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S. Hares
Q. Wu
Huawei
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An Information Model for Basic Network Policy
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Abstract

This document contains three information Models: Basic Network Policy (BNP IM), Policy-Based Routing (PBR), I2RS Local-Config (I2RS-LC IM). The I2RRS-LC IM provides both an I2RS store of Policies plus a store of Policy Templates. The BNP IM has the following levels of Policy Hierarchy: Policy Set, Policy Group, Policy Rule, and conditional actions within the policy rule (conditional match and Action). The PBR IM, I2RS LC IM, BGP Information Model (BGP IM), Service Topology Information Model (SF-Topo IM), and the Service Forwarding Chaining IM (SFC IM) utilize and extend the BNP IM. This draft lists the extensions to the BNP IM that support these information models (PBR IM, I2RS LC IM, BGP IM, SSF-Topo IM and SFC-Policy IM).

The BNP IM is based on the concept of an extensible information model for representing policies. This concept is also found in the Policy Core Information Model (PCIM) ([RFC3060](#)) and the Quality of Service (QoS) Policy Information Model (QPIM) ([RFC3644](#)) and policy based routing.

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[1.](#) Introduction

The Interface to the Routing System (I2RS) provides read and write access to the information and state within the routing process within routing elements. The I2RS client interacts with one or more I2RS agents to collect information from network routing systems.

Processing of collected information at the I2RS agent may require the I2RS Agent to filter certain information or group pieces of information in order to reduce the data flow through the network to the I2RS client. Some applications that that utilize the services of I2RS client may also wish to require specific data in response to network events or conditions based on pre-established rules. This functionality is necessary to meet the requirements of i2rs enabled services which include service-layer routing improvements, and control of traffic flows and exit points.

This document introduces a Basic Network Policy information model (BNP IM) to handle policies related to the network. This basic policy model can be easily extended beyond the basic functions. The [\[I-D.ietf-i2rs-architecture\]](#) suggests that associated with the i2RS RIB model there will be "Policy-based Routing (ACLs)" and RIB "policy controls". These basic policy functions can operate as part of this functional blocks providing the basic model for policy operators. This model can also be considered as the substance of the policy templates.

The BNP IM is extensible allowing other extensions to make the BNP IM policy adaptable to specific I2RS protocol features. This policy model can be linked with other information models such as the following:

- o Policy Base Routing Information model (PBR-IM) (Model in [section 4](#)),
- o I2RS RIB Informational Model (RIB IM) (see [section 6](#)) ([\[I-D.ietf-i2rs-rib-info-model\]](#))
- o BGP Informational Model (BGP IM) (see [section 6](#)) ([\[I-D.hares-i2rs-bgp-im\]](#))
- o Service Topology (see [section 6](#)) ([\[I-D.hares-i2rs-info-model-service-topo\]](#))

- o Service Forwarding Chaining Filters Information Mode (SFC IM) (see [section 6](#)) ([ietf-hares-dunbar-i2rs-sfc-policy-im-00.txt](#))

The BNP IM model is a product of the industry approach to I2RS that standardizes on a few basic functions network functions to obtain quick deployment of initial I2RS RIB modules, and build on this success to create network functions. Additional I2RS modules add I2RS interfaces to policy-based routing, BGP, Service topology creation, Service Chaining functions, and policy templates.

This information model leverages previous work done on extensible information model for representing policies, for example, the Policy Core Information Model (PCIM) [[RFC3060](#)] [[RFC3060](#)], and an extension to this model to address the need for QoS management, called the Quality of Service (QoS) Policy Information Model (QPIM) [[RFC3644](#)] [[RFC3644](#)].

Most policy within routing and forwarding systems has become hierarchical with individual specific policies being grouped as a set policy. The hierarchical policy rule definition enhances policy readability and reusability. Groups of network policies have labels to aid operational use. Named groups of policy are easily identified and reused as blocks.

The Basic Network Policy information model contains the following three components:

Policy Group

Policy is described by a set of policy rules that may be grouped into subsets. A Policy group is used to provide a hierarchical policy definition that provides the model context or scope for sub-rule actions. The model context includes identity, scope, role, precedence, priority and security model. In a policy group policy rules and policy groups can be nested within other policy rules.

Policy Set

is a set of Policy Groups identified by a Policy Set Name.

Policy Rule

Policy Rule is represented by semantics "If Condition then Action", therefore condition and action comprise Policy Rule model.

This draft contains the following Informational Models

Basic Network-Policy Information Model (BNP IM)

is generic network policy model. It can be thought of as a coherent set of rules to administer, manage, and control access to network resources and defines a network policy at its most general level of abstraction. It models aspects such as actions and conditions that constitute a policy element relationship, as well as operators contained in the both condition and action that can either be used to overwrite an old value of the variable or imply match relationship.

Policy Based Routing Information Model (PBR IM)

defines information that allows the network administrator to forward the packet based on other criteria than the destination address in the packet.

I2RS Local Config Information Model (I2RS-LC IM)

defines I2RS Local Configuration database kept in the I2RS Agent that can be leveraged to quickly set-up policies via the I2RS Agent. This local configuration store contains basic network

policies and network templates, and provides quick local access to polies rather than transfer the policies down from the I2RS Client prior to enacting a policy via I2RS interface.

[2.](#) Definitions and Acronyms

IGP: Interior Gateway Protocol

Information Model: An abstract model of a conceptual domain, independent of a specific implementations or data representation

