

An IP Traffic Engineering PIB for Accounting purposes
<[draft-boucadair-ip-te-acct-pib-02.txt](#)>

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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:

- [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 [RFC-2119](#) [4].

[3.](#) Changes since last version

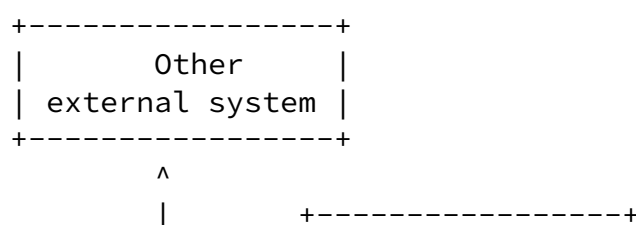
- The introduction has been reworded
- The references section has been updated
- Modification of [section 4](#)

[4.](#) Accounting and Traffic Engineering

[4.1.](#) 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 [3].



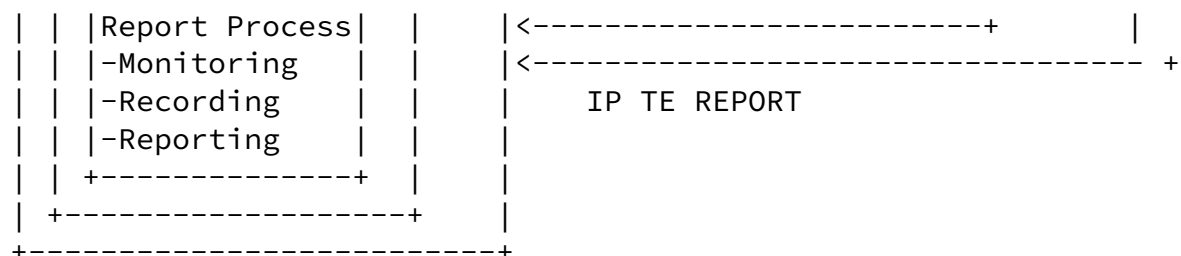
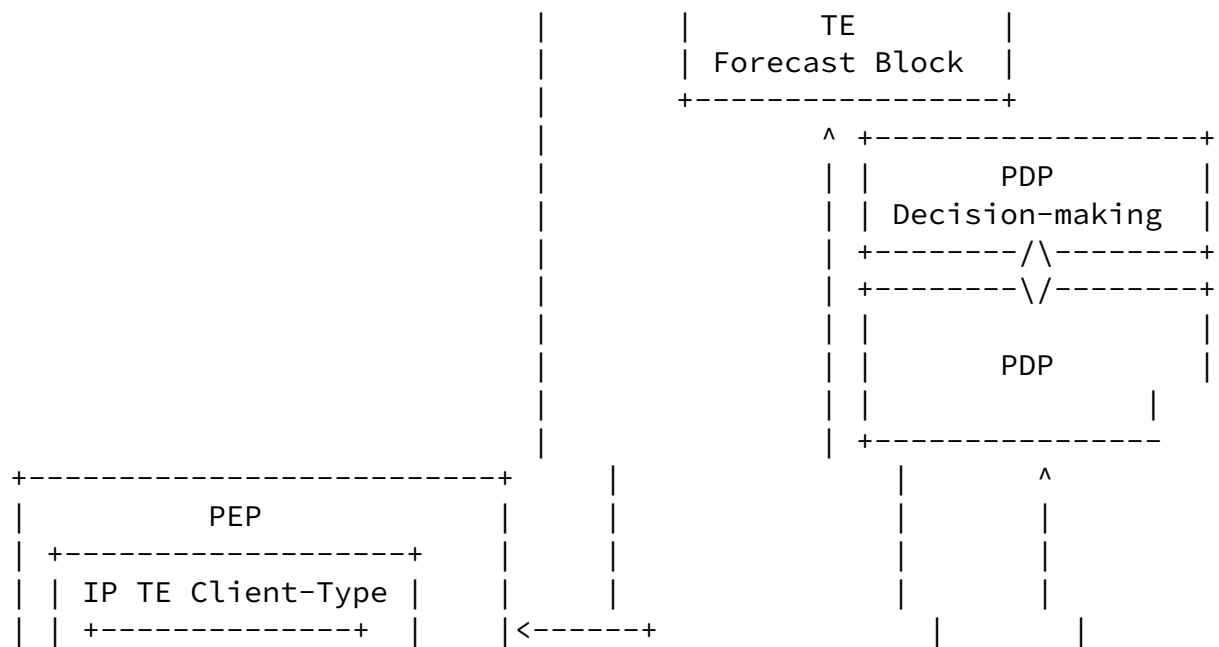


