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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for the NGN – Resource control protocols

Resource control protocol No. 4 (rcp4) – Protocols at the Rc interface between a transport resource control physical entity and a transport physical entity: COPS alternative

Recommendation ITU-T Q.3304.1

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Recommendation ITU-T Q.3304.1

Resource control protocol No. 4 (rcp4) – Protocols at the Rc interface between a transport resource control physical entity and a transport physical entity: COPS alternative

Summary

Recommendation ITU-T Q.3304.1v2 provides the Stage 3 technical specifications for a protocol variant which uses the common open policy service (COPS) (described in IETF RFC 2748) to satisfy the requirements for information transfer across the Rc reference point, as defined in clause 9.3 of Recommendation ITU-T Y.2111. This protocol allows a transport resource control physical entity (TRC-PE) to collect network topology and resource status information from elements of an access or a core network.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Q.3304.1	2007-10-29	11
2.0	ITU-T Q.3304.1 v2	2012-06-15	11

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Recommendation ITU-T Q.3304.1

Resource control protocol No. 4 (rcp4) – Protocols at the Rc interface between a transport resource control physical entity and a transport physical entity: COPS alternative

1 Scope

This Recommendation provides the Stage 3 technical specifications for a protocol satisfying the requirements for information transfer across the Rc reference point, as defined in clause 9.3 of [ITU-T Y.2111]. This protocol allows a transport resource control physical entity (TRC-PE) to collect network topology and resource status information from elements of an access or a core network.

The normative part of this Recommendation uses or refers to messages which are defined and their behaviours are described in one or more IETF RFCs. To help the users of this Recommendation, a list of all these messages and their origins is provided in Annex B.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Q.3300 v2] Recommendation ITU-T Q.3300 v2 (2010), *Architectural framework for the Q.33xx series of Recommendations*.

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2011), *Resource and admission control functions in next generation networks*.

[IETF RFC 2104] IETF RFC 2104 (1997), *HMAC: Keyed-Hashing for Message Authentication.*

[IETF RFC 2578] IETF RFC 2578 (1999), *Structure of Management Information Version 2 (SMIv2)*.

[IETF RFC 2748] IETF RFC 2748 (2000), *The COPS (Common Open Policy Service) Protocol*.

[IETF RFC 3084] IETF RFC 3084 (2001), *COPS Usage for Policy Provisioning (COPS-PR).*

[IETF RFC 3159] IETF RFC 3159 (2001), *Structure of Policy Provisioning Information (SPPI).*

[IETF RFC 3318] IETF RFC 3318 (2003), *Framework Policy Information Base*.

[IETF RFC 4001] IETF RFC 4001 (2005), *Textual Conventions for Internet Network Addresses*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 client handle [IETF RFC 2748]: A term used to identify a unique request state for a single PEP per client-type.

3.1.2 policy information base (PIB) [IETF RFC 3084]: A term used to identify the type and purpose of unsolicited policy information that is "pushed" from the PDP to the PEP for provisioning policy or sent to the PDP from the PEP as a notification.

3.1.3 transport physical entity (T-PE) [ITU-T Q.3300 v2]: A term used to refer to any device implementing the transport functions in the limited sense provided in clause 7.2.4 of [ITU-T Y.2111] (i.e., those with which the RACF interacts).

3.1.4 transport resource control physical entity (TRC-PE) [ITU-T Q.3300 v2]: A device that implements the transport resource control functional entity (TRC-FE) as defined in clause 7.2.3.3 of [ITU-T Y.2111].