CLI: Command Line Interface

SNMP: The Simple Network Management Protocol

NETCONF: The Network Configuration Protocol

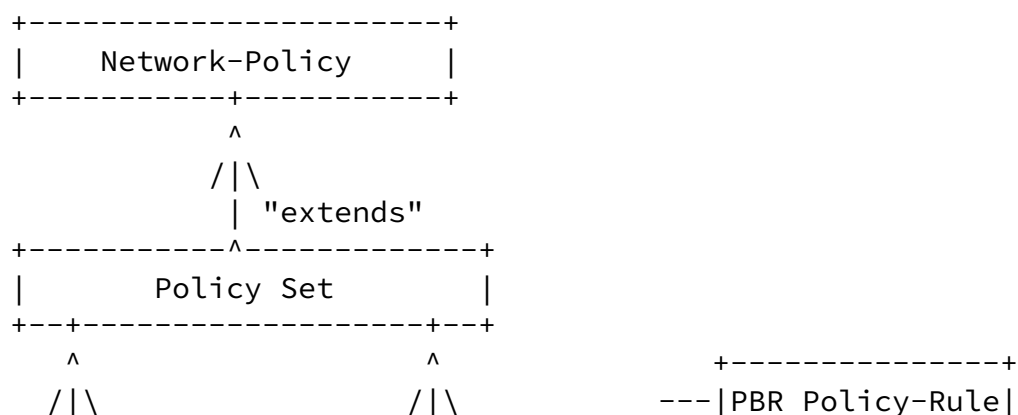
RBNF: Routing Backus-Naur Form

[3.](#) Basic Network Policy Information Model (BNP IM)

[3.1.](#) BNP IM Overview

I2RS needs its own implicit and explicit policy. This section provides an overview of the network policy model. The network policy

model is defined by the following components, whose relationship is roughly depicted in the figure below.



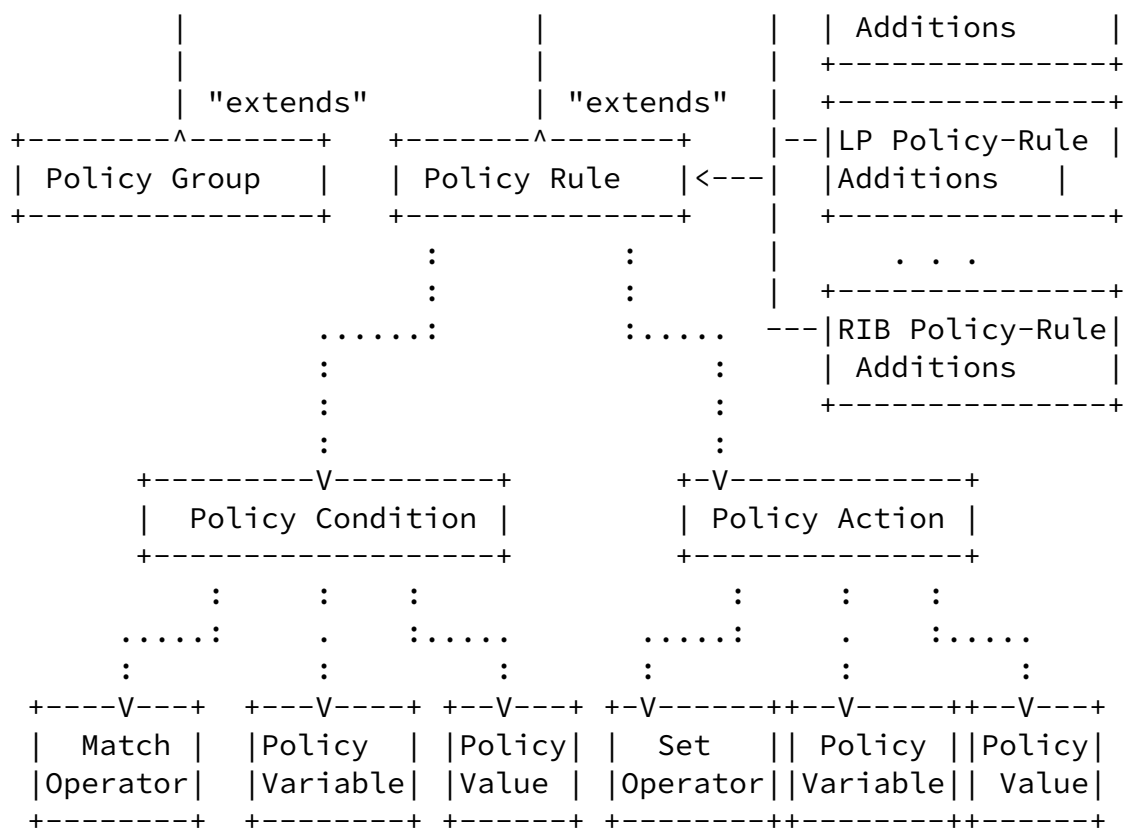


Figure 1: Overall model BNP IM structure

Network_policy - contains sets of policies.

Policy-Set - is introduced to provide an abstraction for a set of rules. it is inserted into the inheritance hierarchy above both Policy-Group and Policy-Rule.

Policy-Group -defines the basic network policy Group model which combines the a list of Policy-Rules.

Policy Rule is represented by semantics "If Condition then Action", therefore condition and action comprise Policy Rule model.

- o Condition models the elementary match operation "<variable> match <value>".
- o Action models the elementary set operation. "SET <variable> TO <value>".

In Condition model, the 'Match' operator is usually implied while in the action model, the 'Set operator is explicitly used.

Policy-Sets, Policy-Groups, and Policy-Rules have basic functionality (Policy-Basic IM) plus extensions defined by specific Information Models such as:

- the PBR Information Model (PBR IM) (contained in this document),

- the I2RS_Local_Policy Model (LP IM) (contained in this document),

- the RIB Information Model (RIB IM)
([[I-D.ietf-i2rs-rib-info-model](#)]),

- the BGP Information Model (BGP-IM) ([[I-D.hares-i2rs-bgp-im](#)]),

- the Traffic Steering Information Model
([[I-D.hares-i2rs-info-model-service-topo](#)]),

- the SFC Information Model (SFC IM) (ietf-hares-dunbar-i2rs-sfc-policy-im-00.txt)

- the MPLS LDP Information Model (MPLS LDP IM) as templates for policy.

I2RS Client-Agents Information Models MAY support only the Policy-Basic IM, or MAY support any additional specific information models.

Each level of the Policy hierarchy (Policy-Set, Policy-Group, and Policy-Rules have both a read and write scope

[3.2.](#) The Policy Set

[3.2.1.](#) Policy Set Overview

The PolicySet structure has the following elements:

- o Policy-Set_Name - Unique Name for Policy Set

- o Policy-Group is introduced to provide an abstraction for a set of

rules. It is derived from Policy, and it is inserted into the inheritance hierarchy above both PolicyGroup and PolicyRule. This reflects the additional structural flexibility and semantic capability of both subclasses.

