Network measurement intent
draft-yang-nmrg-network-measurement-intent-02

Abstract

   As an important technical means to detect network state, network
   measurement has attracted more and more attention in the development
   of network. However, the current network measurement technology has
   the problem that the measurement method and the measurement purpose
   cannot match well. To solve this problem, this memo introduces
   network measurement intent, namely the process of realizing user or
   network operator to allocate network states as needed. And it can be
   as a specified user case of intent based network.

Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

Status of This Memo

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1. Introduction

   With the rapid development of the current network, the scale of the
   network is getting larger and larger, while users' requirements for
   the network are getting higher and higher. At the same time, network
   resources are increasingly restrained. In order to realize the
   efficient allocation of network resources, it is necessary to
   understand the running state of the network, and network measurement,
   as a technical means to detect the network, has been paid of more and
   more attention. The continuous development of network measurement
   technology has also satisfied the higher and higher precision of
   network perception. However, both the traditional network
   measurement technology and the network telemetry technology, which

has emerged with the development of software-defined network in
recent years, need to occupy the network resources when detecting the
network state and feeding back the detection results. Therefore, to
some extent, the choice of network measurement methods, in addition
to different accuracy of measurement results, will also cause
different degrees of burden to the network.

In order to balance the accuracy of network measurement results with
the network load, it is very important to choose the appropriate
network measurement method according to the different requirements of
network measurement. As a result, accurate on-demand network
measurement technology is becoming more and more important. At the
same time, the development of Intent based Network (IBN) enables the
network to be configured according to users' or network
administrators' intent. Therefore, we can combine network
measurement with IBN, that is, the users' or network administrators'
perceived demand for network state is regarded as network measurement
intent.

We want to use the network measurement intent to achieve network
performance acquisition based on user/network administrator intent-
based, verify whether network measurement results meet the
measurement intent, and further improve the accuracy of the
configuration in IBN.

2. Definitions and Acronyms

CLI: Command-line Interface.

IBN: Intent based Network.

Policy: A set of rules that governs the choices in behavior of a
system.

NMI: Network Measurement Intent, refers to based on user/network
operator's demand for network status, and automatically collect
network status information on demand.

SLA: Service Level Agreement.

3. Connections to Existing Documents

As the rise of IBN, different groups have different definitions of
intent. For example, the document
[I-D.irtf-nmrg-ibn-concepts-definitions] defines intent as intent
fulfillment and intent assurance. However, all different definitions
of intent have some common characteristics, and can be classified
according to [I-D.irtf-nmrg-ibn-intent-classification]. And in order

to combine the network measurement intent with the existing drafts of
IBN, we define the components of the network measurement intent
processing process as follows:

At the same time, according to
[I-D.irtf-nmrg-ibn-concepts-definitions], network measurement intent
can be classified as network intent, operational task intent or some
other kinds of intent. And a detailed flow of network measurement
intents will be given

And in order to combine the NMI with the existing drafts of IBN, in
this document we define the components of the NMI processing process
as follows:

o NMI Recognition and Acquisition

o NMI Translation

o NMI Orchestration and pre-Verification

o Data Collection and Analytics

o NMI Compliance Assessment

4. Overview

As mentioned above, NMI refers to the on-demand measurement of the
network state based on the user/network operators' perceived intent
of the network state. We will present the detailed process of it
within each part and take the measurement of busy network
performances as a simple example.

o NMI Recognition and Acquisition.

   * In this function, NMI will be recognized by "ingesting" users'
      or network operators' measurement intent. They have the
      ability to identify the NMI of a certain network performance
      that users want to measure, such as delay, jitter, etc., and at
      the same time allow users to express the NMI of network
      performance in a variety of interactive ways to ensure the
      accuracy of the identification of the NMI. To achieve this
      functionality, such an interaction requires the use of the
      intent-northbound interface defined in the IBN.

o NMI Translation.

   * In this function, NMI needs to be translated into actions and
      requests taken against the network. For a simple example, in

the measurement of busy network performances, due to dynamic
changes such as daily network bandwidth occupancy rate, the
period of network busy time is not fixed. As a result, NMI
Translation can determine the threshold when the network state
is busy on the same day based on the historical data learned by
AI. In other words, the realization of NMI Translation needs
to be based on the continuous optimization of AI algorithm that
based on historical data and expert experience. And after NMI
translation, the content to be measured is determined.

o NMI Orchestration and pre-Verification.

   * In this function, according to the previous NMI Translation
      step, NMI Orchestration and pre-Verification determines the
      measurement scheme according to the required measurement
      content and equipment support degree, and pre-verifies whether
      the measurement scheme is feasible. For example, it determines
      to choose In-band network telemetry technology to measure the
      round trip time of the local area network.