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 session: The term "session" used in this Recommendation refers to a common open policy service (COPS) signalling relationship established between the TRC-PE acting in the role of a COPS policy decision point (PDP) and the T-PE of acting in the role of a COPS policy enforcement point (PEP).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

COPS	Common Open Policy Service
COPS-PR	COPS usage for policy provisioning
DEC	COPS DECision message
DEC Install	COPS DECision Install message
DEC Remove	COPS DECision Remove message
Diffserv	Differentiated Services model
DRE	Data Relay Entity
HMAC	keyed-Hashing for Message Authentication
LSP	Label Switched Path
MPLS	MultiProtocol Label Switching
PDP	Policy Decision Point
PEP	Policy Enforcement Point
PIB	Policy Information Base
PRC	Provisioning Class
PRI	Provisioning Instance
PRID	Provisioning Instance Identifier

QoS	Quality of Service
REQ	COPS Request message
RPT	COPS Report state message
TCP	Transmission Control Protocol
TLS	Transport Layer Security
T-PE	Transport Physical Entity
TRC-PE	Transport Resource Control Physical Entity
VSWITCH	Virtual Switches

5 Conventions

None.

6 Resource Control Protocol No. 4 (rcp4)

This variant of the Rc Stage 3 definition uses the COPS protocol, and in particular the COPS-PR procedures and data models defined in [IETF RFC 3084].

The COPS protocol is a request/response protocol intended to operate in the Client/Server mode. The T-PE serves as the policy enforcement point (PEP) and Client and the TRC-PE as the policy decision point (PDP) and Server.

COPS implementations supporting this Recommendation shall support the COPS client type 0x800d (ITUT-RcPIB) and shall support the policy information base (PIB) defined in Annex A.

7 Procedures

7.1 Establishment of the COPS session

The T-PE shall initiate a TCP connection and open a COPS session with the TRC-PE as described in [IETF RFC 2748]. To establish an Rc session, the T-PE shall send a Client-Open message with the client identifier 0x800d (ITUT-RcPIB). The TRC-PE shall respond with a Client-Accept message for that client type. State synchronization may proceed as described in sections 2.5 of [IETF RFC 2748] and 3.1 of [IETF RFC 3084]. The client handle within the REQ message is of local significance to the T-PE. This Recommendation does not specify use of a ClientSI object within the Client-Accept message.

7.2 COPS session maintenance and termination

The T-PE and TRC-PE shall use the Keep-Alive procedures defined in [IETF RFC 2748] to ensure the continued availability of the COPS session. The session shall be terminated only by the loss of availability of one of the peers through failure or management action.

7.3 Provision of policy by the TRC-PE

The TRC-PE shall provide policy to the T-PE to indicate what information the TRC-PE wishes to acquire, using the contents of Named Decision objects within COPS-PR DEC messages. A DEC message must be returned in response to a REQ message from the T-PE. The TRC-PE may also send further DEC messages as required to modify previously set policy or collect additional information on a one-time basis.

Details are provided in clause A.2.

7.4 Generation of reports by the T-PE

The T-PE shall provide information to the TRC-PE as determined by the policy installed by the DEC messages it receives. This information is provided within instances of the Named ClientSI object within COPS Report-State (RPT) messages.

Details are given in clause A.2.

8 Application of the policy information base (PIB)

8.1 Role of the PIB

The policy information base (PIB) provides a means to interwork between different product vendors. The PIB defines a collection of provisioning classes (PRC) which can be used by the COPS to request or pass data instances (i.e., PRIs) for any given data structure (i.e., PRC). Instances of the policy classes (i.e., PRIs) are each identified by a provisioning instance identifier (PRID) in the PIB. (A PIB is just like a virtual database of the PRC.)

This Recommendation defines a PIB and inherits part of the data definitions from other PIBs, including PIBs in [IETF RFC 3159], [IETF RFC 3318] and [IETF RFC 4001].

8.2 Encoding of the PIB

ASN.1 BER shall be used to encode the provisioning instance identifier (PRID) and policy data as described in section 2.2.1 of [IETF RFC 3084].

8.3 Definition of the PIB

See clauses A.1 and A.3 for details.

9 Reference to functional architecture

9.1 Recommendation ITU-T Y.2111

The protocol defined in this Recommendation (i.e., rcp4) operates across the Rc reference point as defined in [ITU-T Y.2111]. The realization presented in this Recommendation accepts the considerations of scalability and domain independence that motivated the development of the functional architecture as defined in [ITU-T Y.2111]. As a result, it maps each functional entity of the functional architecture to a separate type of physical entity. Figure 1 shows an example configuration of the physical entities identified in Figure 1 of [ITU-T Q.3300 v2].