[3.2.2.](#) Policy-Set RBNF

Figure 2 – Policy Set RBNF

```
<Network_policy> ::= (<Policy_Set> ...)
<Policy-Set> ::= <Policy-Set-Name>

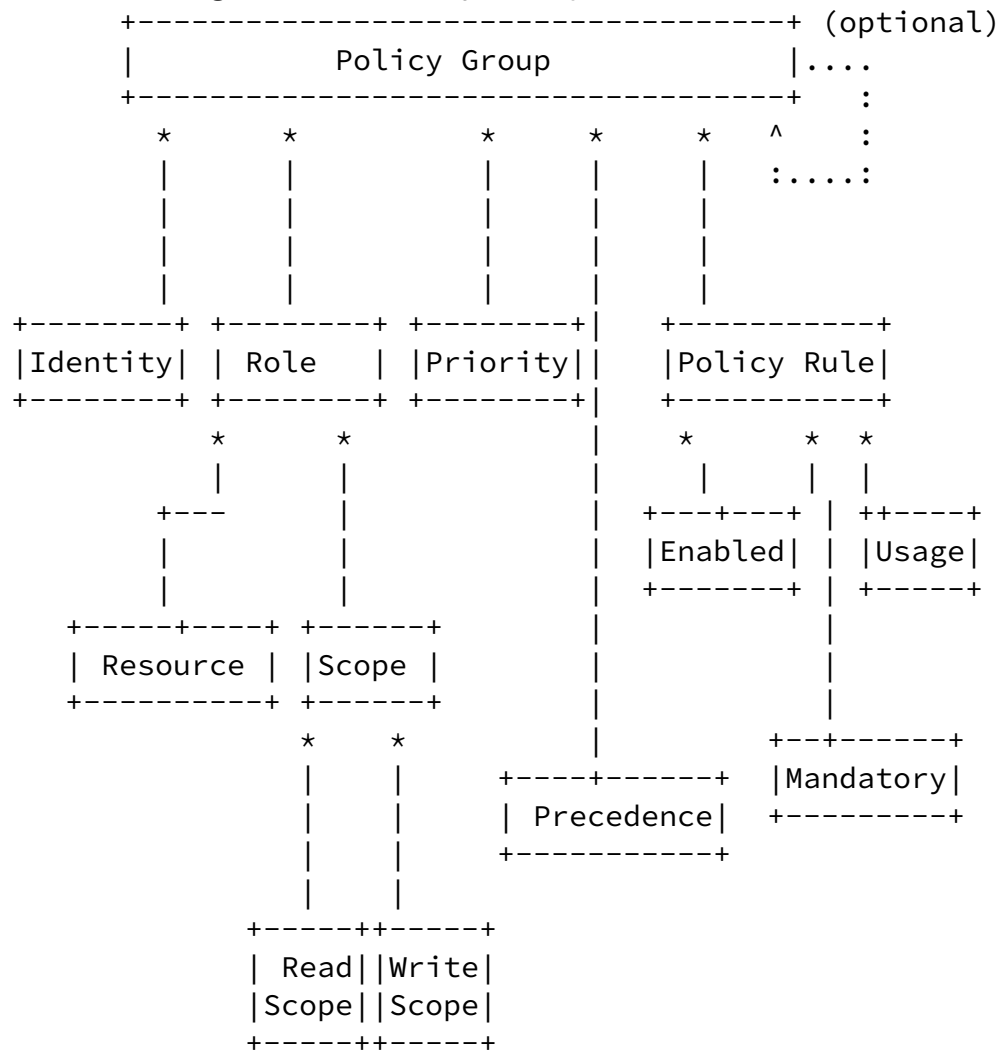
<Policy-Group_list> ::=
    (<Policy-Group> ...)
    (<Policy-Rule> ...)
    (<local_Config>)
    (<PBR_rule>)
```

[3.3.](#) The Policy Group

[3.3.1.](#) Policy Group Overview

In order to provide hierarchical policy definition and associate policy rule with other constraint, the basic policy group model needs to be defined. The corresponding extensions are introduced in a component, whose structure is informally depicted in the following diagram.

Figure 3 - Policy Group



The basic information model works as follows: Within the policy group information model, hierarchy is used to model context or scope for the sub-rule actions. A policy group contains Identity, scope, priority, precedence, and policy rule. Optionally, the policy group can contain a list of policy groups.

The elements of the Policy Group information model are as follows:

- o Each policy group is captured in its own list, distinguished via a identity, role, priority, precedence.
- o A policy group has a certain role, such as resource or scope. A policy group can even have multiple roles simultaneously. The role, are captured in the list of "role" component.
- o A policy role has a certain Scope, such as read scope or write

scope. A policy group can even have multiple scope

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simultaneously. The scope, or scopes, are captured in the list of "scope" components.

- o A policy has a certain priority, such as priority 0-255. A policy can only have one priority. The priority is captured in the list of "priority" component.
- o A policy rule can inherit properties (e.g., identity, role, priority, precedence) from policy group. A policy rule also can have its own properties, e.g., enabled, mandatory, usage.
- o The policy, policy group elements can be extended with policy-specific components (policy-extensions, policy-group-extension respectively).

[3.3.2.](#) Policy-Group RBNF

A more formal depiction in RBNF format follows below

Figure 4 - Policy-Group RBNF

```
<Policy-Group> ::= <Policy-Group_Identity>
                  <Policy-Group_Roles>
                  <Policy-Group_priority>
                  <Policy-Group_precedence>
                  (<Policy-Rule-list>)
                  [<Supporting-Policy-Group>]
                  [<Policy-Group-Extension>]

<Policy-Group_Identity> ::= <Policy-Group-Name>
                           [<Policy-Group-Secure-Identity>]
<Policy-Group-priority> ::= INTEGER (0..255);
<Policy-Group-precedence> ::= INTEGER (0..250);
<Policy-Rule-list> ::= ((<Policy-Rule> <Policy-Rule-Status>) ...)

<Policy-Rule-Status> ::= <POLICY-RULE-ENABLE>
                       [<POLICY-RULE-MANDATORY>]
                       [<Policy-Rule_usage>]
```

```

<Policy-Rule_usage> ::= <Policy-Rule-REFCNT>

<Policy-Group-Roles> ::= (<Policy-Group-Role> ...)
<Policy-Group-Role> ::= <Node-RESOURCES> | <Policy-Group-Scope>
<Node-RESOURCES> ::= [<I2RS_AGENT_RESOURCE>]

<Policy-Group-Scope> ::= (<READ_SCOPE> <Policy-Group_Read_Scope>)
                        | (<WRITE_SCOPE> <Policy-Group_Write_Scope>)

