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ANIMA Intent Policy and Format
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Abstract

One of the goals of autonomic networking is to simplify the management of networks by human operators. Intent Based Networking (IBN) is a possible approach to realize this goal. With IBN, the operator indicates to the network what to do (i.e. her intent) and not how to do it. In the field of Policy Based Management (PBM), the concept of intent is called a declarative policy. This document proposes a refinement of the intent concept initially defined in [RFC7575] for autonomic networks by providing a definition, a hierarchy of policy levels, examples and a tentative format of the ANIMA Intent Policy.

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1. Introduction

One of the goals of autonomic networking is to simplify the management of networks by human operators. Intent Based Networking (IBN) is a possible approach to realize this goal. With IBN, the operator indicates to the network what to do (i.e. her intent) and not how to do it. In the field of Policy Based Management (PBM), the concept of intent is called a declarative policy. This document proposes a refinement of the intent concept initially defined in [RFC7575] for autonomic networks by providing a definition, a hierarchy of policy levels, examples and a tentative format of the ANIMA Intent Policy.

An Autonomic Network must be able to operate with minimum intervention from human operators. However, it still needs to

receive some form of guidance (e.g. ANIMA Intent Policies) in order to fulfil the operator requirements.

In PBM, the Policy Continuum defines the levels at which the policies are defined (policy creation point), consumed (policy execution point) and translated (policy refinement point). Using PBM, the operator can manage the network as a whole, and does not need to configure each individual devices in the network. The transformation of the high-level/abstract policies to the low-level device configurations is realized automatically by a set of functions usually regrouped inside a Policy Engine.

The use of policies and in particular of declarative policies assumes that the entities in the Autonomic Network receiving the ANIMA Intent Policy are capable of processing (refining and/or executing) the policy with no ambiguity. For that, the format of the ANIMA Intent Policy and the hierarchy of policy levels must be specified.

This document proposes a base format of the ANIMA Intent Policy. Application-specific extensions of the base format should be defined on a per need basis in dedicated documents.

2. Requirements Language and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119] when they appear in ALL CAPS. When these words are not in ALL CAPS (such as "should" or "Should"), they have their usual English meanings, and are not to be interpreted as [RFC2119] key words.

Autonomic Function: A feature or function which requires no configuration, and can derive all required information either through self-knowledge, discovery or through Intent.

Autonomic Node: A node which employs exclusively Autonomic Functions.

Legacy Node: A non-autonomic node, i.e., a node which employs some non-autonomic functions.

Autonomic Network: A network containing exclusively Autonomic Nodes. It may contain one or several Autonomic Domains.

Autonomic Domain: A collection of autonomic nodes that instantiate the same Intent.

Autonomic Service Agent: An agent implemented on an Autonomic Node which implements an Autonomic Function.

Intent: An abstract, high-level policy used to operate the network.

ANIMA Intent Policy: A declarative type of policy used in Autonomic Networks.

Administrative Intent: Intent that is used to manage the network infrastructure. (definition to be revised)

Service Intent: Intent that is used to intervene the network services running over the network infrastructure. (definition to be revised)

3. Concept of ANIMA Intent Policy

In the scope of autonomic networking, the definition of intent can be found in [I-D.ietf-anima-reference-model], in which intent is described as "an abstract, declarative, high-level policy used to operate an autonomic domain, such as an enterprise network."

An Autonomic Network will comprise multiple ANIMA Intent Policies. Different ANIMA Intent Policies will be "interpreted" by different entities in autonomic networks, and the "level" of understanding of the intent will impact how the intent will be presented to this entity. So there should be "intermediate" mechanisms/functions that cater for the intent translation continuum across the heterogeneity (in policy capabilities) of the network entities. Also, ANIMA Intent Policies will possibly overlap and this overlapping should be managed (e.g., avoid conflicts, resolve applicable policies in context).

4. Use Cases for ANIMA Intent Policy

In this section, some use cases are introduced to clarify the concept of ANIMA Intent Policy.

4.1. Role-based Intent Example

A typical ANIMA Intent Policy can be found in [I-D.ietf-anima-prefix-management]. It is suggested that the prefix lengths for the CSG, ASG, RSG (different roles in IP RAN) can be assigned as an "intent". The information carried in the intent are distributed in the autonomic domain to influence the detail configurations on each autonomic node.

Intent could perfectly well cover a high level policy such as "all nodes of type x do this; type y does that". However, it should not

be abused. For example, policies like "node 17: here is your CLI; node 23: here is your CLI; node 37: here is your CLI" should not be considered as an intent.

4.2. Coordination of Multiple Intents Example

This example is about "arranging VM guest distribution". The autonomic network is supposed to be able to monitor the CPU/power utilization on each host machine, and control the status of each host machine (e.g. turn on/off). The operator may have an intent "there should be enough hosts to keep CPU utilization less than 70%", and also another one "there are few enough hosts powered so that electricity isn't wasted".

These two intents can both influence the ASA responsible for controlling how many hosts are needed. The decision is made according to multiple factors, including network environment and intents entered by the operators.

In this case, the first intent should have a higher priority than the later one. The two intents should be analyzed and coordinated to ensure the ASA act rightly.

4.3. Intent per Domain Example

Autonomic Network of Operator A is composed of Autonomic Function Agents such as load balancing (LB_AFA) and energy saving (ES_AFA). Operator A wants to limit the proportion of links loaded over a certain threshold and thus defines an Intent to activate load balancing if the load is superior to 0.6 on more than 30% of the links.