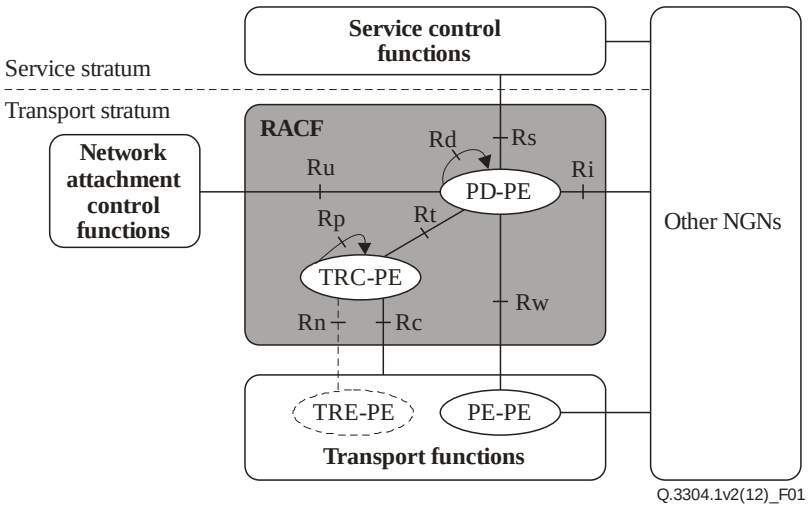

Figure 1 – Position of the Rc reference point within the RACF architecture

10 Security considerations

There may be several possible security threats at the Rc interface, such as denial of service, message disclosure by unauthorized snooping and unauthorized message creation and modification.

In general, an attacker can surreptitiously intercept information, attempt to create unauthorized information and send modified, reordered information, or both.

There may be a risk that an attacker impersonate a COPS server and illicitly acquire and tamper with the information. Even though the information is encrypted, a replay attack is possible.

The COPS protocol specification [IETF RFC 2748] requires all implementations to support use of an integrity object to prevent third-parties from acquiring and tampering. This integrity object consists of a keyed-hashing for message authentication (HMAC) Digest [IETF RFC 2104] over the contents of the message. Its use requires a shared secret (key) available to the client and server.

Deployments which use the integrity object are required to have a means to manage the exchange of keys. However, the integrity object does not resolve all of the threats identified above, and in particular does not provide confidentiality.

Two reasonable means are available to satisfy the requirements for confidentiality and authentication. First is the use of IPSEC [b-IETF RFC 4301] and second the use of transport layer security (TLS) [b-IETF RFC 5246]. The use of one of these transports is strongly recommended in any deployment of the protocol documented in this Recommendation. Use of both IPSEC with encryption enabled and TLS on the same connection is a wasteful use of processing resources and must be avoided for that reason.

Annex A

Policy information base

(This annex forms an integral part of this Recommendation.)

A.1 Static description of the PIB

The ITUT-RcPIB consists of six provisioning classes (PRCs) grouped into larger classes. The RcResourceInfoClasses group contains four PRCs:

– RcMPLSLabelTable, which provides a linked list of MPLS label objects;

– RcMPLSInfoTable, which provides the following information for individual label switched paths (LSPs):

  • active/inactive status;

  • by reference, the label value;

  • next-hop IP address;

– RcDreInterfaceTable, which provides the active/inactive status and interface name for interfaces on non-MPLS data relay entries (e.g., VSWITCHes);

– RcResourceManageTable, which the TRC-PE uses to request status reports.

The second major group of PRCs is the RcServiceReportClasses group. This group may be expanded in the future, but at the moment contains only a single sub-group, RcServiceReportClasses. RcServiceReportClasses contains two PRCs:

– RcStateReportTable, which indicates the success or failure of a particular query and may provide diagnostic information in the case of failure;

– RcOverloadReportTable, which can be used to indicate that the T-PE is overloaded or has recovered from overload.