```

```

<Policy-Group_Read_Scope> ::= <Policy-Group_Read_Scope_Type>
                              [<RIB-IM_READ_list>]
                              [<BGP-IM-READ_list>]

<Policy-Group_Read_Scope_Type> ::= <RIB-IM_READ_SCOPE_TYPE>
                                   | <BGP-IM_READ_SCOPE_TYPE>

<Policy-Group_Write_Scope> ::= <Policy-Group_Write_Scope_Type>
                              [<RIB-IM_WRITE_list>]
                              [<BGP-IM-WRITE_list>]

<Policy-Group_Write_Scope_Type> ::= <RIB-IM_WRITE_SCOPE_TYPE>
                                   | <BGP-IM_WRITE_SCOPE_TYPE>

<Supporting-Policy-Group> ::= <SUPPORT-POLICY-GROUP> (
                              <Policy-Group> ...)

<Policy-Group-Extension> ::= ... /* Vendor Specific Policy */

```

[3.4.](#) The Policy Rule

[3.4.1.](#) Policy-Rule Overview

The following diagram contains an informal graphical depiction of the main elements of the information model:

Figure 5 - Policy Rule

+-----+

```

      |   Policy Rule   |<...
      +-----+
      *               *   :   :
      |               |   :   :
      |               |   :...:
      +-----+       +-----+
...>|Condition|<.....| Action |<...
:   +-----+<.....+-----+   :
:   :   *               *   :   :
:..... |               :   :... :
      |               :
      +-----+.....:
      |Operator|
      +-----+

```

Roughly speaking, the basic information model works as follows: A policy rule contains conditions and actions. Each condition or each action in turn contains operator. A operator connects variable and value in the action or condition. Condition can map onto and be supported by other condition, while action can map onto and be supported by other actions. Policy rule can map onto other, policy rules.

The elements of the Policy Rule information model are as follows:

- o A policy can in turn be part of a hierarchy of policies, building on top of other policies. Each policy is captured in its own level, distinguished via a policy-identity.
- o Policy rule inherit scope from policy group. A policy rule has a certain Scope, such as read scope or write scope. A policy rule can even have multiple scope simultaneously. The scope, or scopes, are captured in the list of "scope" components.
- o Furthermore, a policy rule contains conditions and actions, each captured in their own list.
- o A condition contains a variable and a value and use a match operator, to connect variable with value. An examples of an operator might be a " IP ADDRESS AS RESOLVED BYDNS" or "Set to a

member". Also, a condition can in turn map onto other condition in an underlay policy. This is captured in list "supporting-condition".

- o An action contains a variable and a value. An action uses Set operator to connect variable with value. Analogous to a node, an action can in turn map onto other actions in an underlay policy. This is captured in list "supporting-action".
- o The policy, condition, action and operator elements can be extended with policy-specific components (policy-extensions, condition-extension, action-extension and operator-extension respectively).

[3.4.2.](#) Policy-Rule RBNF

The information model for the Network-policy component is more formally shown in RBNF below:

Figure 6 Policy Rule RBNF

```
<Policy-Rule> ::= <Policy-Rule_identity>
                  <Policy-Rule_priority>
```

```
<Policy-Rule_precedence>
<Policy-Rule_Roles>
(<Policy-Rule_Condition>
<Policy-Rule_Action> ...)
<Policy-Rule_Security_model>
[<Policy-Rule_rule_extensions>]

<Policy-Rule_identity> ::= <Policy-Rule-Name>
                           [<Policy-Rule-Secure-Identity>]
<Policy-Rule_priority> ::= INTEGER (0..250);
<Policy-Rule_precedence> ::= INTEGER (0..250);

<Policy-Rule_Roles> ::= (<Policy_Rule_Role> ...);
<Policy-Rule_Role> ::= <RESOURCES> |
                      <Policy_Rule_Scope>

<RESOURCES> ::= [<I2RS_AGENT_RESOURCE>]
<Policy-Rule_Scope> ::= (<READ_SCOPE>
```

```

        <Policy-Rule_Read_scope>
    | (<WRITE_SCOPE>
        <Policy-Rule_Write_scope>)

<Policy-Rule_Read_scope> ::= ((<BNP_READ_SCOPE_TYPE>
                                <BNP_READ_SCOPE_list>) ...)
    | [<Policy-Rule_Read_Scope_External>]

<Policy-Rule_Write_scope> ::= ((<BNP_WRITE_SCOPE_TYPE>
                                <BNP_WRITE_SCOPE_list>)...)
    [<Policy-Rule_Write_Scope_External>]

<Policy-Rule_Condition> ::= <Policy-Rule_Match_node>
    (<Policy-Rule_Match_value> ...)
    [<Policy-Rule_mode>]
    [<Policy-Rule_Match_Operator>]
    [<Policy-Rule_Condition_extension>]

<Policy-Rule_Match_node> ::= [<Policy-Rule_Match_Node_BNP-IM>]
    | [<Policy-Rule_Match_node_external>]

<Policy-Rule_Match_value> ::= [<Policy-Rule_Match_Value_BNP-IM>]
    | [<Policy-Rule_Match_Value_external>]

<Policy-Rule_mode> ::= PERMIT | DENY ;
<Policy-Rule_Match_operator_external> ::=
    [<Policy-Rule_Match_Operator_BNP-IM>]
    | [<Policy-Rule_Match_Operator_external>]

```

```

<Policy-Rule-action> ::= <Policy-Rule_Action_variable>
    <Policy-Rule_Action_value>
    <Policy-Rule_Set-Operator>
    [<Policy-Rule_action-extension> ]

<Policy-Rule_Security-Model> ::= <First-Matching>
    |<All-Matching>]

<Policy-Rule_rule_extension> ::=
    <I2RS-LC-policy_rule_extensions>

