is illustrated in Figure 2.

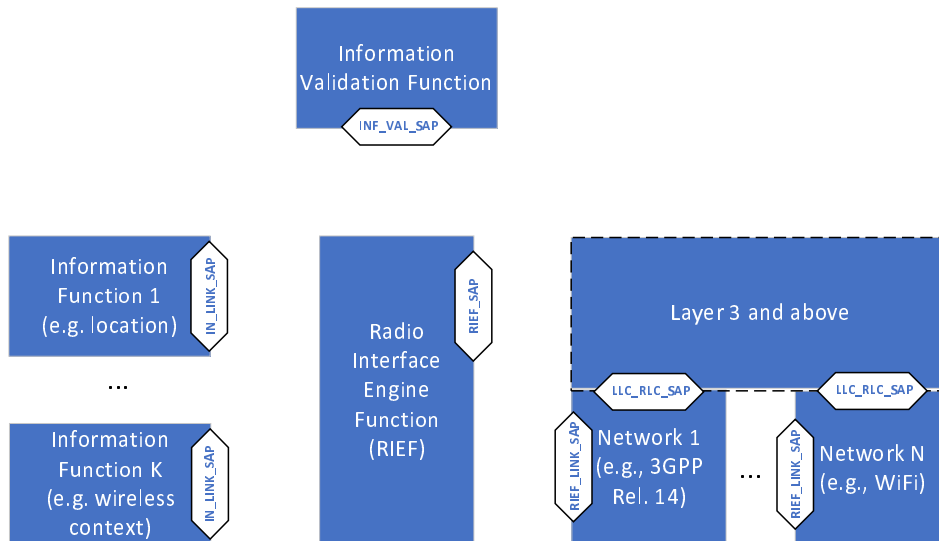


**Figure 2: Separation of an "individual" Layer 3 (and above) for each communication components and a "Common" Layer 3 (and above) for coordination across multiple communication components**



### 4.3 Architecture Reference Model (Option 2)

The 2<sup>nd</sup> option for an architecture reference model complements Option 1 introduced in clause 4.2 by adding an Information Validation Function as illustrated in Figure 3.



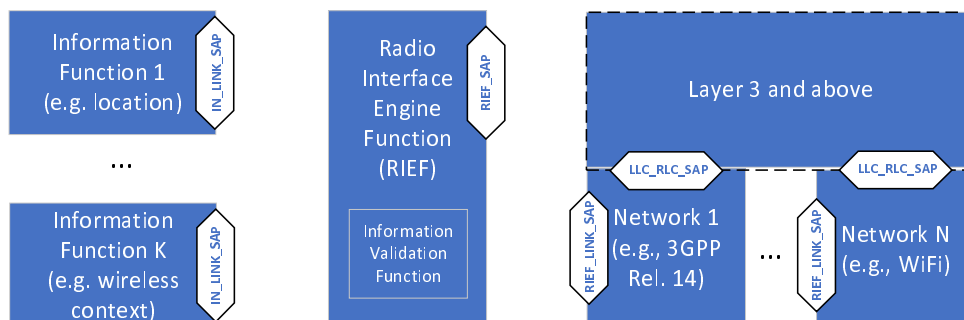
**Figure 3: Option 2 - an Information Validation Function component is added**

- The "Information Validation Function" component may be accessed by the RIEF in order to request a cross-check/validation of the context information provided by various Information Function components. This may be achieved through various means, including:
  - Certificates provided for specific Information Function components or even specific information elements. The certificates are typically provided by a trusted source validating the provided information.
  - Cross check of provided information with historic data that was previously collected (e.g. for a user which is repeatedly passing through the same area).
  - Cross check of provided information with other observations, e.g. with information provided by redundant sensors, etc.

The RIEF is typically using the "Information Validation Function" component to validate critical information, for example if it is being used for safety-related applications, such as autonomous driving, etc. It may be the RIEF itself to decide whether certain information needs to be validated (or not). Alternatively, a communication component may request the validation of information from the RIEF through the appropriate Service Access Points.