A.2 Usage

To query the status of a specific MPLS LSP, the TRC-PE places an RcResourceManageTable entry instance into a DEC install request message, with the value of the RcResourceManageContent attribute pointing to a specific entry of the RcMPLSInfoTable. In response, the T-PE generates a RPT message into which it places:

– an RcStateReportTable entry instance indicating whether the query was processed successfully;

– in the case of success:

  • the RcMPLSInfoTable entry instance to which the RcResourceManageTable entry instance pointed, with the appropriate values filled in;

  • except where the status of the RcMPLInfoTable entry instance was "not exist", the RcMPLSLabelTable entry instance to which the RcMPLSInfoMPLSLabel attribute points, giving the value of the path label;

  • in the case where the previous query failed because of overload, an RcOverloadReportTable entry instance indicating recovery;

– in the case of failure where the failure is due to overload of the T-PE, an RcOverloadReportTable entry instance indicating overload.

To acquire the status of every MPLS path supported by the T-PE, the TRC-PE should begin by requesting the status of the RcMPLSInfoTable entry with instance value equal to 1. This entry may or may not exist, as indicated by the returned RcMPLSInfoMPLSStatus attribute value. If it does not exist, the value of the RcMPLSInfoNext attribute returned by the T-PE shall point to the first

valid RcMPLSInfoTable entry instance, thus giving the TRC-PE a starting point for walking through the complete table.

To acquire the status of a specific data relay interface, the TRC-PE places an RcResourceManageTable entry instance into a DEC install request, with the value of the RcResourceManageContent attribute pointing to a specific entry of the RcDreInterfaceTable. In response, the T-PE generates a RPT message into which it places:

– an RcStateReportTable entry instance indicating whether the query was processed successfully;

– in the case of success:

  • the RcDreInterfaceTable entry instance to which the RcResourceManageTable entry instance pointed, with the appropriate values filled in;

  • except where the status of the RcDreInterfaceTable entry instance was "not exist", the RcDreInterfacePrid entry instance to which the RcDreInterfaceStatus attribute points, giving the value of the interface entry.

To acquire the status of every data relay interface supported by the T-PE, the TRC-PE should begin by requesting the status of the RcDreInterfaceTable entry with instance value equal to 1. This entry may or may not exist, as indicated by the returned RcDreInterfaceStatus attribute value. If it does not exist, the value of the RcDreInterfaceStatus attribute returned by the T-PE shall point to "noExit" in RcDreInterfaceStatus instance, thus giving the TRC-PE a starting point for walking through the complete table.

Similar operations apply to the retrieval of status and capabilities.

