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Framework Policy Information Base for Usage Feedback

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Abstract

This document describes a portion of the Policy Information Base (PIB) to control policy usage collection and reporting in a device.

The provisioning classes specified here allow a Policy Decision Point (PDP) to select which policy objects should collect usage information, what information should be collected and when it should be reported.

This PIB requires the presence of other PIBs (defined elsewhere) that provide the policy objects from which usage information is collected.

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1. Introduction

The Framework of Common Open Policy Service with Policy Provisioning (COPS-PR) Usage Feedback describes the overall approach to policy usage monitoring and reporting. This document defines the specific Policy Information Base (PIB) framework for policy usage feedback. The policy classes for monitoring and reporting policy usage feedback, as well as policy classes for controlling reporting intervals, suspension, resumption and solicitation are defined.

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 [RFC2119].

2. General Concepts

2.1. Selection, Usage and Linkage Policies

There are three basic types of policies used to define what the PEP is to monitor, record and report. These are the selection criteria policy, the usage policy and the feedback report linkage policy.

The selection criteria policy is installed by the PDP. It defines the conditions used by the PEP to monitor and record a usage policy. The selection criteria policy may only be used for defining usage feedback selection criteria. However, a more general case is a policy that already exists for policy enforcement that may also be used for specifying feedback usage selection criteria. An example of this is the frwkRoleCombo instance, which may be used in defining QoS enforcement policies, but may also be used to specify conditions on which to base usage - i.e. count the number of packets meeting the criterion of an interface capability set name and role combination.

The usage policy defines what attributes are recorded by the PEP. These policies have an ACCESS clause of 'report-only'. Generally, the usage policies specify counts related to a specific action such as a packet being dropped. The feedback framework PIB defines two usage policy classes, frwkFeedbackTraffic and frwkFeedbackIfTraffic. Usage PRCs may be generic, collecting basic statistics, or they may be specific to a particular usage. The PDP decides which PRC(s) best suit(s) its requirements. The PEP may support only one usage feedback PRC, in which case all statistics are gathered using instances of that PRC. Alternatively, the PEP may support multiple usage feedback PRCs. The PDP then decides which PRC to associate with a particular selection criterion.

A usage feedback policy and selection policy are tightly associated with one another. A third policy, the frwkFeedbackLinkTable, is used to associate, or provide a linkage for the selection and usage policies. The frwkFeedbackLinkTable also specifies when to report the usage feedback. The frwkFeedbackLinkTable entry permits the same selection criteria instance to be re-used for various usage feedback policies. The frwkFeedbackLinkTable contains the value of the selection criteria instance as well as the value of the usage feedback PRC.

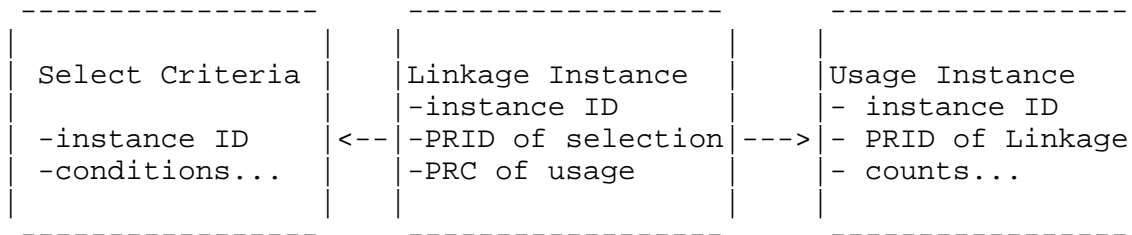


Figure 1

Figure 1 illustrates the relationship between the selection criteria, linkage and usage policies.

The PDP is not aware of the instance identifier of the usage feedback policy when installing the selection criteria and feedback linkage policies. The usage feedback policy is instantiated on the PEP by the installation of a feedback report linkage and the PEP designates the instance identifier. The usage feedback policy class always contains an attribute of type `ReferenceId` that contains the instance value of the associated `frwkFeedbackLinkTable` instance installed by the PDP. An example of this is the attribute `frwkFeedbackTrafficLinkRef`.

2.2. Normal Operations

2.2.1. Connection Establishment and Initial Configuration Request

The Accounting Timer object in the COPS Connection Accept message contains the minimum number of seconds between reporting intervals as described in [COPS] and [FEEDBACKFWK]. This is used as the basic unit of measurement in defining intervals for specific usage policies with the `frwkFeedbackLinkInterval` attribute.

The PEP notifies the PDP of the selection criteria policy classes and usage policy classes it supports during the initial request for configuration data using `frwkPRCSupport` instances [FR-PIB]. The PEP also indicates whether it supports the `frwkFeedbackLinkTable` as well.

The PDP responds to the initial request for configuration with a `DECISION` that installs policies. The PDP may also specify maximum reporting intervals associated with each of the usage policies. This is done with the `frwkFeedbackLinkInterval` attribute in the `frwkFeedbackLink` class. It may also specify reporting thresholds by including an instance of a threshold class (e.g. `frwkFeedbackTrafficThreshold`) in the decision. The PEP monitors and records the usage per the conditions defined by its associated selection criteria policy. Periodically the PEP reports the usage

with a REPORT message or provides a REPORT when solicited by the PDP. The PDP solicits usage feedback with the frwkFeedbackActionIndicator attribute of the frwkFeedbackAction class.

2.2.2. Unsolicited Reports - Periodic Reporting

Reporting may be periodic in nature and unsolicited. The intervals at which the unsolicited reports are provided by the PEP are defined in the specific Linkage policies. The defined intervals are based on the number of seconds specified by the PDP in the ACCT Timer value. The PDP may specify that the associated usage instance be included in a periodic unsolicited report only if the threshold is reached and/or if the usage value has changed from the previous reporting interval.

There are cases when the PEP must supply unsolicited feedback reports that may not fall on an interval boundary. The PEP MUST provide an unsolicited REPORT containing all defined usage instances just prior to the PEP issuing a Delete Request State and just prior to the PEP de-activating a PIB instance context.