### 4.4 Architecture Reference Model (Option 3)

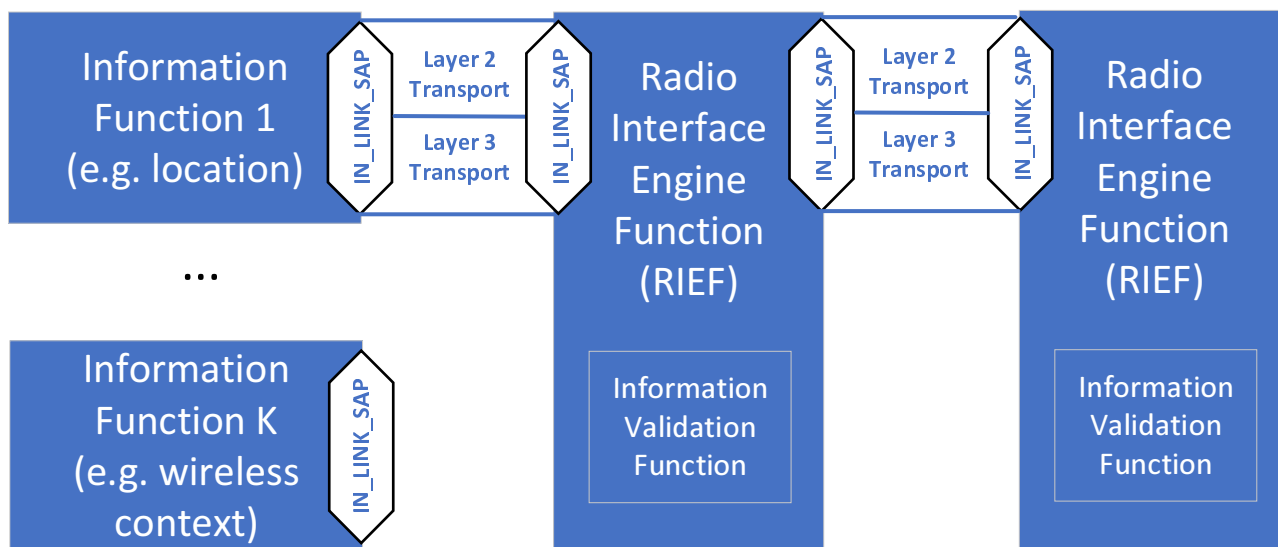
The 2<sup>nd</sup> option for an architecture reference model introduces a variant of option 2 defined in clause 4.3. The Information Validation Function is integrated into the RIEF.



**Figure 4: Option 3 - an Information Validation Function is available as part of the RIEF**

As illustrated above, the validation of information is performed within the RIEF.

In case that an interaction with remote functions is required, Layer 2 or Layer 3 Transport is used for the corresponding exchanges.



**Figure 5: Exchange between remote functions through Layer 2 or Layer 3 connectivity**

The Service Access Points (SAPs) group Service Primitives which are used for all exchanges defined in the present document.

