Network Working Group Internet Draft Document: <u>draft-boucadair-ipte-acct-pib-02.txt</u> Category: Experimental

# An IP Traffic Engineering PIB for Accounting purposes <<u>draft-boucadair-ipte-acct-pib-02.txt</u>>

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# Abstract

This document defines a set of IP Traffic Engineering Policy Provisioning Classes (PRCs) for accounting usage within the context of a COPS-based policy enforcement scheme. The purpose of those PRCs is to provide information exploitable by the IP Traffic Engineering decision-making process. Those PRCs are intended for use by the reporting process of the IP TE Client-Type [2].

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#### **1**. Introduction

Traffic engineering is one of the possible means for solving congestion problems and permitting efficient use of the network resources. Indeed, several tools have been proposed to achieve this goal. Nevertheless, only few solutions introduce a high level of automation for the allocation of resources and the configuration operations.

The design of an IP Traffic Engineering (IP TE) policy implies the manipulation of a large amount of configuration information that includes routing considerations, traffic forecast, available resources, etc. These parameters are provisioned as configuration information to the network devices by means of a COPS-based communication scheme, thanks to the use of a specific client-type [2]. But remains the choice of the appropriate parameters to meet network constraints as well as Quality Of Service (QOS) requirements, and also to observe the impact of such choice on the stability of the network.

From this standpoint, several methods can be adopted: either use statistical data based on mathematical models, or data resulting of measurements. The advantage of the second method is that it allows for real time statistics.

Therefore, the actual enforcement of a traffic engineering policy requires a feedback mechanism not only to qualify how efficient such enforcement is, but also the impact the future decisions made by the Policy Decision Point (PDP) and installed by the PDP at the Policy Enforcement Point (PEP)-embedded devices.

Within the context of this document, the data recorded, monitored and/or reported by the PEP are the results of the activation of dynamic routing processes (e.g. Open Shortest Path First (OSPF) and Border Gateway Protocol version 4 (BGP)).

We propose in this document to define a set of IP TE accounting usage Policy Rule Classes (PRC) that will be monitored, recorded and/or reported by the PEP. Those PRCs complement the PRC classes that have been defined in the Framework of COPS-PR PIB for Policy Usage [3].

This document is organised as follows:

-  $\underline{\text{Section 4}}$  shows the use of accounting mode within a TE context.

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- Section 5 presents the IP TE Usage PIB.

#### 2. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in <u>RFC-2119</u> [4].

#### **<u>3</u>**. Changes since last version

- The introduction has been reworded
- The references section has been updated
- Modification of section 4

# <u>4</u>. Accounting and Traffic Engineering <u>4.1</u>. Introduction

The actual enforcement of an IP TE policy is conditioned by the manipulation of information such as traffic forecast (according to customers' requests, for example [5]), and traffic load calculation (see fig.1). Within the context of a COPS architecture, the qualification of a policy's efficiency could be based upon the accounting mode.

[6] defines the capability to report information to the PDP. Several types of reports are defined: success, failure and accounting. A framework of the use of the accounting mode is introduced in  $[\underline{3}]$ .



+-----

+   PEP		-+ 			/	\ 		
+     IP TE Clien     +	+ t-Туре   +	    <	   +		I	   		
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Report Process	<+	
-Monitoring	<	+
-Recording	IP TE REPORT	
-Reporting		
++		
++		
+	+	

Fig.1: IP TE Reporting Mechanism

According to Fig.1, the report sent by the IP TE client type is received by the PDP.

The IP TE report classes are instantiated as multiple Provisioning Instance (PRI) instances, each of which being identified by PRovisioning Instance iDentifier (PRID). These classes contain attributes that actually describe the accounting IP TE-related information collected in the network.

# 4.2. The IP TE Selection Tables

The documents [7], [8] and [9] define IP Traffic Engineering Policy Information Base (IP TE PIB). The IP TE PIB could be organized into the following provisioning classes:

- The Forwarding classes: the information contained in these classes is meant to provide a detailed description of the trafficengineered routes. Only one table is defined: the IP TE Route table, which describes the information related to TE routes that have been installed by the routers in their FIBs.
- 2. The Metrics classes: the information stored in the tables included in this class is meant to provide the description of the metric values that will be taken into account by intra- and inter-domain routing protocols for the computation and the selection of traffic-engineered routes.
- The Statistics classes: the information contained in these classes is meant to provide statistics on the enforcement of the TE policies.

These tables are used as selection tables.