   * Take busy time network measurement as an example, except for
      choosing of measurement schemes and contents, it also needs to
      determine whether the network is busy according to the current
      network state. In addition, this function performs automatic
      network deployment, such as in CLI mode.

o Data Collection and Analytics.

   * In NMI, data collection and analysis should be based on the
      selected measurement scheme and the content to be measured that
      determined in previous steps, automatically realize the
      collection on demand, and generate corresponding data analysis
      results.

o NMI Compliance Assessment.

   * At the end, this function verifies whether the results meets
      the requirement and whether the NMI is satisfied. If either of
      the two conditions is not satisfied, the NMI should be modified
      and re-enter the NMI Orchestration and pre-Verification.

And he measurement flow diagram is shown as the following figure:

```
              +                                 ^
      NMI input|                     Measurement|
               |                         Results|
       +--------v-------+               Feedback|
       | NMI Recognition |                      |
       | and Acquistion  |                      |
       +--------+--------+                      |
                |                               |
       +--------v--------+    +------------+     |
       | NMI Translation <----+ NMI Policy |     |
        +--------+--------+    +------------+     |
                |                               |
                |              +----------------+ |
                |     +-------+ NMI Compliance |  |
                |     |       | Assessment     |  |
                |     |       +-------^--------+  |
                |     |               |          |
       +---------v-----v-----+ +-------+---------+ |
       | NMI Orchestration   | | Data Collection +-+
       | and pre-Verification| | and Analytics   |
       +---------+----------+ +-------^---------+
                |                     |
           +-----v---------------------+---+
           |    Network Infrastructure    |
           +------------------------------+
```
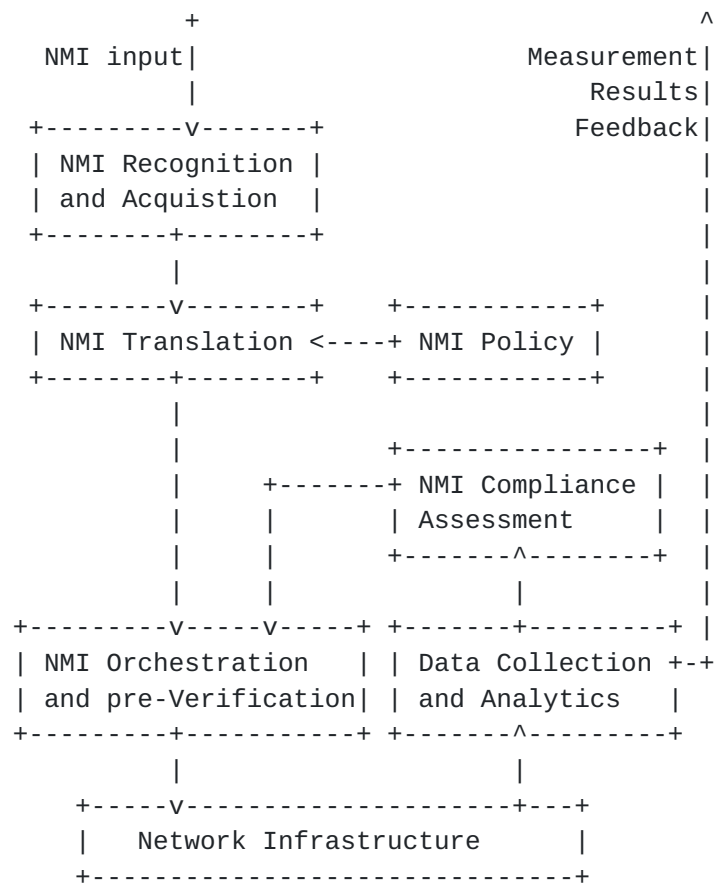
[5]. Concrete Examples

   In this section, we will take SLA measurement intent as an example to
   illustrate each step of the process.