2.2.3. Unsolicited Reports - Reporting Conditions

Periodic unsolicited reports for individual usage feedback instances can be suppressed by specifying additional conditions in the frwkFeedbackLink instances. Supported conditions are:

ChangeOnly

If this flag is set in the frwkFeedbackLinkFlags attribute, the associated usage instance is only included in a periodic unsolicited report if its value changed since the last unsolicited report.

Threshold

If this flag is set in the frwkFeedbackLinkFlags attribute, the associated usage instance is only included in a periodic unsolicited report if the threshold condition referenced in the frwkLinkThreshold field evaluates successfully for the associated usage instance.

Both conditions can be combined in one frwkFeedbackLinkUsage object. In this case, both conditions need to succeed for the usage instance to be reported.

Unsolicited reports triggered by a Delete Request State or the deactivation of a PIB instance are not subject to these conditions - all usage objects must be included in these cases.

2.2.4. Solicited Reports

The PDP may solicit policy usage feedback by issuing an unsolicited Decision containing the `frwkFeedbackActionIndicator` set to `'solicitReport'`. The PEP is to provide a solicited REPORT feedback containing usage feedback. The PEP shall continue to provide periodic feedback at the specified intervals established at client connection acceptance.

The reporting conditions (`ChangeOnly` and `Threshold`) do not affect solicited reports - all requested usage instances must be included.

2.2.5. Resuming and Suspending Periodic Feedback Reporting

The PDP may suspend usage monitoring and tracking at the PEP with the `frwkFeedbackActionIndicator` set to `'suspendMonitoringAndReports'`. The PEP must stop tracking usage information and must not issue any feedback reports. The PDP may only suspend feedback reporting by setting the `ActionIndicator` to `'suspendReports'`. The PEP must cease sending unsolicited reports but is to continue monitoring and tracking usage. The PDP may resume the sending of feedback reports and may resume usage monitoring by setting the `ActionIndicator` to `'resume'`.

The PDP may suspend or resume all usage instances or the PDP may specify one or more instances that are to be suspended or resumed. The `frwkFeedbackActionList` attribute contains a tag identifier that references a list of one or more `frwkFeedbackActionList` instances.

The PDP may halt usage monitoring, tracking and reporting of usage policies by removing the associated Linkage entry.

2.2.6. Failover

In the event that the connection is lost between the PEP and PDP, the PEP continues to track usage information as long as it continues to operate with the installed policy. When the locally installed policy at the PEP expires, the usage policy data also expires.

Upon successful reconnection where the PEP is still caching policy, the PDP indicates to the PEP that the PEP may resume sending of the COPS accounting type report messages. The PDP does this by issuing an unsolicited decision containing the `frwkFeedbackResumeIndicator` set to `'resume'`. The PEP should resume reporting at the next appropriate feedback interval established upon the acceptance of the re-connection. The PDP is aware of the request state `Handle(s)` and

the supported PRCs either through the state synchronization mechanism or because the PDP considers itself synchronized with the PEP upon reconnection.

2.3. Usage Policy and Under-specified Selection Criteria

Some of the usage policy objects created in the PEP with COPS-PR can be used by the PEP multiple times - they effectively act as templates for the objects created by the PEP. COPS-PR only has the identity (OID) of the object that is shared between all the assignments the PEP created. However it is desirable to collect usage information for each of the derived objects individually.

This capability is achieved in the feedback framework PIB by distributing additional information to qualify a specific assignment of an object between the selection criteria PRC and the feedback usage PRC.

A selection criteria PRC that refers to a shared object, but contains no qualifying information, selects all of the object's assignments. Such a selection criteria PRC SHOULD be combined with a feedback usage PRC that includes all the necessary information to identify a specific assignment - a single selection criteria policy can then result in the generation of many feedback usage objects, one for each derived object.

If the selection criteria PRC contains all the required qualifying attributes for a specific assignment, it is combined with a feedback usage PRC that only contains the desired metrics but no additional attributes.

Example:

A `frwkRoleCombo` instance may be used as a selection criteria, identifying a set of interfaces through their role combination and capability set. If it is desired to get per-interface traffic statistics, the usage PRC has to include an additional attribute to qualify the specific interface.

This could be achieved by linking the `frwkFeedbackIfTraffic` class with a `frwkRoleCombo` instance in a `frwkFeedbackLink` instance. Multiple `frwkFeedbackIfTraffic` instances will be created by the PEP, one for each interface selected by the `frwkRoleCombo` instance. The `frwkFeedbackIfTraffic` class contains the `frwkFeedbackIfTrafficIfIndex` attribute that allows the PDP to identify each interface's individual counters when the PEP reports the `frwkFeedbackIfTraffic` instances.

If traffic usage collection is only desired for an individual interface, a selection criteria should be used that qualifies the interface completely, for example a `frwkIfRoleCombo` instance. In this case, it can be linked to the usage class that has no additional qualifying attributes, `frwkFeedbackTraffic`.

3. Summary of the Feedback Framework Policy Information Base

3.1. SPPI ACCESS Clause Report-Only

The selection criteria and linkage policy classes follow the definitions specified by [SPPI]. This structure specifies well-defined policy classes and their instances residing in a common, virtual repository [FR-PIB]. The additional PIB-ACCESS clause attribute of "report-only" denotes the usage policy class reported by the PEP.

3.2. Usage32 and Usage64 Textual Conventions

The SPPI does not support the Counter32/64 textual conventions (TC) of SNMP - for feedback collection two similar textual conventions have been defined in this PIB: Usage32 and Usage64.

In addition to the differential functionality of 'Counter', where only the difference between two samples generally carries information, a single value of a 'Usage' attribute usually provides absolute information, since

- its initial value is known (0)
- no wrap-around events should occur
- the time or event when the initial value was set should be available directly or indirectly from other objects.

When 'Usage' attributes are defined in a PRC, events that could cause a reset of the attribute to its initial value should be defined in the description as well as the mechanism that allows the PDP to detect the time of the last reset.

No usual COPS activity however should cause the reset of a Usage attribute. In the case of a suspension of monitoring activity (`frwkFeedbackActionIndicator` set to 'suspendMonitoringAndReports'), 'Usage' attributes should keep their values and continue counting after monitoring is resumed.