## 4.5 Mapping of Architectural Components to the system requirements

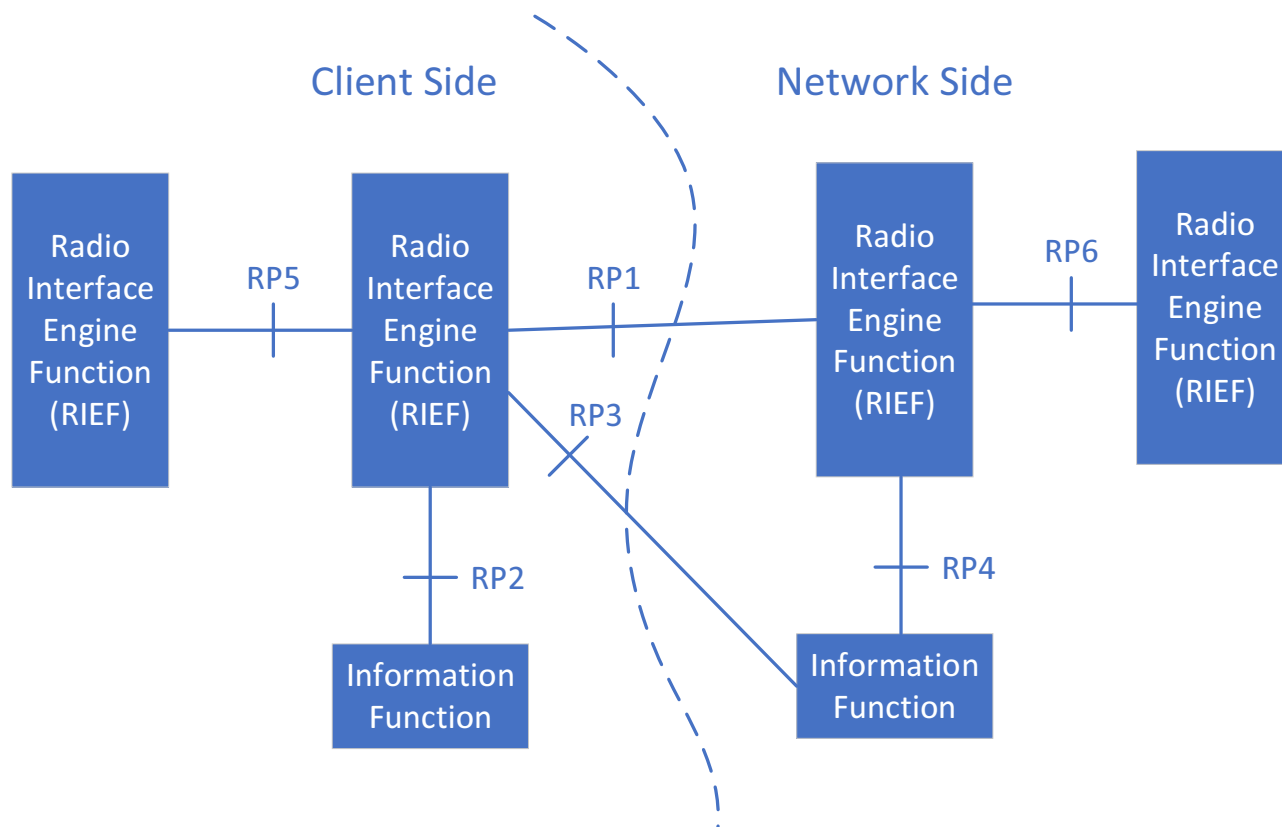
The upper architecture is based on the Technical Requirements derived in ETSI TS 103 655-1 [1]. A mapping of the novel components onto system requirements is summarized in Table 1.

**Table 1**

Component	System Requirements as defined in ETSI TS 103 655-1 [1]	Comments
Radio Interface Function	R-FUNC-REC-01: Gathering and processing function	The system shall support a gathering and processing function to gather and process radio related metrics and parameters.
	R-FUNC-REC-06: Support of information provisioning function	The system shall support an information provisioning function to provide updated network configuration information to the appropriate system devices.
	R-FUNC-REC-06: Support of information provisioning function	The system shall support an information provisioning function to provide updated network configuration information to the appropriate system devices.
Information Validation Function	R-FUNC-MOB-04: Support of authentication	The system shall support authentication methods to provide traceable and trustable data sources from WDs.
	R-PERF-KPI-CON-04: Sensor reliability	The system shall assess the reliability of sensors that assess data to be integrated as context information (such as pressure and humidity) and provide the measurement data.
	R-PERF-KPI-CON-02: Integrity of the localization performance	The system shall assess the integrity of the estimated localization performance.
Information Function #K	R-FUNC-REC-06: Support of information provisioning function	The system shall support an information provisioning function to provide updated network configuration information to the appropriate system devices.

## 5 Reference Points

The reference points in this clause are for illustration purposes only. This clause does not preclude any specific network deployment architecture.



**Figure 6: Reference Points between Functions on Client and Network Side**

A summary of the Reference Points is given in Table 2.

**Table 2**

Reference Point RP1	RP1 connects a RIEF in a client device with a RIEF in the network infrastructure. Both functions are able to exchange context information.
Reference Point RP2	RP2 connects a RIEF in a client device to a (distributed) Information Function (e.g. a stand-alone sensor, a neighboring Client Device, etc.).
Reference Point RP3	RP3 connects a RIEF in a client device to a Information Function in the network infrastructure (e.g. within the a Base Station or Access Point).
Reference Point RP4	RP4 connects a RIEF in the network infrastructure to an Information Function in the network infrastructure.
Reference Point RP5	RP5 connects two RIEF located on the client side. For example, this enables the exchange of context information between Client Devices such as Smartphones.
Reference Point RP6	RP6 connects two RIEF located on the network side. For example, this enable the exchange of context information between network equipment.