#### **<u>4.3</u>**. The IP TE Accounting Usage Tables

Within the context of [10], three policies are defined:

- The selection criteria policy: defines the conditions used by PEP to monitor and record a usage policy.
- The usage policy: defines what attributes are monitored and/or recorded by the PEP.

- The linkage policy: provides a linkage for the selection and usage policies.

As mentioned above, the tables defined in the IP TE PIB are used as the Selection policies and we introduced in the following <u>Section 4</u> the Usage classes.

In addition, the IP TE Selection Usage Combination Capability Table contains objects pointing to the IP TE Usage tables, IP TE Selection tables and Threshold tables.

# 4.4. PIB overview

The PIB defined within the context of IP traffic engineering for accounting purposes has the goal to complete the whole COPS TE reporting machinery. This PIB contains the following tables:

- ospfTeRouterUsageTable: this class defines the usage attributes to be reported, and which are related to the router identified by the Router-Id.
- ospfTeUsageTable : this class defines the usage attributes to use

for OSPF TE purposes.

- isisTeUsageTable : this class defines the usage attributes to use

for IS-IS TE purposes.

- bgpTeTable

set of accounting

information related to the activation of BGP process enabling exchange of QOS information.

: this table contains a

- ospfTeThresholdTable: this class defines the threshold attributes corresponding to OSPF TE usage attributes specified in ospfTeUsageTable.
- isisTeThresholdTable: this class defines the threshold attributes corresponding to IS-IS TE usage attributes specified in isisTeUsageTable.

- bgpTeThresholdTable: this class defines the threshold attributes corresponding to BGP usage attributes specified in bgpTeUsageTable.

# <u>4.5</u>. The relation of the Accounting PIB with external PIB modules

In the actual stage of the IPTE PIB design effort, several PIB modules have been proposed to the IETF, mainly [8],[9] and [12].

The accounting PIB could impact these modules by providing additional input to the process of configuration of the aforementioned modules.

---- The PIB defined within the context of IP traffic engineering -- for accounting purposes has the goal to complete the whole -- COPS TE reporting machinery.

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```
Internet Draft IP TE PIB for Accounting purposes
                                                       June 2003
    -- Data contained in this PIB aren t stabilized yet and will be
   -- modified and updated as necessary.
   - -
   IPTE-ACCOUNTING-PIB PIB-DEFINITIONS ::= BEGIN
         IMPORTS
           ExtUTCTime, Unsigned32, Unsigned64,
            Integer32, MODULE-IDENTITY, OBJECT-TYPE
                       FROM COPS-PR-SPPI
           TruthValue, TEXTUAL-CONVENTION
                      FROM SNMPv2-TC
           PolicyInstanceId, PolicyReferenceId
                       FROM COPS-PR-SPPI-TC;
            RoleCombination
                      FROM POLICY-DEVICE-AUX-MIB;
            Counter64
                      FROM SNMPv2-SMI;
         ipTeAccountingPib MODULE-IDENTITY
             SUBJECT-CATEGORIES {tbd}
             LAST-UPDATED "200201250900Z"
            ORGANIZATION
                              "France Telecom R&D"
            CONTACT-INFO
                      Mohamed Boucadair
                      Adresse: 42, rue des Coutures
                       BP 6243
                       14066 Caen Cedex
                       Phone: +33 2 31 75 92 31
                       Email: Mohamed.Boucadair@francetelecom.com"
           DESCRIPTION
                   "The PIB module that contains classes describing the
                   parameters to be monitored, recorded and/or reported
                   by the PEP for Traffic Engineering accounting
                   purposes."
               ::= {tbd}
      - -
      -- The ipTe Accounting Class
      - -
      ipTeAccountingClasses
              OBJECT IDENTIFIER ::= { ipTeAccountingPib 1 }
      -- The MPLS TE Accounting Class
```

- -