3.3. Feedback Groups and PRCs

These policy classes defined in this PIB are common to account type reporting for various technologies and apply to ALL SUBJECT-CATEGORIES. The policy classes are divided into three new groups, namely, The Feedback Report Group, The Feedback Usage Group and The Feedback Selection Group.

The policy classes in the Feedback Report Group are:

- Feedback Action
- Feedback Action List
- Feedback Selection Usage Combination Capability
- Feedback Linkage
- Feedback Traffic Statistics Threshold

The policy classes in the Feedback Usage Group are:

- Feedback Traffic
- Feedback Interface Traffic

The policy class in the Feedback Selection Group is:

- Feedback RoleCombo Filter Selection

3.3.1. Feedback Action

The Feedback Action class contains the attributes that specify action that the PEP is to take regarding policy usage, monitoring and tracking. The PDP may suspend usage monitoring and periodic reporting, suspend periodic reporting only, resume usage and periodic reporting or solicit immediate reporting. The action may affect all feedback policies or be associated with one or more frwkFeedbackLink instances.

The frwkFeedbackActionIndicator attribute defines the action. The frwkFeedbackActionPri attribute indicates whether the action applies to all of the usage policies or to a list. The frwkFeedbackActionList attribute is the identifier of the list of Linkage policy instances to which the action is to be applied.

The PDP can solicit the PEP for immediate usage feedback. The PEP shall respond with a solicited report containing the usage feedback.

The PDP can direct the resumption of usage monitoring and reporting per the defined intervals. For example, the PEP may have re-connected to a PDP and has cached usage policies. The PDP indicates to the PEP to resume usage tracking and monitoring and to send all

the cached usage policy. The PEP shall respond at the next appropriate interval with an unsolicited report containing the usage feedback.

The PDP can suspend the monitoring of usage policy. The PEP maintains the current usage that has been monitored, but discontinues any further monitoring until the PDP directs the PEP to resume monitoring in a subsequent Decision.

The PDP can also suspend just the reporting of usage, but not interrupt the monitoring and tracking of usage. The PEP shall discontinue sending Report messages with usage feedback until the PDP directs the PEP to resume. The PEP then begins reporting the usage feedback at the next interval.

3.3.2. Feedback Action List

This class defines sets of linkage instances that can be referred to from the `frwkFeedbackActionList` attribute.

3.3.3. Feedback Linkage Capability

This class defines the valid selection criteria PRC, usage PRC and threshold PRC combinations supported by the PEP.

3.3.4. Feedback Linkage

This class links the selection criteria instance with the usage class. This table permits the reuse of a selection criteria instance for multiple usage policies.

The linkage table also permits the definition of a maximum reporting interval to use when issuing the COPS accounting type reports for the usage instance. A value of 0 in this attribute indicates that the usage policy must be solicited.

3.3.5. Feedback Traffic Statistics Threshold

This class is used to provide threshold values for the attributes described in the traffic usage classes below.

3.3.6. Feedback Traffic

This class includes the packet counts, byte counts and a reference to the associated Linkage instance.

3.3.7. Feedback Interface Traffic

This class is similar to the previous Feedback Traffic class, except that it includes an additional reference to an interface index. This class should be used with a selection criteria instance that matches an element that is assigned to multiple interfaces. The interface field can be used to associate the instances of this table with the specific element's assignment.

3.3.8. Feedback RoleCombo Filter Selection

This class is used as selection criteria based on role combination, capability set and a filter instance.

4. The Feedback Framework PIB Module

```
FRAMEWORK-FEEDBACK-PIB PIB-DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    pib, Unsigned32, Unsigned64, Integer32,
    MODULE-IDENTITY, OBJECT-TYPE, MODULE-COMPLIANCE, OBJECT-GROUP
        FROM COPS-PR-SPPI
    TruthValue, TEXTUAL-CONVENTION
        FROM SNMPv2-TC
    InstanceId, ReferenceId, Prid,
    TagId, TagReferenceId
        FROM COPS-PR-SPPI-TC
    PrcIdentifierOid, PrcIdentifierOidOrZero
        FROM FRAMEWORK-TC-PIB
    frwkRoleComboEntry
        FROM FRAMEWORK-PIB
    InterfaceIndex
        FROM IF-MIB;
```

```
frwkFeedbackPib MODULE-IDENTITY
    SUBJECT-CATEGORIES { all }
    LAST-UPDATED "200307140000Z" -- 14 July 2003
    ORGANIZATION "IETF RAP WG"
    CONTACT-INFO "IETF RAP WG
        Email: rap@ops.ietf.org
```

```
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DESCRIPTION

"The PIB module containing the base set of policy rule classes that are required for support of all policy usage monitoring, tracking and reporting policies.

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REVISION "200307140000Z"

DESCRIPTION

"Initial version, published in RFC 3571."

::= { pib 5 }

--
-- Textual Conventions
--

Usage32 ::= TEXTUAL-CONVENTION
STATUS current

DESCRIPTION

"The Usage32 type represents a non-negative integer which monotonically increases. Usage32 initial value is 0 and the object-type using Usage32 needs to specify when it is initialized.

The Usage32 type is intended to reflect the absolute number of counted events, so that even a new PDP after a COPS reconnect can use the value directly.

If there is the possibility that the maximum Usage32 value of $2^{32}-1$ is exceeded during the lifetime of the Usage32 object, the larger Usage64 type should be used.

If conditions other than the reset of the COPS subsystem exist that disrupt the monotonic characteristics of Usage32, these conditions and a method how to detect their presence should be specified in the description of the object-type using Usage32 or its enclosing object-types (e.g. the Entry or Table object-type of the Usage32 object-type).

Whenever the monotonic increase of Usage32 is violated, it should be reset to 0 and the fact that this occurred should be indicated through an appropriate mechanism, for example a corresponding object of type TimeStamp or TimeAndDate."

SYNTAX Unsigned32

Usage64 ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"The Usage64 type represents a non-negative integer which monotonically increases. Usage64 initial value is 0 and the object-type using Usage64 needs to specify when it is initialized.

The Usage64 type is intended to reflect the absolute number of counted events, so that even a new PDP after a COPS reconnect can use the value directly.

The lifetime of the Usage64 object should be defined in a way that ensures the maximum Usage64 value of $2^{64}-1$ is never exceeded.

If conditions other than the reset of the COPS

subsystem exist that disrupt the monotonic characteristics of Usage64, these conditions and a method how to detect their presence should be specified in the description of the object-type using Usage64 or its enclosing object-types (e.g. the Entry or Table object-type of the Usage64 object-type).

Whenever the monotonic increase of Usage64 is violated, it should be reset to 0 and the fact that this occurred should be indicated through an appropriate mechanism, for example a corresponding object of type TimeStamp or TimeAndDate."

SYNTAX Unsigned64

--

-- The feedback report group

--

frwkFeedbackGroupClasses

OBJECT IDENTIFIER ::= { frwkFeedbackPib 1 }

--

-- Feedback Action Table

--

frwkFeedbackActionTable OBJECT-TYPE

SYNTAX SEQUENCE OF FrwkFeedbackActionEntry

PIB-ACCESS install

STATUS current

DESCRIPTION

"This class represents commands that the PDP sends to suspend, resume or solicit collection or reporting of usage data."

::= { frwkFeedbackGroupClasses 1 }

frwkFeedbackActionEntry OBJECT-TYPE

SYNTAX FrwkFeedbackActionEntry

STATUS current

DESCRIPTION

"Each frwkFeedbackActionEntry represents a command from the PDP. FrwkFeedbackActionIndicator specifies the command itself while frwkFeedbackActionSpecificPri indicates if all frwkFeedbackLink objects in the system are affected by the command, or just the set that is referenced by frwkFeedbackActionList."