```

```

<Policy-Rule-action> ::= <Policy-Rule_Action_variable>
                        <Policy-Rule_Action_value>
                        <Policy-Rule_Set-Operator>
                        [<Policy-Rule_action-extension> ]

<Policy-Rule_Action_variable> ::= <Policy-Rule_Action_var>
                                   (<Policy-Rule_Action_value> ...)
                                   [<Policy-Rule_Set_Operator>]
                                   [<Policy-Rule_Action_extension>]

<Policy-Rule_Action_var> ::=  [<Policy-Rule_Action_Vars_BNP-IM>]
                               | [<Policy-Rule_Action_external>]

<Policy-Rule_Action_value> ::=  [<Policy-Rule_Action_Vars_BNP-IM>]
                                 | [<Policy-Rule_Action_external>]

<Policy-Rule_Set_Operator> ::=  [<Policy-Rule_Set_Operator_BNP-IM>]
                                 | [<Policy-Rule_Set_Operator_external>]

<Policy-Rule-action-extension> ::=
                                   [<Policy-Rule_act_ext_BNP-IM>]
                                   | [<Policy-Rule_act_ext_external>]

<Policy-Rule-Match-Operator-Policy-IM> ::= <IS-SET-MEMBER'>
                                           |<IN-INTEGGER-RANGE>
                                           |<IP-ADDRESS-AS-RESOLVED-BY-DNS>
                                           |<Policy_IM-Match-Operator-extension>

<Policy-Rule_condition_extension> ::=
                                   <Policy_Rule_condition_ext-BNP-IM>
                                   [<Policy-Rule_Condition_ext_external>]

/* these scopes besides RIB IM are defined in each IM */

<PR_Read_Scope_RIB_IM> ::= <RIB-IM_READ_SCOPE_TYPE>
                           <RIB-IM_READ_list>

```

```

<PR_Read_Scope_RIB_IM> ::= <RIB-IM_READ_SCOPE_TYPE>
                           <RIB-IM_READ_list>

<RIB-IM_READ_list> ::= [<RIB-IM-Tree-Match> ...]

```



```

<RIB-IM_WRITE_list> ::= [<RIB-IM-Tree-Match> ...]
<RIB-IM-Tree-Match> ::= <RIB-IM-Match-routing-instance>
                        <RIB-IM-Match-interface-list>
                        <RIM-IM-Match-rib_list>
                        <RIB-IM-match-route-list>

/* extensions to other IM */

/* External Read and Write Scope */
<Policy-Rule_Read_Scope_External> ::=
    [<PR_Read_Scope_RIB_IM>]
    [<PR_Read_Scope_BGP_IM>]
    [<PR_Read_Scope_PBR_IM>]
    [<PR_Read_Scope_I2RSLC_IM>]
    [<PR_Read_Scope_STopo_IM>]
    [<PR_Read_Scope_SFC-Policy_IM>]

<Policy-Rule_Write_Scope_External> ::=
    [<PR_Write_Scope_RIB_IM>]
    [<PR_Write_Scope_BGP_IM>]
    [<PR_WriteScope_PBR_IM>]
    [<PR_Read_Scope_I2RSLC_IM>]
    [<PR_Read_Scope_STopo_IM>]
    [<PR_Read_Scope_SFC-PolicyIM>]

/* External Rule Conditionals */
<Policy-Rule_Match_node_external> ::=
    [<Policy-Rule_Match_Node_RIB-IM>]
    | [<Policy-Rule_Match_Node_PBR-IM>]
    | [<Policy-Rule_match_Node_I2RSLC-IM>]
    | [<Policy-Rule_Match_Node_BGP-IM>]
    | [<Policy-Rule_Match_Node_STopo-IM>]
    | [<Policy-Rule_Match_Node_SFC-Policy-IM>]

<Policy-Rule_Match_Value_external> ::=
    [<Policy-Rule_Match_Value_RIB-IM>]
    | [<Policy-Rule_Match_Value_PBR-IM>]
    | [<Policy-Rule_Match_Value_I2RSLC-IM>]
    | [<Policy-Rule_Match_Value_BGP-IM>]
    | [<Policy-Rule_Match_Value_STopo-IM>]
    | [<Policy-Rule_Match_Value_SFC-Policy-IM>]

<Policy-Rule_Match_operator_external> ::=
    [<Policy-Rule_Match_Operator_RIB-IM>]

```

```

| [<Policy-Rule_Match_Operator_PBR-IM>]
| [<Policy-Rule_Match_Operator_I2RSLC-IM>]
| [<Policy-Rule_Match_Operator_BGP-IM>]
| [<Policy-Rule_Match_Operator_STopo-IM>]
| [<Policy-Rule_Match_Operator_SFC-Policy-IM>]

<Policy-Rule_Action_value_external> ::=
    [<Policy-Rule_Action_Values_RIB-IM>]
|   [<Policy-Rule_Action_Values_PBR-IM>]
|   [<Policy-Rule_Match_Operator_I2RSLC-IM>]
|   [<Policy-Rule_Action_Values_BGP-IM>]
|   [<Policy-Rule_Set_Operator_STopo-IM>]
|   [<Policy-Rule_Set_Operator_SFC-Policy-IM>]

<Policy-Rule_Set_Operator_external> ::=
    [<Policy-Rule_Set_Operator_RIB-IM>]
|   [<Policy-Rule_Set_Operator_PBR-IM>]
|   [<Policy-Rule_Match_Operator_I2RSLC-IM>]
|   [<Policy-Rule_Set_Operator_RIB-IM>]
|   [<Policy-Rule_Set_Operator_BGP-IM>]
|   [<Policy-Rule_Set_Operator_STopo-IM>]
|   [<Policy-Rule_Set_Operator_SFC-Policy-IM>]

<Policy-Rule_act_ext_external> ::=
    [<Policy-Rule_extension_RIB-IM>]
|   [<Policy-Rule_act_ext_PBR-IM>]
|   [<Policy-Rule_act_ext_I2RSLC-IM>]
|   [<Policy-Rule_act_ext_RIB-IM>]
|   [<Policy-Rule_act_ext_BGP-IM>]
|   [<Policy-Rule_act_ext_STopo-IM>]
|   [<Policy-Rule_act_ext_SFC-Policy-IM>]
|   [<I2RS_Vendor-Rule_act_ext>]/* other I2RS IM */

```

3.5. BNP IM Grammar

This section specifies the network policy information model in Routing Backus-Naur Form (RBNF, [RFC5511](#)). It also provides diagrams of the main entities of which the information model is comprised.

```

<basic-network_policy_in> ::= (<policy-set> ...)
<basic-network_policy_out> ::= (<policy-set> ...)
<network-policy_rules_list> ::= (<policy-rule>...)

