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**Telecommunications and information exchange between
systems—~~Future network~~— Recursive inter-network
architecture— ~~—~~ —**

**Part 1:
Reference model**

~~*Télécommunications et échange d'information entre systèmes — Architecture récursive inter-réseaux —*~~

~~*Partie 1: Modèle de référence*~~

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6 *Telecommunications and information exchange between systems*.

A list of all parts in the ISO/IEC 4396 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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Introduction

The purpose of this document is to provide a reference model for the concepts in Recursive Inter-Network Architecture (RINA) [1], [2]. This document provides the fundamental definitions for the ISO/IEC 4396 series. It defines an architecture.

This document is the high-level description of the concepts, the elements and how they work. This is a top-level specification, not a tutorial. Other more detailed specifications will draw on the ISO/IEC 4396 series as their starting point.

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The following patents may apply:

10,135,689 Position parameterized recursive network architecture with topological addressing

9,762,531 Position parameterized recursive network architecture with topological addressing

9,584,633 Method and system for managing network communications

9,288,176 Position parameterized recursive network architecture with topological addressing

8,769,077 Parameterized recursive network architecture with topological addressing

8,352,587 Parameterized recursive network architecture with topological addressing

8,103,797 Parameterized recursive network architecture with topological addressing

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~~Future network information exchange between systems — Recursive inter-network architecture —~~

Part 1: Reference model

1 Scope

This document provides the reference model for the Recursive Inter-Network Architecture (RINA). It describes:

- the basic concepts of distributed systems and distributed applications;
- distributed management systems; ~~(DMSs)~~;
- the fundamental structure of distributed Inter-Process Communications;
- the Distributed Inter-Process Facility (DIP) operations.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

address

identifier that is a synonym for the fully qualified IPC-Process-Instance-name, which is a member of a *distributed-IPC-facility (DIP)* ~~(3.32)~~(3.32)

Note 1 to entry: An address is only unambiguous within the DIP (and is assigned by the DIP). This identifier can be assigned to facilitate its usefulness to the operation of the DIP, i.e. location-dependent.

3.2

application connection

shared state maintained by two communicating peer *application entities (AEs)* ~~(3.3)~~(3.3)

Note 1 to entry: Application connections go initially through an establishment phase, in which enough data is exchanged to establish a shared understanding between both AEs, to later proceed to the data transfer phase, in which both AEs exchange data. In Recursive Inter-Network Architecture (RINA), the establishment phase is handled

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by *common application connection establishment procedure (CACEP)* (3.17)(3.17), while the data transfer phase is the responsibility of *common distributed application protocol (CDAP)* (3.18)(3.18).

3.3 application-entity

AE
task within an application process that is directly involved with exchanging application information with other *application processes (APs)* (3.9)(3.9)

3.4 application entity instance

AE-instance
AEI
instantiation of an *application entity (AE)* (3.3)(3.3) within an *application process (AP)* (3.9)(3.9)

3.5 application entity instance identifier

AE-instance-id
AEI-id
identifier which is unambiguous within the *application entity (AE)* (3.3)(3.3)

Note 1 to entry: The AE-instance-id may be ambiguous within the *application process (AP) name space* (3.13)(3.13) unless qualified by the application process name, *application process instance id* (3.11)(3.11), and the *application entity (AE) name* (3.6)(3.6).

3.6 application entity name

AE name
identifier from the *application entity (AE) name space* (3.8)(3.8) which is unambiguous within the *scope* (3.55)(3.55) of the *application process (AP)* (3.9)(3.9)

Note 1 to entry: An AE name when concatenated with an *AP name* (3.12)(3.12) is unambiguous within the *AP name space* (3.13)(3.13), as is an AE name concatenated with an AP name and an *AP instance id* (3.11)(3.11).

3.7 application programming interface primitive

API primitive
library or system call used by an application to invoke functions, in particular *inter process communication (IPC)* (3.39)(3.39) functions, such as requesting the allocation of IPC resources

3.8 application entity name space

AE name space
set of strings which may be assigned to *application entities (AEs)* (3.3)(3.3) of a given *application process (AP)* (3.9)(3.9) and used to reference them by other applications in the same naming domain

3.9 application- process

AP
software program in a *processing system* (3.46)(3.46) intended to accomplish some purpose

Note 1 to entry: An application process contains one or more tasks or *application entities(AEs)* (3.3)(3.3) as well as functions for managing the resources (e.g. processor, storage, and IPC) allocated to this AP.