Meanwhile, operator A wants different load balancing policies per (technology, administrative, topology) domain. Let's consider a metropolitan network domain and a core network domain, or different LB policy for border routers than interior routers. For the metropolitan network domain, Operator A defines an Intent to minimize the link load variance. For the core network domain, Operator A applies the previously defined intent (activate load balancing if the load is superior to 0.6 on more than 30% of the links).

The intents will be distributed to the right network domain, and take effect after being interpreted and coordinated, and it is easy to change them without the need to configure every device manually.

5. Scope of ANIMA intent

In the development of ASAs, some network-level parameters for a specific autonomic function can also be defined in an ANIMA Intent Policy. GRASP is a candidate protocol for distributing and synchronizing these ASA parameters (or ANIMA Intent Policies) after the definition by human administrators.

{Editor Notes: it is still at a preliminary stage, and the owner of an autonomic function should decide what is needed when the autonomic function is developed. A better understanding of what Intent can and cannot contain requires more research and experience. At this moment we include any item (parameter, policy, etc) which should be flooded across the network.}

6. ANIMA Intent Policy Hierarchy

The Autonomic Networks are supposed to be self-managed. It includes managing the network infrastructure, and also the network services that are running over the network infrastructure. However, the network services have different features against network administration, as listed below. Hence, it may be better introduce a hierarchy and to organize them into separated Administrative (Network) Intent and Service Intent.

- o A Service Intent has a different scope than the Administrative Intent because only the nodes related to the service need to know this intent. Although it may only affect a few nodes, the Service Intent may also be propagated domain wide.
- o A Service Intent may have a limited lifetime, while the Administrative Intents are normally permanent although the content of the Administrative Intent may be updated from time to time.
- o There could be many Service Intents in the Autonomic Domain.

7. Distribution of ANIMA Intent Policy

The distribution of intent can be done by using GRASP [I-D.ietf-anima-grasp] and ACP [I-D.ietf-anima-autonomic-control-plane]. The operator can issue a new intent or modify an intent through any authorized nodes in the autonomic network. After that, the intent will be flooded to all the nodes in the autonomic network, or more accurately, to a group of nodes that are influenced by that intent.

Another scenario is that when a new node joins into an autonomic domain, it may receive an intent from its neighbor.

As mentioed in Section 3.1, the intent may consist of different parts, so that partial updating should also be supported. Detailed mechanisms for intent distribution can be found in [I-D.liu-anima-grasp-distribution].

8. Management of ANIMA Intent Policy

Every Autonomic Node in the Autonomic domain should own an intent with the same version. Any updating of intent, even partial updating, will cause the change of the intent version number. To ensure all the nodes own the same intent, the nodes should be able to communicate with neighbors in the domain about the version of the intent. If its neighbor has a newer version of intent, it can request an intent update.

If the operator issues a new intent or modify intents, it will trigger a domain level updating of intent. Nodes in the Autonomic Network should be aware which domain it belongs to, and accept intent for that domain.

{Editor Notes: talk about the questions as follows. When/on which triggers are intents generated, updated? How the domain(s) are defined and recognized (if I am an AFA, how do I know I am part of domain x, y or z...?). }

9. Interpretation of ANIMA Intent Policy

After receiving an intent, the Autonomic Node should confirm whether it is acceptable, according to the domain name information, intent version, signature, and so on. If it passes the validation, an intent interpretation module will be involved to decide which ASAs will be involved in. Coordination of intents may be needed before the execution of the policies interpreted from the intent.

{Editor Notes: talk about the questions as follows. How the AFAs receive, understand and react to an intent? }

10. Uniform Format of the ANIMA Intent Policy

{Editor Notes: It is still remaining an open issue for the way that intent may be organized. Should the intent be a single one in a given AN domain with a hierarchical version, or multiple intents, each of which targets different Autonomic Service Agent? For now, the below text takes the later approach.}

This section proposes a uniform intent format. It uses the tag-based format.

Autonomic intent: The root tag for the Autonomic Network Intent.

Intent type: It indicates the intent type, which is associated with a specific Autonomic Service Agent.

Autonomic domain: It indicates the domain of the Autonomic Network. It is also the scope of the Autonomic Network Intent.

Intent version: It indicates the version of the ANIMA Intent Policy. This is an important feature for synchronization.

Model version: The version of the model used to define the intent.

Name: The name of the intent which describes the intent for human operators.

Signature: The signature is used as a security mechanism to provide authentication, integrity, and non-repudiation.

Timestamp: The timestamp of the creation of the intent using the format supported by the IETF [TBC].

Lifetime: The lifetime in which the intent may be observed. A special case of the lifetime is the definition of permanent intents.

Content: It contains the main information of the intent. It may include objects, policies, goals and configuration data. The detailed contents and formats should be defined under their specific situations by documents that specifies the Autonomic Service Agent. Within the content, there may be sub_intents.

{Editor Notes: JSON is one of the term candidates for the Autonomic Network Intent format.}

11. Security Considerations

Relevant security issues are discussed in [I-D.ietf-anima-grasp]. The ANIMA Intent Policy requires strong security environment from the start, because it would be great risk if the ANIMA Intent Policy had been maliciously tampered. The Autonomic Intent should employ a signature scheme to provide authentication, integrity, and non-repudiation.

12. IANA Considerations

This document defines one new format. The IANA is requested to establish a new assigned list for it.

13. Acknowledgements

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14. Change log [RFC Editor: Please remove]

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draft-du-anima-an-intent-02: add the intent concept section, and some other sections, 2015-10-14.

draft-du-anima-an-intent-03: modify the use case section, and add some other contents, 2016-03-17.

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