```

PIB-INDEX { frwkFeedbackActionId}

 ::= { frwkFeedbackActionTable 1}

FrwkFeedbackActionEntry ::= SEQUENCE {
    frwkFeedbackActionId          InstanceId,
    frwkFeedbackActionIndicator   INTEGER,
    frwkFeedbackActionSpecificPri TruthValue,
    frwkFeedbackActionList        TagReferenceId
}

frwkFeedbackActionId OBJECT-TYPE
    SYNTAX      InstanceId
    STATUS      current
    DESCRIPTION
        "An arbitrary integer index that uniquely identifies an
        instance of the frwkFeedbackAction class."

 ::= { frwkFeedbackActionEntry 1}

frwkFeedbackActionIndicator OBJECT-TYPE
    SYNTAX      INTEGER {
        suspendMonitoringAndReports(1),
        suspendReports(2),
        resume(3),
        solicitReport(4)
    }
    STATUS      current
    DESCRIPTION
        "The value indicates if the PEP is to send cached
        usage policies via COPS accounting type report
        messages.
        The enumeration values are:
        (1) suspendMonitoringAndReports
        (2) suspendReports
        (3) resume
        (4) solicitReport "

 ::= { frwkFeedbackActionEntry 2 }

frwkFeedbackActionSpecificPri OBJECT-TYPE
    SYNTAX      TruthValue
    STATUS      current
    DESCRIPTION
        "A value of 0 indicates that the
        frwkFeedbackActionList attribute should be ignored,
        and the action applied to all policies. A value of
        1 indicates that the action entry has a specific

```

```

        list of policies to which it is to be applied."
 ::= { frwkFeedbackActionEntry 3}

frwkFeedbackActionList OBJECT-TYPE
    SYNTAX      TagReferenceId
    PIB-TAG     { frwkFeedbackActionListTag }
    STATUS      current
    DESCRIPTION
        "Identifies a group of frwkFeedbackLink instances
        that this action should affect. The group is
        identified through a tag reference in the
        frwkFeedbackList class."
 ::= { frwkFeedbackActionEntry 4}

--
-- Feedback Action List Table
--

frwkFeedbackActionListTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FrwkFeedbackActionListEntry
    PIB-ACCESS   install
    STATUS      current
    DESCRIPTION
        "This class defines groups of linkage instances.
        Groups can be referenced by commands sent by the
        PDP in a frwkFeedbackActionEntry -in this case the
        command affects all linkage instances that are part
        of the group.
        A group can be referred to by its tag stored in
        frwkFeedbackActionListTag."
 ::= { frwkFeedbackGroupClasses 2}

frwkFeedbackActionListEntry OBJECT-TYPE
    SYNTAX      FrwkFeedbackActionListEntry
    STATUS      current
    DESCRIPTION
        "Each instance associates a linkage instance with a
        specific ActionListGroup."

    PIB-INDEX {frwkFeedbackActionListId }
    UNIQUENESS { frwkFeedbackActionListTag,
                  frwkFeedbackActionListRefID
                }
 ::= { frwkFeedbackActionListTable 1}

FrwkFeedbackActionListEntry ::= SEQUENCE {
    frwkFeedbackActionListId      InstanceId,
    frwkFeedbackActionListTag     TagId,

```



```

        frwkFeedbackActionListRefID      ReferenceId
    }

frwkFeedbackActionListId OBJECT-TYPE
    SYNTAX      InstanceId
    STATUS      current
    DESCRIPTION
        "Arbitrary integer index that uniquely
        identifies an instance of the class."

    ::= { frwkFeedbackActionListEntry 1 }

frwkFeedbackActionListTag OBJECT-TYPE
    SYNTAX      TagId
    STATUS      current
    DESCRIPTION
        "Identifies a group of linkage instances that can
        be referenced from the Action class."

    ::= { frwkFeedbackActionListEntry 2 }

frwkFeedbackActionListRefID OBJECT-TYPE
    SYNTAX      ReferenceId
    PIB-REFERENCES { frwkFeedbackLinkEntry }
    STATUS      current
    DESCRIPTION
        "A frwkFeedbackLink instance that is referred to
        by this ReferenceId becomes part of the group,
        that is identified by the
        frwkFeedbackActionListTag."