```

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[4.](#) The Policy Based Routing Information Model

[4.1.](#) Policy Based Routing Overview

Policy based Routing is a technique used to make routing decisions based on policies set by the network administrator. PBR enables network administrator to forward the packet based on other criteria than the destination address in the packet, which is used to lookup an entry in the routing table.

The policy based routing problem can be viewed as a resource allocation problem that incorporates business decision with routing. Policy based routing provides many benefits, including cost saving, load balancing and basic QoS.

Routing decisions in policy based routing are based on several criteria beyond destination address, such as packet size, application, protocol used, and identity of the end system. Policy constraints are applied before applying QoS constraints since policy constraint overrides QoS constraint. Policy constraints may be exchanged by routing protocols while updating routing information.

The I2RS use cases which benefit from PBR are:

[\[I-D.white-i2rs-use-case\]](#) and
[\[I-D.krishnan-i2rs-large-flow-use-case\]](#),

PBR-Rules extends from Policy Basic Rule with a set of condition, action and attributes. Routing decisions in policy based routing are based on several criteria beyond destination address, such as packet size, application, protocol used, and identity of the end system.

[4.2.](#) PBR-RIB definition

One routing instance (named by an INSTANCE_NAME) can contain multiple PBR RIBs, and is associated with a set of interfaces, and a ROUTER-ID. The entries associated with each routing instance relating to the PBR are:

- o INSTANCE NAME

- o interface_list
- o PRB RIB list - with each entry having an order set of routes
- o PRB Default RIB - default forwarding FIB.
- o ROUTER-ID

Each PBR RIB has the following:

- o PRB RIB NAME
- o PBR Route-entry

The Route entry in a PRB has the following information:

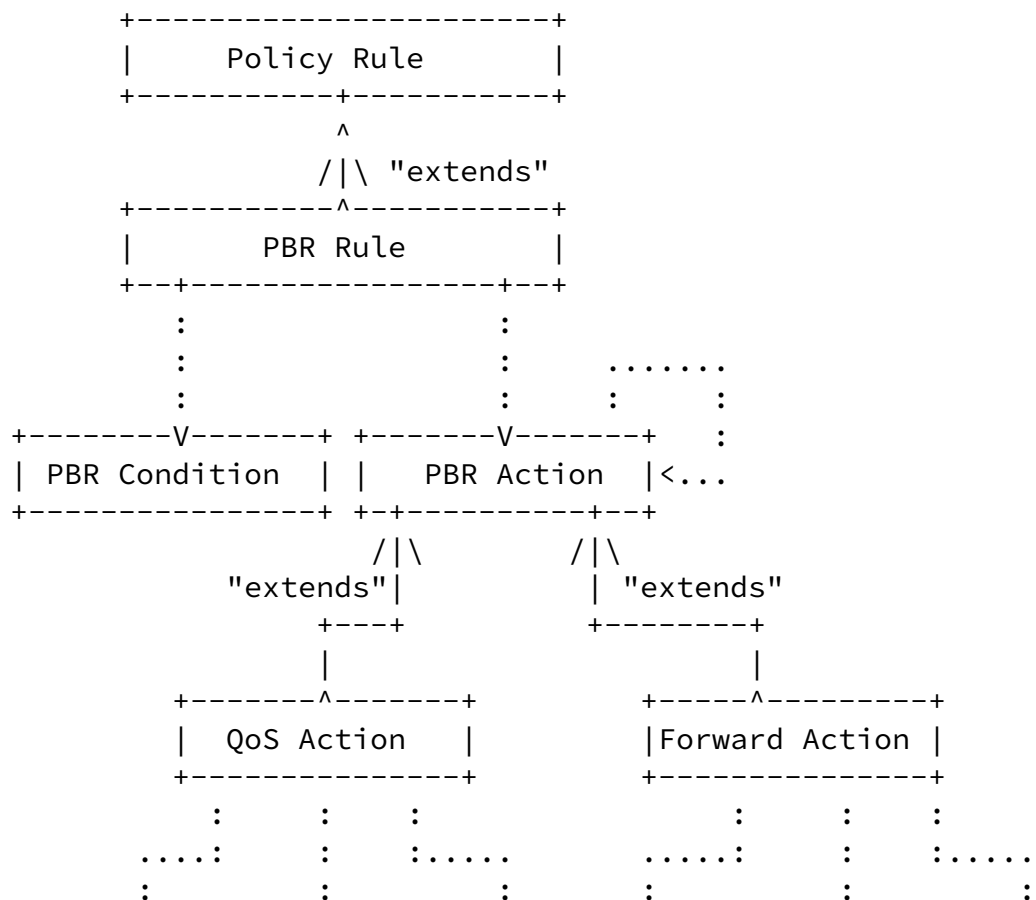
- o match field - as in the RIB IM route
- o order_list PBR route list with each entry having: a) next-hops, b) PBR route attributes, and c) vendor-attributes

The PRB route attributes include QOS Attributes as show in the policy list below.

[4.3.](#) PBR Rule Component

A PBR rule is constructed using condition, action and attributes that are inherited from Policy Group Component.