   With the development of measurement technology in recent years,
   network measurement can be divided into active measurement, passive
   measurement and a combination of active and passive measurement. As
   mentioned above, no matter which measurement technology will occupy
   network resources. For example, if the transmission frequency of
   active measurement message is too fast, it will occupy too much
   bandwidth resources and affect the normal operation of actual
   business. While if the transmission frequency is too slow, some
   instantaneous network anomalies will be missed and the network status
   cannot be accurately reflected. Passive measurement requires real-
   time collection of actual business data. If the sampling rate is too
   high, a large amount of data will be accumulated in a short time.
   The analysis system for real-time analysis of these data needs strong
   processing capacity; if the sampling rate is too low, some network
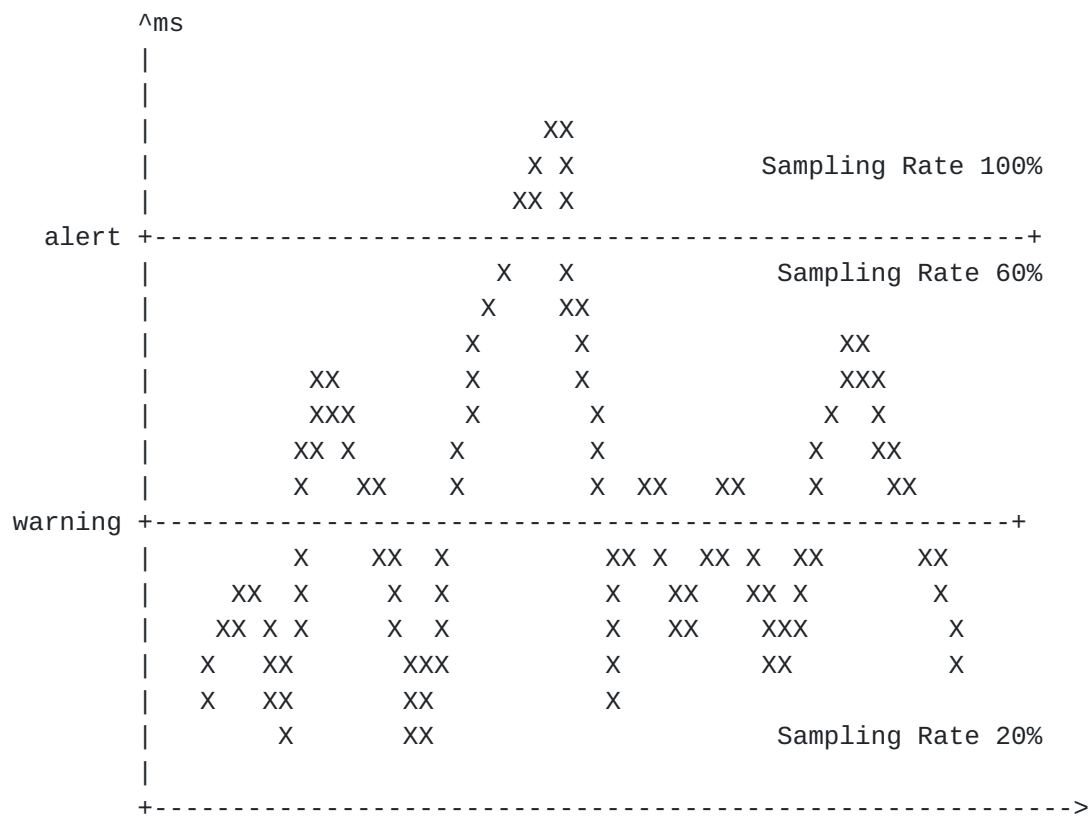   anomalies will also be omitted.

How to balance and accurately measure the network state, especially
the abnormal network affecting the service, while occupying as little
network bandwidth as possible, and the processing capacity of the
data analysis system is not high, this is the function that the NMI
scheme based on IBN should realize.

In this section, we will consider two examples to illustrate each
step of the process.

5.1. SLA measurement intent

Taking network SLA performance index -- time delay measurement as an
example, the simple schematic diagram is as follows, different
thresholds, warning value and alert value should be set for network
delay in advance. When the delay value is below warning, the network
is normal and the business is normal. When the delay is between
warning value and alert value, the network fluctuation is abnormal,
but the business is normal. When the delay exceeds the alert value,
both the network and business are abnormal. For delay in different
thresholds, different measurement strategies should be adopted:

o When the network delay exceeds the alert value, or when the
   historical data predict that the delay will exceed the alert
   value, passive measurement requires 100% sampling of business
   data, and the transmission frequency of active measurement is
   modulated to the maximum. At the same time, the log and alarm
   data of the whole network equipment are collected to realize the
   most fine-grained measurement of the network, locate the root
   cause of the problem and repair the network in time.

o When the network delay exceeds warning value but is lower than
   alert value, passive measurement samples 60% of business data, and
   the transmission message frequency of the active measurement is
   adjusted to the median value, and the running state data of some
   key devices in the network is collected synchronously.