Fig.1: IP TE Reporting Mechanism

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 PProvisioning 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:

1. The Forwarding classes: the information contained in these classes is meant to provide a detailed description of the traffic-

engineered 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.
3. 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.

[4.3.](#) 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.

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- 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 [Section 4](#) 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 for OSPF TE purposes.
- isisTeUsageTable : this class defines the usage for IS-IS TE purposes.
- bgpTeTable : this table contains a set of information related to the activation of BGP process enabling exchange of QoS information.
- 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.

[4.5.](#) 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.

[5.](#) IP TE Usage PIB

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

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```
-- 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
    STATUS          current
    DESCRIPTION
        "An entry for the ospfTeRouterUsageTable."

    PIB-INDEX { ospfTeRouterUsagePrid}
    UNIQUENESS { ospfTeRouterUsageLinkPrid,
                ospfTeUsageIfActif}

    ::= {ospfTeRouterUsageTable 1}

ospfTeRouterUsageEntry ::= SEQUENCE {
    ospfTeRouterUsagePrid      InstanceID,
    ospfTeRouterUsageLinkPrid Prid,
    ospfTeRouterUsageIfActif

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

```



```
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
```

```
SYNTAX      SEQUENCE OF ospfTeUsageEntry
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 }

ospfTeUsageEntry ::= SEQUENCE { ospfTeUsagePrid InstanceID,
ospfTeUsageLinkPrid Prid,

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ospfTeUsageLinkDelay Unsigned32 }

ospfTeUsagePrid OBJECT-TYPE

SYNTAX Prid

STATUS current

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 {
 isisTeUsagePrid InstanceID,
 isisTeUsageLinkPrid Prid,
 isisTeUsageLinkDelay Unsigned32 }

isisTeUsagePrid OBJECT-TYPE

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

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SYNTAX SEQUENCE OF bgpTeUsageEntry

PIB-ACCESS report-only

STATUS current

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

```

SYNTAX          SEQUENCE OF ospfThresholdEntry
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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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 }

--
-- ISIS Threshold attributes
--

isisTeThresholdTable OBJECT-TYPE

SYNTAX SEQUENCE OF isisThresholdEntry

PIB-ACCESS Install

STATUS current

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

SYNTAX InstanceId

STATUS current

DESCRIPTION

"Arbitrary integer index that uniquely identifies an
instance of the class."

::= { isisTeThresholdEntry 1 }

isisTeThresholdBwThresholds OBJECT-TYPE

SYNTAX Integer64

STATUS current

DESCRIPTION

"The threshold the used bandwidth on the link
shouldn't exceed."

::= { isisTeThresholdEntry 2 }

isisTeThresholdRsvBwThresholds OBJECT-TYPE

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

SYNTAX InetAddress

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

[6.](#) 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.

[7.](#) References

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- [4] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997
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- [12] Ho Chan, K., Durham, D., Gai, S., Herzog, S., McLoghrie, K., Reichmeyer, F., Seligson, J., Smith, A., Yavatkar, R., "COPS Usage for Policy Provisioning (COPS-PR)", [RFC 3084](#), March 2001.
- [12] Boucadair, M., Jacquenet, C., "An IP Forwarding PIB", Work in Progress.

[8.](#) Acknowledgments

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[9.](#) Author's Addresses

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