```
Internet Draft IP TE PIB for Accounting purposes
                                                            June 2003
        -- This class defines tables related to MPLS TE
        -- To be done in next version of this draft.
     lspTeAccountingClasses
             OBJECT IDENTIFIER ::= { ipTeAccountingPib 2 }
      - -
      -- ospfTeRouterUsageTable
      - -
       ospfTeRouterUsageTable OBJECT-TYPE
           SYNTAX
                           SEQUENCE OF ospfTeRouterUsageEntry
           PIB-ACCESS
                            report-only
           STATUS
                           current
           DESCRIPTION
                 "This class defines the usage attributes to be
                 reported, and which are related to the router
                identified by the Router-Id."
            ::= { ipTeAccountingClasses 1}
       ospfTeRouterUsageEntry OBJECT-TYPE
           SYNTAX
                           ospfTeUsageRouterEntry
                           current
            STATUS
            DESCRIPTION
                 "An entry for the ospfTeRouterUsageTable."
           PIB-INDEX { ospfTeRouterUsagePrid}
           UNIQUENESS { ospfTeRouterUsageLinkPrid,
                      ospfTeUsageIfActif}
            ::= {ospfTeRouterUsageTable 1}
       ospfTeRouterUsageEntry ::= SEQUENCE {
                      ospfTeRouterUsagePrid
                                                   InstanceID,
                      ospfTeRouterUsageLinkPrid
                                                   Prid,
ospfTeRouterUsageIfActif
Counter64 }
       ospfTeRouterUsagePrid OBJECT-TYPE
           SYNTAX
                       Prid
           STATUS
                       current
            DESCRIPTION
                 "An integer index that uniquely identifies this
                 instance of the ospfTeRouterUsage class."
```

::= { ospfTeRouterUsageEntry 1 }

ospfTeRouterUsageLinkPrid OBJECT-TYPE

Boucadair Experimental - Expires December 2003 [Page 7]

```
SYNTAX
                  Prid
      STATUS
                  current
      DESCRIPTION
           "The PRID of the Linkage policy instance used to refer
           this usage policy instance."
       ::= { ospfTeRouterUsageEntry 2 }
  ospfTeRouterUsageIfActif
                                   OBJECT-TYPE
      SYNTAX
                   Counter64
      STATUS
                   current
      DESCRIPTION
           "The number of interfaces that participate to an OSPF-
           TE route computation in the router identified by
           Router-ID."
       ::= { ospfTeRouterUsageEntry 3 }
 - -
 -- ospfTeUsageTable
 - -
ospfTeUsageTable OBJECT-TYPE
                      SEQUENCE OF ospfTeUsageEntry
      SYNTAX
      PIB-ACCESS
                      report-only
      STATUS
                      current
      DESCRIPTION
           "This class defines the usage attributes to use for
           OSPF TE purposes."
       ::= { ipTeAccountingClasses 2 }
ospfTeUsageEntry
                  OBJECT-TYPE
      SYNTAX
                      ospfTeUsageEntry
      STATUS
                      current
      DESCRIPTION
           "An entry for the ospfTeUsageTable."
      PIB-INDEX { ospfTeUsagePrid}
      UNIQUENESS
                                          { ospfTeUsageLinkPrid,
                 OspfTeUsageLinkDelay }
       ::= {ospfTeUsageTable 1 }
```