    ::= { frwkFeedbackActionListEntry 3 }

--
-- The Feedback Link Capability Table
--

frwkFeedbackLinkCapsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FrwkFeedbackLinkCapsEntry
    PIB-ACCESS   notify
    STATUS      current
    DESCRIPTION
        "Instances of the frwkFeedbackLink class reference
        instances of selection and threshold classes and a
        usage class.
        This class allows the PEP to communicate valid
        combinations of these three classes to the PDP."
    ::= { frwkFeedbackGroupClasses 3}

```

```

frwkFeedbackLinkCapsEntry OBJECT-TYPE
    SYNTAX          FrwkFeedbackLinkCapsEntry
    STATUS          current
    DESCRIPTION
        "The attributes of this class identify valid
        combinations of selection criteria, usage and
        threshold classes for feedback."
    PIB-INDEX { frwkFeedbackLinkCapsId }
    UNIQUENESS {
        frwkFeedbackLinkCapsSelection,
        frwkFeedbackLinkCapsUsage,
        frwkFeedbackLinkCapsThreshold
    }

    ::= { frwkFeedbackLinkCapsTable 1}

FrwkFeedbackLinkCapsEntry ::= SEQUENCE {
    frwkFeedbackLinkCapsId      InstanceId,
    frwkFeedbackLinkCapsSelection PrcIdentifierOid,
    frwkFeedbackLinkCapsUsage    PrcIdentifierOid,
    frwkFeedbackLinkCapsThreshold PrcIdentifierOidOrZero
}

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

frwkFeedbackLinkCapsSelection OBJECT-TYPE
    SYNTAX          PrcIdentifierOid
    STATUS          current
    DESCRIPTION
        "The identifier of a class that is supported by the
        device for feedback selection in combination with the
        usage and threshold classes referenced in this
        instance."
    ::= { frwkFeedbackLinkCapsEntry 2}

frwkFeedbackLinkCapsUsage OBJECT-TYPE
    SYNTAX          PrcIdentifierOid
    STATUS          current
    DESCRIPTION
        "The identifier of the usage class that is supported by
        the PEP in combination with the selection and threshold
        classes referenced in this instance."

```

```
::= { frwkFeedbackLinkCapsEntry 3 }
```

```
frwkFeedbackLinkCapsThreshold OBJECT-TYPE
```

```
    SYNTAX      PrcIdentifierOidOrZero
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "The identifier of the threshold class that is
        supported by the PEP in combination with the selection
        and usage classes referenced in this instance.
        0.0 is used if this combination does not allow a
        threshold."
```

```
    ::= { frwkFeedbackLinkCapsEntry 4 }
```

```
--
```

```
-- The Feedback Report Linkage Table
```

```
--
```

```
frwkFeedbackLinkTable OBJECT-TYPE
```

```
    SYNTAX      SEQUENCE OF FrwkFeedbackLinkEntry
```

```
    PIB-ACCESS  install
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "This class associates the selection criteria with the
        usage policy. It also permits the defining of the max
        interval used for reporting the usage instance."
```

```
    ::= { frwkFeedbackGroupClasses 4 }
```

```
frwkFeedbackLinkEntry OBJECT-TYPE
```

```
    SYNTAX      FrwkFeedbackLinkEntry
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "This class associates the selection criteria with the
        usage policy. It also permits the defining of the max
        interval used for reporting the usage instance."
```

```
    PIB-INDEX { frwkFeedbackLinkId }
```

```
    UNIQUENESS { frwkFeedbackLinkSel,
                  frwkFeedbackLinkUsage }
```

```
    ::= { frwkFeedbackLinkTable 1 }
```

```
FrwkFeedbackLinkEntry ::= SEQUENCE {
```

```
    frwkFeedbackLinkId      InstanceId,
```

```
    frwkFeedbackLinkSel     Prid,
```

```
    frwkFeedbackLinkUsage   PrcIdentifierOid,
```

```
    frwkFeedbackLinkInterval Integer32,
```

```
    frwkFeedbackLinkThreshold Prid,
```

```
    frwkFeedbackLinkFlags   BITS
```

```
}

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

frwkFeedbackLinkSel OBJECT-TYPE
    SYNTAX      PrId
    STATUS      current
    DESCRIPTION
        "The PRID of the Policy Class instance as the monitoring
         point, or the PRID of the selection criteria instance that
         defines the conditions for monitoring, to be use by the
         PEP for usage reporting."

    ::= { frwkFeedbackLinkEntry 2}

frwkFeedbackLinkUsage OBJECT-TYPE
    SYNTAX      PrcIdentifierOid
    STATUS      current
    DESCRIPTION
        "The identifier of the usage class that the PEP uses to
         monitor, record and report."

    ::= { frwkFeedbackLinkEntry 3}

frwkFeedbackLinkInterval OBJECT-TYPE
    SYNTAX      Integer32
    STATUS      current
    DESCRIPTION
        "Maximum interval in units of the value of the
         Accounting Timer specified by the PDP in the client
         accept message. A frwkFeedbackLinkInterval of 1 is
         equal to the value of the Accounting Timer. This value
         must be 1 or greater. "

    ::= { frwkFeedbackLinkEntry 4}

frwkFeedbackLinkThreshold OBJECT-TYPE
    SYNTAX      PrId
    STATUS      current
    DESCRIPTION
        "The PRID of a threshold class instance. This instance
         specifies the threshold values for the usage policy."
```

```

 ::= { frwkFeedbackLinkEntry 5}

frwkFeedbackLinkFlags OBJECT-TYPE
    SYNTAX      BITS {
                                periodic(0),
                                threshold(1),
                                changeOnly(2)
                        }
    STATUS      current
    DESCRIPTION
        "This value indicates the reporting basis of the usage
        policy. The feed back may be generated on demand, on a
        periodic basis regardless of a change in value from the
        previous report, on a periodic basis if a change in
        value has occurred, or the usage is reported when an
        identified threshold value in the usage instance has
        been reached.
        If the 'periodic' flag is set, the PEP will provide
        unsolicited reports at the rate specified in
        frwkFeedbackLinkInterval.
        If the 'periodic' flag is not set, reports will only be
        generated when solicited by the PDP.
        The 'threshold' and 'changeOnly' flags make the
        periodic reports conditional - these flags only make
        sense in combination with the 'periodic' flag."