## 6 Service Access Points

### 6.1 Introduction

The present clause introduces the service primitives for each of the SAPs.

### 6.2 SAPs required for RIEF\_SAP

Table 3

Service Primitives	Comments
RIEF_SAP_Register	Register to the Radio Interface Engine Function.
RIEF_SAP_Deregister	De-register from the Radio Interface Engine Function.
RIEF_SAP_ProvideInformation	Provide Information to the the Radio Interface Engine Function, typically valid for a given geographic location and time.
RIEF_SAP_RequestInformation	Request Information from the the Radio Interface Engine Function, typically for a given geographic location and time.

### 6.3 SAPs required for RIEF\_LINK\_SAP

Table 4

Service Primitives	Comments
RIEF_LINK_SAP_Register	Register to the Radio Interface Engine Function.
RIEF_LINK_SAP_Deregister	De-register from the Radio Interface Engine Function.
RIEF_LINK_SAP_ProvideInformation	Provide Physical Layer and/or Medium Access Control Layer Information to the the Radio Interface Engine Function, typically for a given geographic location and time.
RIEF_LINK_SAP_RequestInformation	Request Physical Layer and/or Medium Access Control Layer Information from the the Radio Interface Engine Function, typically for a given geographic location and time.

### 6.4 SAPs required for IN\_LINK\_SAP

Table 5

Service Primitives	Comments
IN_LINK_SAP_Register	Register to the Information Function.
IN_LINK_SAP_Deregister	De-register from the Information Function.
IN_LINK_SAP_ProvideInformation	Provide Information to the Information Function, typically provided by a sensor for a given geographic location and time.
IN_LINK_SAP_RequestInformation	Request Information from the Information Function, typically requested by the Radio Interface Engine Function for a given geographic location and time.

### 6.5 SAPs required for INF\_VAL\_SAP

Table 6

Service Primitives	Comments
INF_VAL_Register	Register to the Information Validation Function
INF_VAL_Deregister	De-register from the Information Validation Function
INF_VAL_RequestValidation	Request validation of information
INF_VAL_ProvideValidationAssessment	Provides result of validation assessment of information

## 7 High level operating procedures

### 7.1 Procedures for Network requesting information from Radio Interface Engine Function (Option 1)

In the present clause, message exchanges are defined for the 1<sup>st</sup> option of an architecture reference model as defined in clause 4.2 of the present document: a communication component interacts with the RIEF in order to request context information. The RIEF acquires the requested information by interacting with the relevant Information Functions. Finally, the requested context information is provided to the communication component.