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Internet Draft IP TE PIB for Accounting purposes June 2003 ospfTeUsageLinkDelay Unsigned32 } ospfTeUsagePrid **OBJECT-TYPE** SYNTAX Prid current STATUS DESCRIPTION "An integer index that uniquely identifies this instance of the ospfTeUsage class." ::= { ospfTeUsageEntry 1 } ospfTeUsageLinkPrid OBJECT-TYPE SYNTAX Prid STATUS current DESCRIPTION "The PRID of the Linkage policy instance used to refer this usage policy instance." ::= { ospfTeUsageEntry 2 } ospfTeUsageLinkDelay OBJECT-TYPE SYNTAX Unsigned32 STATUS current DESCRIPTION "The one-way delay that has been observed on this route." ::= { ospfTeUsageEntry 3 } - --- isisTeUsageTable - isisTeUsageTable OBJECT-TYPE SYNTAX SEQUENCE OF isisTeUsageEntry PIB-ACCESS report-only STATUS current DESCRIPTION "This class defines the usage attributes to use for IS-IS TE purposes." ::= { ipTeAccountingClasses 3 } isisTeUsageEntry OBJECT-TYPE

SYNTAX	isisTeUsageEntry
STATUS	current

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DESCRIPTION "An entry for the isisTeUsageTable." PIB-INDEX { isisTeUsagePrid} UNIQUENESS { isisTeUsageLinkPrid, isisTeUsageLinkDelay } ::= {isisTeUsageTable 1 } isisTeUsageEntry ::= SEQUENCE { InstanceID, isisTeUsagePrid isisTeUsageLinkPrid Prid, isisTeUsageLinkDelay Unsigned32 } **OBJECT-TYPE** isisTeUsagePrid SYNTAX Prid STATUS current DESCRIPTION "An integer index that uniquely identifies this instance of the isisTeUsage class." ::= { isisTeUsageEntry 1 } isisTeUsageLinkPrid OBJECT-TYPE SYNTAX Prid STATUS current DESCRIPTION "The PRID of the Linkage policy instance used to refer this usage policy instance." ::= { isisTeUsageEntry 2 } isisTeUsageLinkDelay OBJECT-TYPE SYNTAX Unsigned32 STATUS current DESCRIPTION "The one-way delay that has been observed on this route." ::= { isisTeUsageEntry 3 } - --- bgpTeUsageTable - bgpTeTable OBJECT-TYPE

Boucadair

Internet Draft IP TE PIB for Accounting purposes June 2003 SYNTAX SEQUENCE OF bgpTeUsageEntry report-only PIB-ACCESS current STATUS DESCRIPTION "This table contains a set of accounting information related to the activation of BGP process enabling exchange of QOS information." ::= { ipTeAccountingClasses 4 } bgpTeUsageEntry OBJECT-TYPE SYNTAX bgpTeUsageEntry STATUS current DESCRIPTION "An entry to bgpTeUsage Class." PIB-INDEX { bgpTeUsagePrid } UNIQUENESS { bgpTeUsageLinkPrid, bgpTeUsageActIf, bgpTeUsageOneWayDelay } ::= { bgpTeUsageTable 1 } bgpTeUsageEntry ::= SEQUENCE { bgpTeUsagePrid InstanceId, bgpTeUsageLinkPrid Prid, bgpTeUsageActIf Counter64, bgpTeUsageOneWayDelay Unsigned32 } bgpTeUsagePrid **OBJECT-TYPE** SYNTAX InstanceId STATUS current DESCRIPTION "An integer index that uniquely identifies this instance of the bgpTeUsage class." ::= { bgpTeUsageEntry 1 } bgpTeUsageLinkPrid **OBJECT-TYPE** SYNTAX Prid STATUS current DESCRIPTION

"The PRID of the Linkage policy instance used to base this usage policy instance upon."

::= { bgpTeUsageEntry 2 }

bgpTeUsageActIf **OBJECT-TYPE** 

> SYNTAX Counter64 STATUS current DESCRIPTION "Specifies the number of interfaces that participate to the BGP route computation process."

::= { bgpTeUsageEntry 3 }

bgpTeUsageOneWayDelay OBJECT-TYPE

> SYNTAX Unsigned32 STATUS current DESCRIPTION "Specifies the one-way delay that has been observed on this route."

::= { bgpTeUsageEntry 4 }

- -

-- The Threshold class that accompanies the OSPF and BGP usage

- -- tables
- -

-- OSPF Threshold attributes

- -

- -

ospfTeThresholdTable OBJECT-TYPE

SEQUENCE OF ospfThresholdEntry SYNTAX PIB-ACCESS Install STATUS current DESCRIPTION "This class defines the threshold attributes corresponding to OSPF TE usage attributes specified in ospfTeUsageTable."

::= { ipTeAccountingClasses 5 }