Figure 7 - PBR Policy Rule



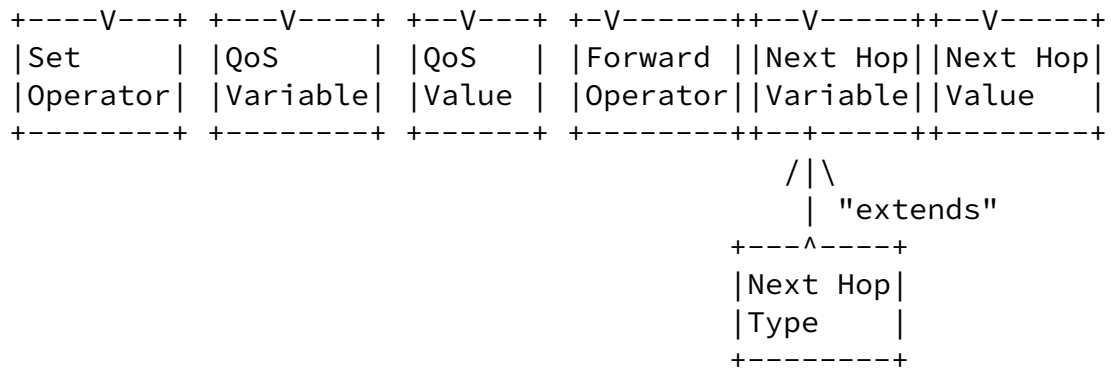


Figure 3: Policy based routing IM structure

4.4. PBR QOS RBNF

The PBR QOS RBNF is below

Figure 8 - PRB QOS RBNF

```

/* policy rules */
<Policy-Rule_Match_Node_PBR-IM> ::= <IPv4_QoS_Node_Matches>
| <IPv6_QoS_Node_Matches>

```

```

<Policy-Rule_Match_Value_PBR-IM> ::= <IPv4_QoS_Value_Matches>
| <IPv6_QoS_Value_Matches>

```

```

<IPv4_QoS_Node_matches> = <IPv4-QoS_Matches>
<IPv6_QoS_Node_matches> = <IPv6-QoS_Matches>
<IPv4_QoS_Value_matches> = <IPv4-QoS_Matches>
<IPv6_QoS_Value_matches> = <IPv6-QoS_Matches>

```

```

<IPv4-QoS_Matches> ::= [<IPv4-SRC>]
                        [<IPv4_DST>]
                        [<IPv4_Proto>]
                        [<IPv4_TOS-DSCP>]
                        [<IPv4_ICMP_field>]
                        [<IPv4_length>]

```

```

<IPv6-QoS_Matches> ::= [<IPv6-SRC>]
                        [<IPv6_DST>]
                        [<IPv6_Proto>]
                        [<IPv6_Flow>]

```

```

[<IPv6_length>]

<Policy-Rule_Match_Operator_PBR-IM> ::= [<Longest-prefix>]
| [<Exact>]
| [(<IPv4-RANGE> <IPv4-Low> <IPv4-High>)]
| [(<IPv6-RANGE> <IPv6-Low> <IPv6-High>)]
| [(<LENGTH-Range> <LENGTH_Low> <LENGTH_High>)]

<IPv4_low> ::= <IPv4-Prefix>
<IPv4_high> ::= <IPv4-Prefix>
<IPv6_low> ::= <IPv6-Prefix>
<IPv6_high> ::= <IPv6-Prefix>

<Policy-Rule_Action_value_PBR-IM> ::= [<QoS_action>]
| [<FWD_action>]

<QoS_action> ::= <QoS_IP-TOS_Set>
| <QoS_DSCP>

<FWD_action> ::= <Drop_packet>
| <Drop_Packet_ICMP>
| (<Forward_Specific> <next-hop>)
| (<Forward_Default>)

<Policy-Rule_Set_Operator_PBR-IM> ::= [<SET_QOS_BITS>]
| [<SET_FWD_ACTION<

```

[4.5.](#) Relationship between PBR Rule Model and RIB Information Model

As described in [[I-D.ietf-i2rs-rib-info-model](#)], each Routing instance contains a collection of RIBs, interfaces, and routing parameters including the following:

- o The set of interfaces indicates which interfaces are associated with this routing instance.
- o The RIBs specify how incoming traffic is to be forwarded based on destination.

- o the routing parameters control the information in the RIBs/PIBs.

PIB and RIB can not be used at the same time, which means:

- o If a router doesn't support policy based routing, a router MUST use rib and MUST not use PIB.
- o If a router supports policy based routing,
 - * PIB is used if several criteria beyond destination address is matched.
 - * RIB is used if several criteria beyond destination address is not matched.

Policy constraints information either comes from RSVP,BGP/IGP, or comes from manual configuration or policy configuration tool. Therefore PBR uses from the RIB IM:

- o Interface-list: The interface list contains a list of identifiers, with each identifier uniquely identifying an interface.
- o Origin: an indication used to identify from which protocols (e.g., ISIS, OSPF, BGP, I2RS, CLI etc.) the policy based route is.

[4.6.](#) PBR RBNF

Figure 9 - PBR RBNF
/* pbr defintion */

```
<pbr-routing-instance> ::= <PBR_INSTANCE_NAME>  
                           [<interface-list>] <pbr-rib_list>
```



```

[<prb-default-rib>]
[<Router-ID>]

<pbr-rib-list> ::= <PRB_RIB_NAME>
                  <PRB_rib_family>
                  (<prb_rib> ...)

<PRB_rib_family> ::= <IPv4_PRB_FAMILY>
                  | <IPv6_PRB_FAIMILY>

<prb_rib> ::= <PRB_RIB_NAME>
              <PRB_rib_family>
              <prb_policy_set>

<prb_policy_set< ::= <BNP_policy_set>
                    <RIB_policy_set_extensions>
                    <PRB_policy_set_extensions>
                    <BGP_policy_set_extensions>
                    <QOS_policy_set_extensions>

<prb_policy_set_exetensions> ::=
    <Policy-Rule_Match_Node_PBR-IM>
    <Policy-Rule_Match_Value_PBR-IM>
    <Policy-Rule_Match_Operator_PBR-IM>
    <Policy-Rule_Action_value_PBR-IM>
    <Policy-Rule_Set_Operator_PBR-IM>

```

[4.7.](#) Remaining PRB Issues

Policy based routing MUST tackle the following difficult questions:

- o How is policy management strategy selected? Centralized or distributed.
- o At which point in a network domain are policy constraints checked and enforced? i.e., policy coverage, here policy constraint can be exchanged by routing protocol?
- o How are policy constraints exchanged within a domain?
- o How is policy data stored, refreshed and retrieved from policy repository?