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Note 2 to entry: Tasks are also application processes.

3.10 application process instance AP instance

instantiation of an *application process (AP)* (3.9)(3.9) on an operating system

3.11 application process instance id AP instance id

identifier that is unambiguous within the *application process (AP)* (3.9)(3.9) and is bound to an *AP instance* (3.10)(3.10) in order to distinguish among multiple AP instances

Note 1 to entry: An AP instance id concatenated with an *AP name* (3.12)(3.12) is unambiguous in the *AP name space* (3.13)(3.13).

3.12 application -process -name AP -name

string assigned to a single *application process (AP)* (3.9)(3.9) from an *AP name space* (3.13)(3.13)

Note 1 to entry: An AP name is not assigned to any other AP while bound to the one to which it has been assigned.

3.13 application process name space AP name space

set of strings which may be assigned to *application processes (APs)* (3.9)(3.9) and used to reference them by other APs in the same naming domain

3.14 application protocol

protocol used between two *application entities (AEs)* (3.3)(3.3) to perform operations external to the *protocol machine (PM)* (3.50)(3.50) itself

Note 1 to entry: The distinguishing characteristic of application protocols is that they modify states external to the protocol.

3.15 assignment

operation that allocates a name in a *name space* (3.43)(3.43), essentially marking it as being in use

Note 1 to entry: Assignment makes names available to be bound. This allows certain portions of a name space to be "reserved" and not be available for *binding* (3.16)(3.16). The corresponding reverse operation, *de-assignment* (3.25)(3.25), removes it from use.

3.16 binding

function, F_M, N_s , that defines the mapping of a subset of elements of $\{NS\}$ to elements of $\{M\}$

Note 1 to entry: This function is one-to-one and *in-to*. The operation, *binding*, binds a name to an object.

Note 2 to entry: Once bound, any reference to the name locates or accesses the object.

3.17 common application connection establishment procedure

CACEP

procedure to authenticate flow participants and initialize the application naming and protocol information

Note 1 to entry: CACEP naming and protocol information relates to the *application protocol* (3.14)(3.14) that will be used by applications to exchange information (e.g. abstract and encoding rules, object model versions). In case of Recursive Inter-Network Architecture (RINA), the application protocol is *common distributed application protocol (CDAP)* (3.18).

~~(CDAP) (3.18).~~

3.18 common distributed application protocol

CDAP

application protocol (3.14)(3.14) component of a *distributed application facility (DAF)* (3.27)(3.27) used

to construct arbitrary distributed applications

Note 1 to entry: CDAP enables distributed applications to deal with communications at an object level, rather than forcing applications to explicitly deal with serialization and input/output operations. CDAP provides a straightforward and unifying approach to sharing data over a network without having to create specialized protocols.

Note 2 to entry: *Distributed IPC facility (DIF)* (3.32)(3.32) is an example of a *distributed application facility (DAF)* (3.27)(3.27).

3.19 computing system

collection of all *processing systems* (3.46)(3.46) (some specialized) in the same management domain

Note 1 to entry: There are no restrictions on the connectivity of computing systems.

3.20 connection

shared state between *error and flow control protocol machine EFCP PMs* (3.34)(3.34)

3.21 connection-endpoint-identifier

CEP-id

identifier that is unambiguous within the *scope* (3.55)(3.55) of an *interprocess communication (IPC)* process which identifies an *error and flow control protocol machine EFCP PM* (3.34)(3.34) instance

3.22 connection-identifier

identifier internal to the *distributed IPC facility (DIF)* (3.32)(3.32) that are unambiguous within the scope of communicating *error and flow control protocol machine EFCP PMs* (3.34)(3.34) from that DIF

Note 1 to entry: The connection identifier is formed by the concatenation of the source and destination connection establishment procedure (CEP)-ids to identify the two directions of the connection.