 ::= { frwkFeedbackLinkEntry 6}

```

```
--
```

```
-- The Threshold class that accompanies the above Usage PRCs
```

```
--
```

```

frwkFeedbackTrafficThresTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FrwkFeedbackTrafficThresEntry
    PIB-ACCESS   install
    STATUS      current
    DESCRIPTION
        "This class defines the threshold attributes
        corresponding to usage attributes specified in
        frwkFeedbackTrafficTable, frwkFeedbackIfTrafficTable
        and other similar usage classes.

        The usage object is considered to match the threshold
        condition if at least one of the packet or byte
        threshold conditions match.

        The byte and packet thresholds are considered to
        match, if the threshold is present (not ASN1 NULL)"

```

and the corresponding usage value exceeds the threshold."

```
::= { frwkFeedbackGroupClasses 5 }
```

```
frwkFeedbackTrafficThresEntry OBJECT-TYPE
    SYNTAX          FrwkFeedbackTrafficThresEntry
    STATUS          current
    DESCRIPTION
        "Defines the attributes to hold threshold values."
    PIB-INDEX {frwkFeedbackTrafficThresId}
```

```
::= { frwkFeedbackTrafficThresTable 1 }
```

```
FrwkFeedbackTrafficThresEntry ::= SEQUENCE {
    frwkFeedbackTrafficThresId          InstanceId,
    frwkFeedbackTrafficThresPackets    Unsigned64,
    frwkFeedbackTrafficThresBytes      Unsigned64
}
```

```
frwkFeedbackTrafficThresId OBJECT-TYPE
    SYNTAX          InstanceId
    STATUS          current
    DESCRIPTION
        "Arbitrary integer index that uniquely identifies
         an instance of the class."
    ::= { frwkFeedbackTrafficThresEntry 1 }
```

```
frwkFeedbackTrafficThresPackets OBJECT-TYPE
    SYNTAX          Unsigned64
    STATUS          current
    DESCRIPTION
        "The threshold, in terms of packets, that must be
         matched or exceeded to trigger a report in the
         next reporting interval."
    ::= { frwkFeedbackTrafficThresEntry 2 }
```

```
frwkFeedbackTrafficThresBytes OBJECT-TYPE
    SYNTAX          Unsigned64
    STATUS          current
    DESCRIPTION
        "The threshold, in terms of bytes, that must be
         exceeded to trigger a report in the next reporting
         interval."
    ::= { frwkFeedbackTrafficThresEntry 3 }
```

--

```

-- All actual usage classes are in the separate
-- frwkFeedbackUsageClasses group
--

frwkFeedbackUsageClasses
  OBJECT IDENTIFIER ::= { frwkFeedbackPib 2 }

--
-- The generic traffic (byte & packet count) usage class
--

frwkFeedbackTrafficTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF FrwkFeedbackTrafficEntry
    PIB-ACCESS      report-only
    STATUS          current
    DESCRIPTION
        "This class defines the usage attributes that the PEP
        is to monitor for plain traffic handling elements
        like filters. All packets and the bytes contained in
        these packets are counted. It also contains the PRID
        of the linkage instance associating the selection
        criteria instance with the usage instance."

    ::= { frwkFeedbackUsageClasses 1}

frwkFeedbackTrafficEntry OBJECT-TYPE
    SYNTAX          FrwkFeedbackTrafficEntry
    STATUS          current
    DESCRIPTION
        "Defines the attributes the PEP is to monitor,
        record and report."
    PIB-INDEX {frwkFeedbackTrafficId}
    UNIQUENESS { frwkFeedbackTrafficLinkRefID }

    ::= {frwkFeedbackTrafficTable 1}

FrwkFeedbackTrafficEntry ::= SEQUENCE {
    frwkFeedbackTrafficId          InstanceId,
    frwkFeedbackTrafficLinkRefID   ReferenceId,
    frwkFeedbackTrafficPacketCount Usage64,
    frwkFeedbackTrafficByteCount   Usage64
}

frwkFeedbackTrafficId OBJECT-TYPE
    SYNTAX          InstanceId
    STATUS          current

```

DESCRIPTION

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

::= { frwkFeedbackTrafficEntry 1 }

frwkFeedbackTrafficLinkRefID OBJECT-TYPE

SYNTAX ReferenceId

PIB-REFERENCES { frwkFeedbackLinkEntry }

STATUS current

DESCRIPTION

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

::= { frwkFeedbackTrafficEntry 2 }

frwkFeedbackTrafficPacketCount OBJECT-TYPE

SYNTAX Usage64

STATUS current

DESCRIPTION

"The count of packets handled by the associated element. The initial value of 0 is set when the frwkFeedbackTraffic instance is created, for example triggered through the creation of a frwkFeedbackLink instance."

::= { frwkFeedbackTrafficEntry 3 }

frwkFeedbackTrafficByteCount OBJECT-TYPE

SYNTAX Usage64

STATUS current

DESCRIPTION

"The byte count of packets handled by the associated element. The initial value of 0 is set when the frwkFeedbackTraffic instance is created."

::= { frwkFeedbackTrafficEntry 4 }

--

-- The traffic usage class, qualified for an interface

--

frwkFeedbackIfTrafficTable OBJECT-TYPE

SYNTAX SEQUENCE OF FrwkFeedbackIfTrafficEntry

PIB-ACCESS report-only

STATUS current

DESCRIPTION

"A usage class similar to the basic Traffic class that also contains a reference to an interface index. This

class should be used with an underspecified selection criteria entry from the frwkRoleComboTable that matches an element that can be assigned to multiple interface indices. The interface field can be used to associate the instances of this class with the specific element's assignment."