A.3 Rc Policy Information Base

```
ITUT-RcPIB  PIB-DEFINITIONS ::= BEGIN

   IMPORTS
       Unsigned32, Integer32, MODULE-IDENTITY,
       MODULE-COMPLIANCE, OBJECT-TYPE, OBJECT-GROUP
               FROM COPS-PR-SPPI            -- Defined in [IETF RFC 3159]
       InstanceId, Prid
               FROM COPS-PR-SPPI-TC         -- Defined in [IETF RFC 3159]
       zeroDotZero               FROM SNMPv2-SMI  -- [IETF RFC 2578]

       InetAddress, InetAddressType,
       InetAddressPrefixLength
               FROM INET-ADDRESS-MIB;       -- Defined in [IETF RFC 4001]

iTUT-RcPib MODULE-IDENTITY
       SUBJECT-CATEGORIES   { ITUT-Rc(0x800D) } -- ITU-T Rc COPS Client Type

       LAST-UPDATED "200709170000Z"
       ORGANIZATION "ITU-T Study Group 11"
       CONTACT-INFO
                    "XUE LiLi
                     Huawei Technology Co. Ltd.
                     E-mail: xuelili@huawei.com"
       DESCRIPTION
               "A PIB module containing the set of provisioning
               classes that are required for support of policies for
               Rc Cops interface"
       REVISION "201206150000Z"
       DESCRIPTION
               "The Rc PIB for Rec. Q.3304.1 version 2"

       ::= { 0.0.17.3304.127.1.2.1 }
```

```
          -- itu-t(0) recommendation(0) q(17) q3304(3304) hyphen(127) <...>(1)
          --  pib(2) version2 (1)


rcResourceInfoClasses           OBJECT IDENTIFIER ::= { iTUT-RcPIB 1}
rcServiceEventClasses           OBJECT IDENTIFIER ::= { iTUT-RcPIB 2}
rcServiceReportClasses          OBJECT IDENTIFIER ::= { rcServiceEventClasses 1}

-------------------------------------------------------
--  RcMPLSLabelTable Table
--  Lsp Label PRC
   rcMPLSLabelTable OBJECT-TYPE
       SYNTAX         SEQUENCE OF RcMPLSLabelEntry
       PIB-ACCESS     install
       STATUS         current
       DESCRIPTION
           "This table represents the Rc label."
       ::= { rcResourceInfoClasses 1 }


   rcMPLSLabelEntry OBJECT-TYPE
       SYNTAX         RcMPLSLabelEntry
       STATUS         current
       DESCRIPTION
           "LSP"
       PIB-INDEX { rcMPLSLabelPrid }
       UNIQUENESS { }
       ::= { rcMPLSLabelTable 1 }


   RcMPLSLabelEntry ::= SEQUENCE {
           rcMPLSLabelPrid                         InstanceId,
           rcMPLSLabelValue                        Unsigned32,
           rcMPLSLabelNext                         Prid
   }


   rcMPLSLabelPrid OBJECT-TYPE
       SYNTAX         InstanceId
       STATUS         current
       DESCRIPTION
           "An arbitrary integer index that uniquely identifies an
           instance of the RcMPLSLabel class."
       ::= { rcMPLSLabelEntry 1 }


   rcMPLSLabelValue OBJECT-TYPE
       SYNTAX         Unsigned32
       STATUS         current
       DESCRIPTION
           "The label value for this path"
       ::= { rcMPLSLabelEntry 2 }


    rcMPLSLabelNext OBJECT-TYPE
       SYNTAX         Prid
       STATUS         current
       DESCRIPTION
           "References the next of a list RcMPLSLabel instance.
A value of zeroDotZero indicates end of the list. "
       DEFVAL  { zeroDotZero }
       ::= { rcMPLSLabelEntry 3 }

-------------------------------------------------------------
```

```
-- This table is used for MPLS query or report
--
   rcMPLSInfoTable OBJECT-TYPE
      SYNTAX         SEQUENCE OF RcMPLSInfoEntry
       PIB-ACCESS     install
       STATUS         current
       DESCRIPTION
           "This table represents the Rc Query Label."
       ::= { rcResourceInfoClasses 2}


   rcMPLSInfoEntry OBJECT-TYPE
       SYNTAX         RcMPLSInfoEntry
       STATUS         current
       DESCRIPTION
           "LSP state"
       PIB-INDEX { rcMPLSInfoPrid }
       UNIQUENESS { }
       ::= { rcMPLSInfoTable 1 }


   RcMPLSInfoEntry ::= SEQUENCE {
           rcMPLSInfoPrid                  InstanceId,
           rcMPLSInfoMPLSStatus            INTEGER,
           rcMPLSInfoMPLSLabel             Prid,
           rcMPLSInfoCnIpAddrType          InetAddressType,
           rcMPLSInfoCnIpAddr              InetAddress,
           rcMPLSInfoNext                  Prid
   }


   rcMPLSInfoPrid OBJECT-TYPE
       SYNTAX         InstanceId
       STATUS         current
       DESCRIPTION
           "An arbitrary integer index that uniquely identifies an