3.23
data transfer control procedure
DTCP

half of an *error and flow control protocol (EFCP)* (3.33)(3.33) that performs loosely bound (feedback) mechanisms, such as retransmission and flow control

Note 1 to entry: The DTCP protocol machine (PM) maintains state, which can be discarded after long periods of no traffic.

Note 2 to entry: One instance of a DTCP is created for each connection of a flow.

Note 3 to entry: All connections in Recursive Inter-Network Architecture (RINA) have flow control. Connections without flow control are denial of service attack vector.

3.24
data transfer procedure
DTP

half of an *error and flow control protocol (EFCP)* (3.33)(3.33) that performs tightly bound mechanisms, such as ordering and fragmentation/reassembly

Note 1 to entry: One instance of a DTP protocol machine (PM) is created for each connection allocated.

3.25
de-assignment

operation that deallocates a name in a *name space* (3.43)(3.43), removing it from use

3.26
delimiting

operation to delineate the beginning and end of a *service-data-unit (SDU)* (3.56)(3.56) and package it into the user-data field of a *protocol-data-unit (PDU)* (3.45)(3.45)

Note 1 to entry: Delimiting is usually the first operation performed by the *distributed IPC facility (DIF)* (3.32)(3.32) when an SDU is submitted.

Note 2 to entry: Delimiting enables the DIF to deliver the SDU as a unit of data to its recipient intact.

3.27
distributed application facility
DAF

distributed application
collection of *application processes (APs)* (3.9)(3.9) in *processing systems* (3.46)(3.46) that exchange information using *interprocess communication (IPC)* (3.39)(3.39) and maintain shared state to cooperate in performing some task or function

Note 1 to entry: There are at least two APs and at least one processing system in each DAF.

Note 2 to entry: The DAF forms a black box to the members of the DAF who may be executing on one or more processing systems.

Note 3 to entry: In some DAF, all members of the DAF will be the same, i.e. a homogeneous DAF, while in others they may be different, i.e. a heterogeneous DAF.

3.28

distributed application name

whatevercast name ~~(3.61)~~(3.61) for the set of *application processes (APs)* ~~(3.9)~~(3.9) comprising a distributed application depending on the operation

Note 1 to entry: A whatevercast name is generally taken from the same *name space* ~~(3.43)~~(3.43) as the APs and is used to identify a distributed application. An important type of distributed application is a *distributed IPC facility (DIF)* ~~(3.32)~~(3.32), i.e. the set of cooperating *interprocess communication (IPC)* ~~(3.39)~~(3.39) processes.

3.29

distributed application process

DAP

application process (AP) ~~(3.9)~~(3.9) that is a member of a *distributed application facility(DAF)* ~~(3.27)~~(3.27)

3.30

distributed application process name

DAP name

synonym for an *application process (AP)* ~~(3.9)~~(3.9) name

~~3.3031~~

distributed application process synonym

DAP synonym

synonym for a *distributed application process (DAP)* ~~(3.30)~~(3.30) that is a member of a specific *distributed application facility-DAF* ~~(3.27)~~*facilityDAF* ~~(3.27)~~ and is only unambiguous within the DAF (and is assigned by the DAF)

Note 1 to entry: The names may be structured to facilitate their use within the DAF.

3.32

distributed IPC facility

DIF

layer

collection of *application process (AP)instances* ~~(3.10)~~(3.10) that are cooperating to provide *interprocess communication (IPC)* ~~(3.9)~~(3.9)

Note 1 to entry: A DIF is a *distributed application facility(DAF)* ~~(3.27)~~(3.27) that does IPC.

Note 2 to entry: The DIF provides IPC services to AP instances of a DAF or IPC process instances of other DIFs via a set of application programming interface (API) primitives that are used to exchange information with the IPC process instances' peer.

3.33

error and flow control protocol

EFCP

data transfer protocol used to maintain an instance of *interprocess communication (IPC)* ~~(3.39)~~(3.39) within a *distributed IPF facility (DIF)* ~~(3.32)~~(3.32).

Note 1 to entry: The functions of this protocol can be used to provide reliability, order and flow control as required as determined by policy.

3.34

EFCP protocol machine

EFCP PM

instance of the *error and flow control protocol (EFCP)* ~~(3.33)~~(3.33) for a single connection