```

::= { frwkFeedbackUsageClasses 2 }

frwkFeedbackIfTrafficEntry OBJECT-TYPE
    SYNTAX          FrwkFeedbackIfTrafficEntry
    STATUS          current
    DESCRIPTION
        "Defines the attributes the PEP is to monitor,
        record and report."
    PIB-INDEX {frwkFeedbackIfTrafficId}
    UNIQUENESS { frwkFeedbackIfTrafficLinkRefID,
                 frwkFeedbackIfTrafficIfIndex }

    ::= { frwkFeedbackIfTrafficTable 1}

FrwkFeedbackIfTrafficEntry ::= SEQUENCE {
    frwkFeedbackIfTrafficId          InstanceId,
    frwkFeedbackIfTrafficLinkRefID   ReferenceId,
    frwkFeedbackIfTrafficIfIndex     InterfaceIndex,
    frwkFeedbackIfTrafficPacketCount Usage64,
    frwkFeedbackIfTrafficByteCount   Usage64
}

frwkFeedbackIfTrafficId OBJECT-TYPE
    SYNTAX          InstanceId
    STATUS          current
    DESCRIPTION
        "Arbitrary integer index that uniquely identifies
        an instance of the class."
    ::= { frwkFeedbackIfTrafficEntry 1 }

frwkFeedbackIfTrafficLinkRefID OBJECT-TYPE
    SYNTAX          ReferenceId
    PIB-REFERENCES { frwkFeedbackLinkEntry }
    STATUS          current
    DESCRIPTION
        "The ReferenceId of the Linkage policy instance used
        to base this usage policy instance upon."
    ::= { frwkFeedbackIfTrafficEntry 2 }

frwkFeedbackIfTrafficIfIndex OBJECT-TYPE
    SYNTAX          InterfaceIndex

```

```

        STATUS          current
        DESCRIPTION
            "The value of this attribute is the ifIndex which is
            associated with the specified RoleCombination and
            interface capability set name."

        ::= { frwkFeedbackIfTrafficEntry 3 }

frwkFeedbackIfTrafficPacketCount OBJECT-TYPE
    SYNTAX          Usage64
    STATUS          current
    DESCRIPTION
        "The count of packets handled by the associated
        element. The initial value of 0 is set when the
        frwkFeedbackIfTraffic instance is created."
    ::= { frwkFeedbackIfTrafficEntry 4 }

frwkFeedbackIfTrafficByteCount OBJECT-TYPE
    SYNTAX          Usage64
    STATUS          current
    DESCRIPTION
        "The byte count of packets handled by the associated
        element. The initial value of 0 is set when the
        frwkFeedbackIfTraffic instance is created."
    ::= { frwkFeedbackIfTrafficEntry 5 }

--
-- All Selection classes are in the separate
-- FrwkFeedbackSelectionClasses group
--

frwkFeedbackSelectionClasses
    OBJECT IDENTIFIER ::= { frwkFeedbackPib 3 }

--
-- The Role Combination Filter Selection Table
--

frwkFeedbackRoleFilterSelTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF FrwkFeedbackRoleFilterSelEntry
    PIB-ACCESS      install
    STATUS          current
    DESCRIPTION
        "A selection class that defines selection of objects
        for monitoring based on the role combination,
        capability set and a filter."
    ::= { frwkFeedbackSelectionClasses 1 }

```

```

frwkFeedbackRoleFilterSelEntry OBJECT-TYPE
    SYNTAX          FrwkFeedbackRoleFilterSelEntry
    STATUS          current
    DESCRIPTION
        "Each instance selects a filter on multiple interfaces
        that share the same frwkRoleCombo instance."
    PIB-INDEX { frwkFeedbackRoleFilterSelId }
    UNIQUENESS { frwkFeedbackRoleFilterSelRCombo,
                  frwkFeedbackRoleFilterSelFilter
                  }

    ::= { frwkFeedbackRoleFilterSelTable 1 }

FrwkFeedbackRoleFilterSelEntry ::= SEQUENCE {
    frwkFeedbackRoleFilterSelId      InstanceId,
    frwkFeedbackRoleFilterSelRCombo  ReferenceId,
    frwkFeedbackRoleFilterSelFilter  Prid
}

frwkFeedbackRoleFilterSelId  OBJECT-TYPE
    SYNTAX          InstanceId
    STATUS          current
    DESCRIPTION
        "Arbitrary integer index that uniquely identifies
        an instance of the class."
    ::= { frwkFeedbackRoleFilterSelEntry 1 }

frwkFeedbackRoleFilterSelRCombo  OBJECT-TYPE
    SYNTAX          ReferenceId
    PIB-REFERENCES { frwkRoleComboEntry }
    STATUS          current
    DESCRIPTION
        "The ReferenceId of the frwkRoleComboTable policy
        instance used for selection."
    ::= { frwkFeedbackRoleFilterSelEntry 2 }

frwkFeedbackRoleFilterSelFilter  OBJECT-TYPE
    SYNTAX          Prid
    STATUS          current
    DESCRIPTION
        "The identifier of a filter instance. Valid classes
        are the subclasses of frwkBaseFilter:
        - frwkIpFilter
        - frwk802Filter
        - frwkILabelFilter"
    ::= { frwkFeedbackRoleFilterSelEntry 3 }

```

```
--
-- Compliance Section
--

frwkFeedbackPibConformance
    OBJECT IDENTIFIER ::= { frwkFeedbackPib 4 }

frwkFeedbackPibCompliances
    OBJECT IDENTIFIER ::= { frwkFeedbackPibConformance 1 }

frwkFeedbackPibGroups
    OBJECT IDENTIFIER ::= { frwkFeedbackPibConformance 2 }

frwkFeedbackPibCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "Describes the requirements for conformance to the feedback
        framework PIB"

    MODULE -- this module
        MANDATORY-GROUPS { frwkFeedbackLinkCapsGroup,
                           frwkFeedbackLinkGroup,
                           frwkFeedbackActionGroup }

    GROUP frwkFeedbackActionListGroup
        DESCRIPTION
            "The frwkFeedbackActionListGroup is mandatory if
            actions on subsets linkEntries are to be
            supported."

    GROUP frwkFeedbackTrafficGroup
        DESCRIPTION
            "The frwkFeedbackTrafficGroup is mandatory if
            monitoring of traffic data is to be supported."