- o How are policy rule conflicts avoided?

[5.](#) The I2RS Local Policy Information Model

[5.1.](#) I2RS Local Policy IM Overview

The Local Policy Information Model (LB IM) stores I2RS policy and policy templates that are used across many I2RS modules. The LB IM stores a set of policy and a set of policy templates. This section defines the LB IM extensions needed to the Basic Policy set at the Policy-set, Policy-Group, and Policy-Rule level. It also defines the optional extensions to this LP policy model as:

- o PBR IM,
- o RIB IM,
- o BGP IM,
- o Traffic Steering (TS IM)
- o SFC Filter (SFC-F IM),
- o Basic Route Templates IM

The key benefit of the I2RS Local Configure Information Model (Local- is that it provides a place to store I2RS policy, and I2RS templates. The LB IM MAY allow for: a) re-use of these policy templates across multiple I2RS client-I2RS agent sessions, b) storing of some policy into permanent configuration store

[5.2.](#) I2RS Local Policy IM RBNF

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Figure 10 - Local I2RS Policy Story extensions

```

<i2rs-Local-Policy> ::= <I2RS_LOCAL_POLICY_STORE>
                        <Policy-Set>
                        <Policy-Templates>

<i2rs-condition-extension> ::= [<I2RS-Client-Agent_transport_list>]
                                [<I2RS_IPADDRESS_DNS_resolve>]
                                [<Policy-Template_match>]

<I2RS-Client-Agent_transport_list> ::= (< i2rs_transport > ...)
<i2rs_transport> ::= [TCP][SCTP][SSL];

/* these actions allow local I2RS configure store could
 * write to local Node policy store */

<i2rs-action-extension> ::= [<i2rs_write_policy_config_store>]
                            [<i2rs_write_bgp_config_store>]
                            ...

```

The model extends the original network-policy model as follows:

- o A local policy rule can in turn be part of a hierarchy of policies, building on top of other policies. Each local configuration policy is captured in its own level, distinguished via a policy identity.
- o A local policy rule inherit scope from policy group. A local policy rule has a certain Scope, such as read scope or write scope. A local policy rule can even have multiple scope simultaneously. The scope, or scopes, are captured in the list of "scope" components.
- o Furthermore, a local policy contains conditions and actions, each captured in their own list.
- o A condition contains a variable and a value and use a match operator, to connect variable with value. An examples of an operator might be a "IP ADDRESS AS RESOLVED BYDNS" or "Set to a member". Also, a condition can in turn map onto other condition in an underlay policy. This is captured in list in "supporting-

condition".

- o An action contains a variable and a value. An action uses Set operator to connect variable with value. Analogous to a node, an action can in turn map onto other actions in an underlay policy. This is captured in list "supporting-action".

- o The local policy, condition, action and operator elements can be extended with policy-specific components (condition-extension, action-extension and operator-extension respectively).

[6.](#) Extensions to the Policy IM

[6.1.](#) Extension to the RIB IM

Figure 11 - RIB Information Model Extensions

```
<RIB-IM_READ_list> ::= [<RIB-IM-Tree-Match ...>
<RIB-IM_WRITE_list> ::= [<RIB-IM-Tree-Match ...>
<RIB-IM-Tree-Match> ::= <RIB-IM-Match-routing-instance>
                        <RIB-IM-Match-interface-list>
                        <RIB-IM-Match-rib_list>
                        <RIB-IM-match-route-list>;

/* BGP Info Module Tree Match */
<BGP-IM_READ_list> ::= [<BGP-IM-Tree-Match ...>
<BGP-IM_WRITE_list> ::= [<BGP-IM-Tree-Match ...>

<BGP-IM-Tree-Match> ::= <BGP-IM-Tree-Match-protocol-instance>
<BGP-IM-Match-Protocol-instance> ::= (<BGP_protocol> ...)

<prb_rib> ::= <bgp_route_list>

<bgp_route_list> ::= (<bgp_route> ...)
<bgp_route> ::= <BGP_ROUTE_TYPE>
                <bgp_route_prefix>
                <bgp_attribute_list>
                <bgp_route_create>
                <bgp_rt_state_info>

<basic-network_policy_in> ::= (<policy-set> ...)
```

```
<basic-network_policy_out> ::= (<policy-set> ...)
<network-policy_rules_list> ::= (<policy-rule>...)
```

[6.2.](#) Extension from the BGP IM

Figure 12 - BGP Information Model Extensions

```
<BGP-IM_READ_list> ::= [<BGP-IM-Tree-Match ...]
<BGP-IM_WRITE_list> ::= [<BGP-IM-Tree-Match ...]
<BGP-IM-Tree-Match> ::= <BGP-IM-Tree-Match-protocol-instance>
<BGP-IM-Match-Protocol-instance> ::= (<BGP_protocol> ...)
```

[6.3.](#) Extension from SFC Topology IM

Figure 13 - SFC Topology Information Model Extensions

```
/* what part of the STopo Model can access */

<STopo-IM_READ_list> ::= [<STopo-IM-Tree-Match ...]
<STopo-IM_WRITE_list> ::= [<STopo-IM-Tree-Match ...]
<STopo-IM-Tree-Match> ::= <STopo-IM-Tree-Match-protocol-instance>
<STopo-IM-Match-Protocol-instance> ::= (<STopo_protocol> ...)
```

[6.4.](#) Extension from the SFC Traffic Filters

Figure 14 - Traffic Steering Information Model Extensions

```
/* what part of the STopo Model can access */

<SFC-Policy-IM_READ_list> ::= [<SF-Policy-IM-Tree-Match ...]
<SFC-Policy-IM_WRITE_list> ::= [<SF-Policy-IM-Tree-Match ...]
<SFC-Policy-IM-Tree-Match> ::= <SF-Policy-IM-Tree-Match-protocol-instance>
<SFC-Policy-IM-Match-Protocol-instance> ::= <SF_instance_list>
```

[7.](#) IANA Considerations

This draft includes no request to IANA.

[8.](#) Security Considerations

TBD.

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Authors' Addresses

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Susan Hares
Huawei
7453 Hickory Hill
Saline, MI 48176
USA

Email: shares@ndzh.com

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

Email: sunseawq@huawei.com