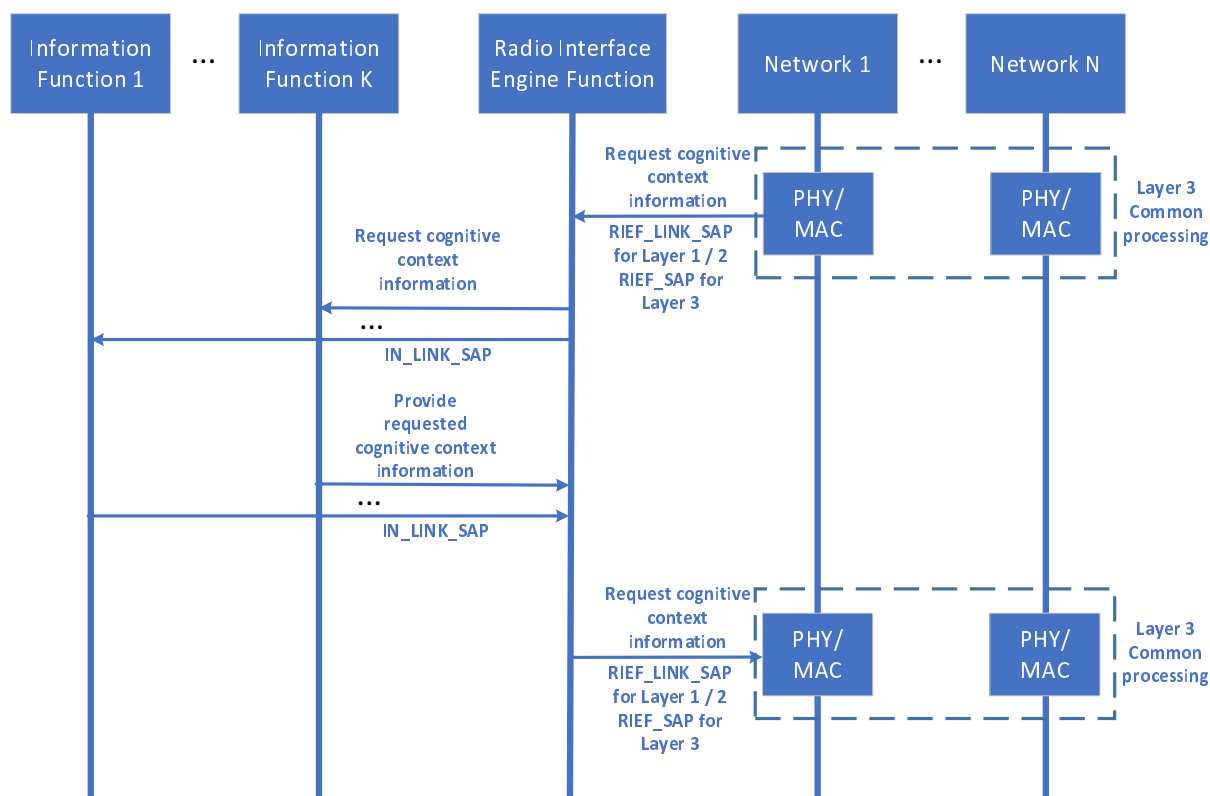


Figure 7: Option 1 - Sequence Flow Diagram

### 7.2 Procedures for Network requesting information from Radio Interface Engine Function (Option 2)

In the present clause, message exchanges are defined for the 2<sup>nd</sup> option of an architecture reference model as defined in clause 4.3 of the present document: a communication component interacts with the RIEF in order to request context information. The RIEF acquires the requested information by interacting with the relevant Information Functions and performs a verification of the information by interacting with the Information Validation Function. Finally, the requested context information is provided to the communication component.