    GROUP frwkFeedbackTrafficThresGroup
        DESCRIPTION
            "The frwkFeedbackTrafficThresGroup is mandatory
            if conditional reporting of traffic usage
            thresholds is to be supported."

    GROUP frwkFeedbackIfTrafficGroup
        DESCRIPTION
            "The frwkFeedbackIfTrafficGroup is mandatory if
            per-interface usage collection of traffic data is
            to be supported."
```

```

GROUP frwkFeedbackRoleFilterSelGroup
  DESCRIPTION
    "The frwkFeedbackRoleFilterSelGroup is mandatory
    if monitoring of filters referenced through the
    frwkRoleCombo class is to be supported."

  ::= { frwkFeedbackPibCompliances 1 }

frwkFeedbackLinkCapsGroup OBJECT-GROUP
  OBJECTS {
    frwkFeedbackLinkCapsId,
    frwkFeedbackLinkCapsSelection,
    frwkFeedbackLinkCapsUsage,
    frwkFeedbackLinkCapsThreshold }
  STATUS current
  DESCRIPTION
    "Objects from the frwkFeedbackLinkCapsTable."

  ::= { frwkFeedbackPibGroups 1 }

frwkFeedbackLinkGroup OBJECT-GROUP
  OBJECTS {
    frwkFeedbackLinkId,
    frwkFeedbackLinkSel,
    frwkFeedbackLinkUsage,
    frwkFeedbackLinkInterval,
    frwkFeedbackLinkThreshold,
    frwkFeedbackLinkFlags }
  STATUS current
  DESCRIPTION
    "Objects from the frwkFeedbackLinkTable."

  ::= { frwkFeedbackPibGroups 2 }

frwkFeedbackActionGroup OBJECT-GROUP
  OBJECTS {
    frwkFeedbackActionId,
    frwkFeedbackActionIndicator,
    frwkFeedbackActionSpecificPri,
    frwkFeedbackActionList }
  STATUS current
  DESCRIPTION
    "Objects from the frwkFeedbackActionTable."

  ::= { frwkFeedbackPibGroups 3 }

frwkFeedbackActionListGroup OBJECT-GROUP
  OBJECTS {

```

```
        frwkFeedbackActionListId,
        frwkFeedbackActionListTag,
        frwkFeedbackActionListRefID }
STATUS    current
DESCRIPTION
    "Objects from the frwkFeedbackActionListTable."

::= { frwkFeedbackPibGroups 4 }

frwkFeedbackTrafficGroup OBJECT-GROUP
OBJECTS {
    frwkFeedbackTrafficId,
    frwkFeedbackTrafficLinkRefID,
    frwkFeedbackTrafficPacketCount,
    frwkFeedbackTrafficByteCount }
STATUS    current
DESCRIPTION
    "Objects from the frwkFeedbackTrafficTable."

::= { frwkFeedbackPibGroups 5 }

frwkFeedbackTrafficThresGroup OBJECT-GROUP
OBJECTS {
    frwkFeedbackTrafficThresId,
    frwkFeedbackTrafficThresPackets,
    frwkFeedbackTrafficThresBytes }
STATUS    current
DESCRIPTION
    "Objects from the frwkFeedbackTrafficThresTable."

::= { frwkFeedbackPibGroups 6 }

frwkFeedbackIfTrafficGroup OBJECT-GROUP
OBJECTS {
    frwkFeedbackIfTrafficId,
    frwkFeedbackIfTrafficLinkRefID,
    frwkFeedbackIfTrafficIfIndex,
    frwkFeedbackIfTrafficPacketCount,
    frwkFeedbackIfTrafficByteCount }
STATUS    current
DESCRIPTION
    "Objects from the frwkFeedbackIfTrafficTable."

::= { frwkFeedbackPibGroups 7 }

frwkFeedbackRoleFilterSelGroup OBJECT-GROUP
OBJECTS {
    frwkFeedbackRoleFilterSelId,
```

```
        frwkFeedbackRoleFilterSelRCombo,  
        frwkFeedbackRoleFilterSelFilter }  
STATUS    current  
DESCRIPTION  
    "Objects from the frwkFeedbackRoleFilterSelTable."  
  
 ::= { frwkFeedbackPibGroups 8 }
```

END

5. Security Considerations

This PIB defines structured information that may be sensitive when transported by the COPS protocol [COPS-PR].

This PIB does not contain classes that directly contain security relevant information like passwords or monetary amounts. However, unauthorized access or changes to information defined in this PIB could compromise network operations or reveal sensitive business or personal information.

Specifically for the classes:

`frwkFeedbackLinkCaps`

This class has the ACCESS clause 'notify'. Access to this information reveals feedback collection capabilities of the COPS client and malicious changes could affect feedback operation by misleading the server to generate corrupt feedback configuration.

`frwkFeedbackLinkTable`, `frwkFeedbackAction`, `frwkFeedbackActionList`,
`frwkFeedbackTrafficThres`, `frwkFeedbackRoleFilterSel`

These classes have the ACCESS clause 'install' and allow the COPS server to control feedback collection and reporting on the client. Access to this information exposes the client's configuration; malicious changes could disrupt network or business operations and raise privacy issues.

`frwkFeedbackTraffic`, `frwkFeedbackIfTraffic`

These classes have the ACCESS clause 'report-only' and contain the usage information delivered from the COPS client to the server. Unauthorized access to this information may reveal detailed information on the network and its users. Malicious changes may affect network and business operations.

[COPS] and [COPS-PR] define mechanisms to secure the COPS protocol communication and implementations of COPS servers or clients supporting this PIB MUST follow the security guidelines specified there.

6. IANA Considerations

This document describes the frwkFeedbackPib Policy Information Base (PIB) module for registration under the "pib" branch registered with IANA. The IANA has assigned PIB number 5.

This PIB uses "all" in the SUBJECT-CATEGORY clause, so it applies to all COPS client types. No new COPS client type is requested for this PIB.

7. Acknowledgements

The authors would like to thank Dave Durham, Ravi Sahita, and Russell Fenger of Intel and John K. Gallant of WorldCom for their contribution to this document.

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