           instance of the RcMPLSInfo class."
       ::= { rcMPLSInfoEntry 1 }

   rcMPLSInfoMPLSStatus OBJECT-TYPE
       SYNTAX         INTEGER {
                               active (0),
                               inactive (1),
                               notExist(0xFF)}
       STATUS         current
       DESCRIPTION
           "The label status, describe the status of LSP label."
       ::= { rcMPLSInfoEntry 2 }

   rcMPLSInfoMPLSLabel OBJECT-TYPE
       SYNTAX         Prid
       STATUS         current
       DESCRIPTION
           " It is referenced the RcMPLSLabelValue  of the
           RcMPLSlable class."
       ::= { rcMPLSInfoEntry 3 }

   rcMPLSInfoCnIpAddrType OBJECT-TYPE
       SYNTAX         InetAddressType
       STATUS         current
       DESCRIPTION
           "Cn IP address type."
       ::= { rcMPLSInfoEntry 4 }
```

```
   rcMPLSInfoCnIpAddr OBJECT-TYPE
       SYNTAX         InetAddress
       STATUS         current
       DESCRIPTION
           ""
       ::= { rcMPLSInfoEntry 5 }

   rcMPLSInfoNext OBJECT-TYPE
       SYNTAX         Prid
       STATUS         current
       DESCRIPTION
           "References the next of a list RcMPLSInfoinstances.
A value of zeroDotZero indicates end of the list."
       DEFVAL  { zeroDotZero }
       ::= { rcMPLSInfoEntry 6 }

------------------------------------------------------------
--  Dre interface PRC

   rcDreInterfaceTable OBJECT-TYPE
       SYNTAX         SEQUENCE OF RcDreInterfaceEntry
       PIB-ACCESS     install
       STATUS         current
       DESCRIPTION
           "This table represents the Rc Dre Interface.
           "
       ::= { rcResourceInfoClasses 3 }


   rcDreInterfaceEntry OBJECT-TYPE
       SYNTAX         RcDreInterfaceEntry
       STATUS         current
       DESCRIPTION
           "Dre Interface"
       PIB-INDEX { rcDreInterfacePrid }
       UNIQUENESS { }
       ::= { rcDreInterfaceTable 1 }


   RcDreInterfaceEntry ::= SEQUENCE {
           rcDreInterfacePrid          InstanceId,
           rcDreInterfaceStatus        INTEGER,
           rcDreInterfaceName          OCTET STRING(SIZE (0..67)),
           rcDreInterfaceNext          Prid
   }


   rcDreInterfacePrid OBJECT-TYPE
       SYNTAX         InstanceId
       STATUS         current
       DESCRIPTION
           "An arbitrary integer index that uniquely identifies an
           instance of the RcIterface  class."
       ::= { rcDreInterfaceEntry 1 }

   rcDreInterfaceStatus OBJECT-TYPE
       SYNTAX         INTEGER {
                           active (0),
                           inactive (1),
                           notExist(0xFF) }
       STATUS         current
       DESCRIPTION
           "The Dre interface status"
```

```
        ::= { rcDreInterfaceEntry 2 }

    rcDreInterfaceName OBJECT-TYPE
        SYNTAX          OCTET STRING(SIZE (0..67))
        STATUS          current
        DESCRIPTION
            "The Interface Name."
        ::= { rcDreInterfaceEntry 3 }


     rcDreInterfaceNext OBJECT-TYPE
        SYNTAX          Prid
        STATUS          current
        DESCRIPTION
            "References the next of a list RcDreInterface class.
A value of zeroDotZero indicates end of the list."
        DEFVAL  { zeroDotZero }
        ::= { rcDreInterfaceEntry 4 }


--------------------------------------------------------------------------
--
-- Rc Resource Query Table
--
    rcResourceManageTable OBJECT-TYPE
        SYNTAX          SEQUENCE OF RcResourceManageEntry
        PIB-ACCESS      install
        STATUS          current
        DESCRIPTION
            "This table represents the Rc Resource Query."       ::= {
rcResourceInfoClasses 4 }


    rcResourceManageEntry OBJECT-TYPE
        SYNTAX          RcResourceManageEntry
        STATUS          current
        DESCRIPTION
            "An instance of the RcResourceManage class"
        PIB-INDEX { rcResourceManagePrid }
        UNIQUENESS { }
        ::= { rcResourceManageTable 1 }


    RcResourceManageEntry ::= SEQUENCE {
            rcResourceManagePrid                InstanceId,
            rcResourceManageContent             Prid
    }


    rcResourceManagePrid OBJECT-TYPE
        SYNTAX          InstanceId
        STATUS          current
        DESCRIPTION