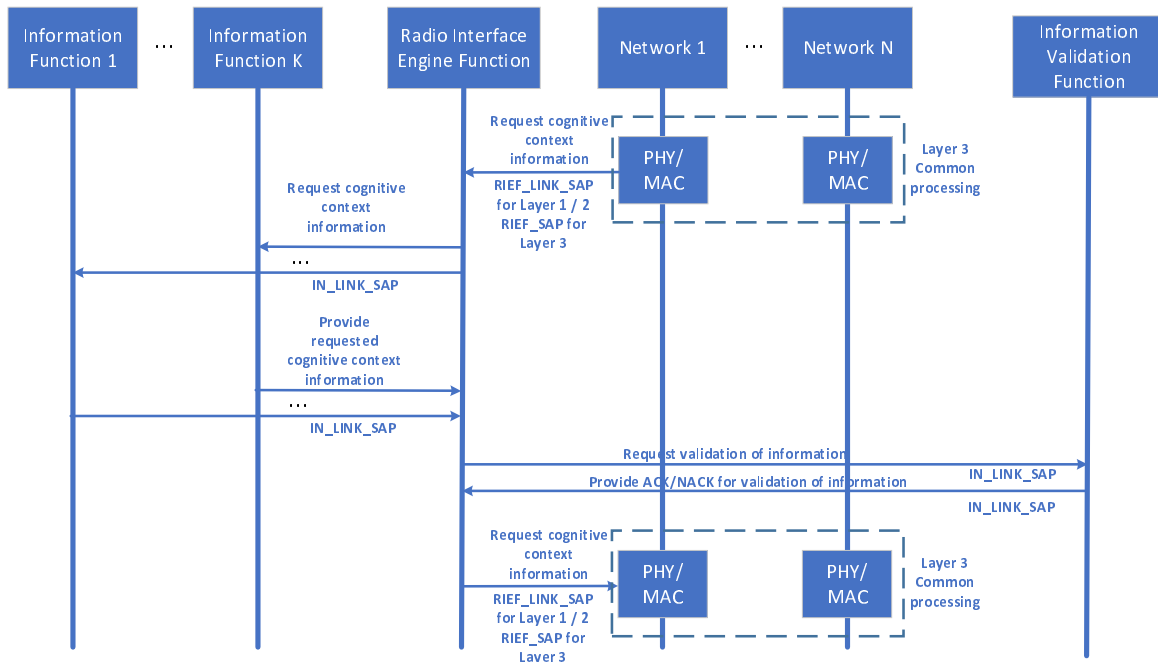


Figure 8: Option 2 - Sequence Flow Diagram

### 7.3 Procedures for Network requesting information from Radio Interface Engine Function (Option 3)

In the present clause, message exchanges are defined for the 3<sup>rd</sup> option of an architecture reference model as defined in clause 4.4 of the present document: a communication component interacts with the RIEF in order to request context information. The RIEF acquires the requested information by interacting with the relevant Information Functions and performs a verification of the information by interacting with the Information Validation Function. Finally, the requested context information is provided to the communication component.

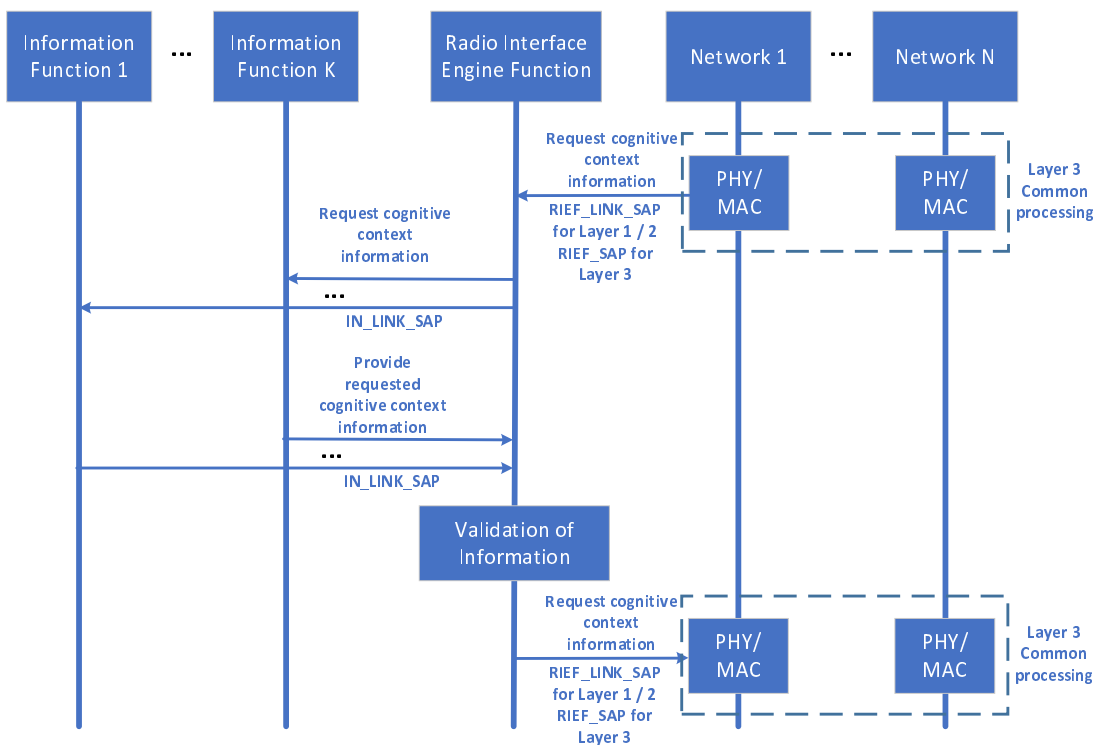


Figure 9: Option 3 - Sequence Flow Diagram

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## History

<b>Document history</b>		
V1.1.1	February 2021	Publication