```
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```

Internet Draft IP TE PIB for Accounting purposes June 2003 ospfTeThresholdEntry OBJECT-TYPE SYNTAX ospfTeThresholdEntry STATUS current DESCRIPTION "Defines the attributes to hold threshold values." PIB-INDEX { ospfTeThresholdId } ::= { ospfTeThresholdId 1 } ospfTeThresholdEntry::= SEQUENCE { ospfTeThresholdId InstanceID, ospfTeThresholdBwThresholds Integer64, ospfTeThresholdRsvBwThresholds Integer64 } ospfTeThresholdId **OBJECT-TYPE** SYNTAX InstanceId STATUS current DESCRIPTION "Arbitrary integer index that uniquely identifies an instance of the class." ::= { ospfTeThresholdEntry 1 } ospfTeThresholdBwThresholds OBJECT-TYPE SYNTAX Integer64 STATUS current DESCRIPTION "The threshold the used bandwidth on the link shouldn't exceed." ::= { ospfTeThresholdEntry 2 } ospfTeThresholdRsvBwThresholds OBJECT-TYPE SYNTAX Integer64 STATUS current DESCRIPTION "The threshold the reserved bandwidth on the link shouldn't exceed." ::= { ospfTeThresholdEntry 3 }

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```
-- ISIS Threshold attributes
isisTeThresholdTable OBJECT-TYPE
                    SEQUENCE OF isisThresholdEntry
     SYNTAX
        PIB-ACCESS
                       Install
                       current
        STATUS
        DESCRIPTION
           "This class defines the threshold attributes
           corresponding to ISIS TE usage attributes specified in
           isisTeUsageTable."
        ::= { ipTeAccountingClasses 6 }
isisTeThresholdEntry OBJECT-TYPE
     SYNTAX
                     isisTeThresholdEntry
        STATUS
                        current
        DESCRIPTION
           "Defines the attributes to hold threshold values."
        PIB-INDEX { isisTeThresholdId }
        ::= { isisTeThresholdId 1 }
isisTeThresholdEntry::= SEQUENCE {
         isisTeThresholdId
                                       InstanceID,
         isisTeThresholdBwThresholds
                                         Integer64,
         isisTeThresholdRsvBwThresholds Integer64 }
isisTeThresholdId OBJECT-TYPE
                  InstanceId
     SYNTAX
        STATUS
                     current
        DESCRIPTION
           "Arbitrary integer index that uniquely identifies an
           instance of the class."
        ::= { isisTeThresholdEntry 1 }
isisTeThresholdBwThresholds OBJECT-TYPE
```

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```
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```

```
Integer64
              SYNTAX
              STATUS
                           current
              DESCRIPTION
                 "The threshold the used bandwidth on the link
                 shouldn't exceed."
              ::= { isisTeThresholdEntry 2 }
     isisTeThresholdRsvBwThresholds
                                      OBJECT-TYPE
           SYNTAX
                        Integer64
              STATUS
                           current
              DESCRIPTION
                 "The threshold the reserved bandwidth on the link
                 shouldn't exceed."
              ::= { isisTeThresholdEntry 3 }
        -- BGP Threshold attributes
        - -
     bgpTeThresholdTable OBJECT-TYPE
           SYNTAX
                          SEQUENCE OF bgpThresholdEntry
              PIB-ACCESS
                             Install
                             current
              STATUS
              DESCRIPTION
                 "This class defines the threshold attributes
                 corresponding to BGP usage attributes specified in
                 bgpTeUsageTable."
              ::= { ipTeAccountingClasses 7 }
     bgpTeThresholdEntry OBJECT-TYPE
           SYNTAX
                           bgpTeThresholdEntry
                              current
              STATUS
              DESCRIPTION
                 "Defines the attributes to hold threshold values."
              PIB-INDEX { bgpTeThresholdPrid }
              ::= { bgpTeThresholdId 1 }
     bgpTeThresholdEntry ::= SEQUENCE {
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                                                               [Page 15]
```

Internet Draft June 2003 IP TE PIB for Accounting purposes bgpTeThresholdId InstanceID, bgpTeThresholdNlriAddress InetAddress, bgpTeThresholdNextHopAddress InetAddress, bgpTeThresholdOneWayDelayThreshold Integer64, bgpTeThresholdInterPacketDelayThreshold Integer64, bgpTeThresholdLossRateThreshold Integer64 } bgpTeThresholdId **OBJECT-TYPE** SYNTAX InstanceId STATUS current DESCRIPTION "Arbitrary integer index that uniquely identifies an instance of the class." ::= { bgpTeThresholdEntry 1 } bgpTeThresholdNlriAddress **OBJECT-TYPE** SYNTAX InetAddress STATUS current DESCRIPTION "The IP address to match against the NLRI field of QOS\_NLRI attribute of the BGP4 UPDATE message introduced in [11]." ::= { bgpTeThresholdEntry 2 } bgpTeThresholdNextHopAddress **OBJECT-TYPE** InetAddress SYNTAX STATUS current DESCRIPTION "The address of the next router." ::= { bgpTeThresholdEntry 3 } bgpTeThresholdOneWayDelayThreshold OBJECT-TYPE SYNTAX Integer64 STATUS current DESCRIPTION "The threshold of the one-way delay, that will trigger a report in the next reporting interval when exceeded." ::= { bgpTeThresholdEntry 4 }

bgpTeThresholdInterPacketDelayThreshold OBJECT-TYPE

SYNTAX Integer64 STATUS current DESCRIPTION "The threshold of the inter-packet delay variation, that will trigger a report in the next reporting interval, when exceeded."

::= { bgpTeThresholdEntry 5 }

bgpTeThresholdLossRateThreshold OBJECT-TYPE

SYNTAX Integer64 STATUS current DESCRIPTION "The threshold, in terms of loss rate, that will trigger a report in the next reporting interval, when exceeded."

::= { bgpTeThresholdEntry 6 }

END

# <u>6</u>. Security Considerations

Data manipulated within the context of IP TE accounting could be used by the IP TE decision-making processes, but only authorized COPS-PR communications can take place. Therefore, this draft does not introduce any additional security issues other than those that have been identified in the COPS-PR specification [12].

Nevertheless, the activation of an integrity mechanism is recommended for external systems making use of the TE accounting data.

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- June 2003
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#### 9. Author's Addresses

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