            "An arbitrary integer index that uniquely identifies an
            instance of the RcResourceManage class."
        ::= { rcResourceManageEntry 1 }


    rcResourceManageContent OBJECT-TYPE
        SYNTAX          Prid
        STATUS          current
        DESCRIPTION
            "Reference the instances of RcResourceInfoClasses, can be used
            to query or report the resource state ."
```

```
        ::= { rcResourceManageEntry 2 }



-------------------------------------------------------------------

-- Rc DecResult Report Table
--
   rcStateReportTable OBJECT-TYPE
       SYNTAX         SEQUENCE OF RcStateReportEntry
       PIB-ACCESS     notify
       STATUS         current
       DESCRIPTION
           "The Rc Decsion Result Report PRC."
       ::= { rcServiceReportClasses 1 }


   rcStateReportEntry OBJECT-TYPE
       SYNTAX         RcStateReportEntry
       STATUS         current
       DESCRIPTION
           "An instance of the RcStateReport class."
       PIB-INDEX { rcStateReportPrid }
       UNIQUENESS { }
       ::= { rcStateReportTable 1 }


   RcStateReportEntry ::= SEQUENCE {
           rcStateReportPrid            InstanceId,
           rcStateReportStatus          INTEGER,
           rcStateReportDetails         Prid
   }


   rcStateReportPrid OBJECT-TYPE
       SYNTAX         InstanceId
       STATUS         current
       DESCRIPTION
           "An arbitrary integer index that uniquely identifies an
           instance of the RcStateReport class."
       ::= { rcStateReportEntry 1 }

   rcStateReportStatus OBJECT-TYPE
               SYNTAX         INTEGER {
                                 success (1),
                                 failure (2),
                                 usage   (3) }
       STATUS         current
       DESCRIPTION
           "When Status is:
              success: Indicates the successful implementation of the
                       decision.
                       RcStateReportDetails:
                         References nothing otherwise (contains the value
                         zeroDotZero).
              Failure: Indicates the failure of implementing the decision.
                       RcStateReportDetails may references an Error object,
                       or may have the value zeroDotZero when no error
                       object is needed, in which case COPS and COPS-PR
                       error codes and error objects are sufficient.
              Usage:   RcStateReportDetails references an instance of
                       frwkBasePibClasses class."
       ::= { rcStateReportEntry 2 }
```

```
   rcStateReportDetails OBJECT-TYPE
       SYNTAX         Prid
       STATUS         current
       DESCRIPTION
           "May reference an instance of frwkBasePibClasses(frwkErrorTable)
           or may have the value of zeroDotZero depending on the value of
           RcStateReportStatus."
       ::= { rcStateReportEntry 3 }



--
-- Rc  Overload Report Table
--
   rcOverloadReportTable OBJECT-TYPE
       SYNTAX         SEQUENCE OF RcOverloadReportEntry
       PIB-ACCESS     install
       STATUS         current
       DESCRIPTION
           "This table represents the Rc overload information."
       ::= { rcServiceReportClasses 2 }


   rcOverloadReportEntry OBJECT-TYPE
       SYNTAX         RcOverloadReportEntry
       STATUS         current
       DESCRIPTION
           "Overload information"
       PIB-INDEX { rcOverloadReportPrid }
       UNIQUENESS { }
       ::= { rcOverloadReportTable 1 }


   RcOverloadReportEntry ::= SEQUENCE {
           rcOverloadReportPrid                    InstanceId,
           rcOverloadReportStatus                  INTEGER
   }


   rcOverloadReportPrid OBJECT-TYPE
       SYNTAX         InstanceId
       STATUS         current
       DESCRIPTION
           "An arbitrary integer index that uniquely identifies an
           instance of the Report Overload class."
       ::= { rcOverloadReportEntry 1 }


   rcOverloadReportStatus OBJECT-TYPE
       SYNTAX         INTEGER {
                            overload(0),
                            recover(1)
                            }
       STATUS         current
       DESCRIPTION
           "Overload status."
       ::= { rcOverloadReportEntry 2 }

END
```

Annex B

List of messages imported from IETF RFCs

(This annex forms an integral part of this Recommendation.)

This annex provides list of IETF messages which have been used or referred to throughout the normative part of this Recommendation.

B.1 IETF RFC 2748

The following messages used or referred to in this Recommendation have been defined in [IETF RFC 2748]:

- Client-Open
- Client-Accept
- Keep-Alive
- REQ
- DEC
- RPT

Appendix I

High-level information flow at Rc Reference point

(This appendix does not form an integral part of this Recommendation.)

The COPS protocol was created to deliver QoS policy between the T-PE and the TRC-PE over a TCP connection as described in [IETF RFC 2748]. Section 6 of [IETF RFC 2748] describes the procedures for establishment of the COPS session, COPS session maintenance and termination, provision of policy by the TRC-PE, and generation of reports by the T-PE at the Rc Reference point.

Figure I.1 shows the high-level information flows for the procedures.

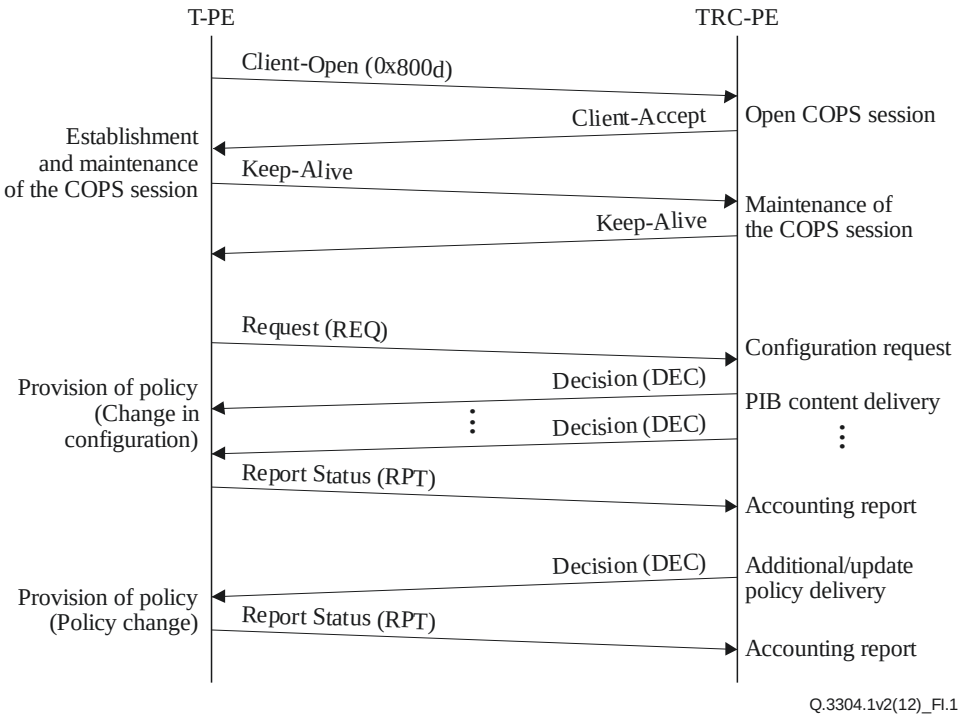

Figure I.1 – COPS signalling between the T-PE and the TRC-PE

Bibliography

[b-IETF RFC 4301] IETF RFC 4301 (2005), *Security Architecture for the Internet Protocol (IPSEC).*

[b-IETF RFC 5246] IETF RFC 5246 (2008), *The Transport Layer Security (TLS) Protocol*.

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