o When the network delay is less than warning value, passive
   measurement data is sampled at 20%, and active measurement message
   frequency is adjusted to the lowest, and the network equipment
   running state of key nodes can be collected as needed.

```
         ^ms
          |
          |
          |                         XX
          |                        X X              Sampling Rate 100%
          |                        XX X
    alert +-----------------------------------------------------------+
          |                          X    X          Sampling Rate 60%
          |                         X    XX
          |                        X       X                 XX
          |           XX          X        X                 XXX
          |           XXX          X        X               X  X
          |          XX X        X          X              X    XX
          |          X    XX     X          X   XX    XX   X     XX
  warning +-----------------------------------------------------------+
          |           X     XX  X            XX X  XX X  XX       XX
          |        XX   X      X  X           X    XX    XX X          X
          |       XX X X       X   X          X    XX    XXX           X
          |      X   XX          XXX          X           XX           X
          |      X   XX          XX           X
          |         X           XX                   Sampling Rate 20%
          |
          +------------------------------------------------------------>
```

Based on the above SLA time delay index measurement, different
thresholds adopt different measurement strategies, the concrete steps
of SLA measurement intent are as follows:

o In NMI Recognition and Acquisition, SLA measurement intent is
   recognized, and business requirements and performance metrics are
   identified by interacting with users. Then the NMI Recognition
   and Acquisition module inputs the SLA measurement intent into the
   NMI Translation module.

o The NMI Translation module combines the SLA measurement intent
   with the measurement policy in NMI Policy, and outputs the
   executable measurement policy, such as the message transmission
   frequency of active measurement, the sampling rate of passive
   measurement, the collection range of equipment running state, etc.

o The NMI Orchestration and pre-Verification module arranges the
   measurement strategy into the specific configuration and policy
   execution time of each device in the tested network. The NMI pre-
   verification module modifies the configuration according to the
   degree of support for the measurement function of the device to
   ensure that the configuration can be executed.

o The Data Collection and Analysis module will collect the
   measurement data according to the requirements of the previous
   step, make a simple analysis of the collected data, and then send
   the collected measurement data to the NMI Compliance Assessment
   module. After that, it feedback the measurement results to the
   user to complete the closed loop of the measurement task.

o According to the change of delay data in the measured data, the
   NMI Compliance Assessment module notifies the NMI Orchestration
   and pre-Verification module to modify the execution time of the
   policy in time, and at the same time updates the measured results
   to the delay history database to improve the accuracy of delay
   prediction.

5.2. Clustered performance measurement intent

The desired approach is to accurately measure the network state,
especially when there are some issues affecting the service, but at
the same time, reduce the resources to be employed to achieve the
desired accuracy.

In this regard, the Clustered Alternate-Marking framework [RFC8889]
adds flexibility to Performance Management (PM), because it can
reduce the order of magnitude of the packet counters. This allows
the NMI Orchestration and pre-Verification module to supervise,
control, and manage PM in large networks.

RFC 8889 [RFC8889] introduces the concept of cluster partition of a
network. The monitoring network can be considered as a whole or
split into clusters that are the smallest subnetworks (group-to-group
segments), maintaining the packet loss property for each subnetwork.
The clusters can be combined in new connected subnetworks at
different levels, forming new clusters, depending on the level of
detail to achieve.

The clustered performance measurement intent represents the spatial
accuracy, that is the size of the subnetworks to consider for the
monitoring. It is possible to start without examining in depth and,
in case of necessity, the "network zooming" approach can be used.

This approach called "network zooming" and can be performed in two
different ways:

1. change the traffic filter and select more detailed flows;

2. activate new measurement points by defining more specified
    clusters.

The network-zooming approach implies that some filters, rules or flow
identifiers are changed. But these changes must be done in a way
that do not affect the performance. Therefore there could be a
transient time to wait once the new network configuration takes
effect. Anyway, if the performance issue is relevant, it is likely
to last for a time much longer than the transient time.

The concrete steps of the clustered performance measurement intent
are as follows:

o In NMI Recognition and Acquisition, the clustered performance
   measurement intent is recognized. Then the NMI Recognition and
   Acquisition module inputs the clustered performance measurement
   intent into the NMI Translation module.

o The NMI Translation module analyzes the clustered performance
   measurement intent and outputs the executable measurement policy,
   such as network partition and the spatial accuracy for the
   monitoring.

o The NMI Orchestration and pre-Verification module arranges and
   calibrates the measurement with the specific configuration to
   split the whole network into clusters at different levels.

o The Data Collection and Analysis module collects the measurement
   data from the different clusters, and then send these data to the
   NMI Compliance Assessment module. It verifies the performance for
   each cluster and send the measurement results to the user.

o The NMI Compliance Assessment module, in case a cluster is
   experiencing a packet loss or the delay is high, notifies the NMI
   Orchestration and pre-Verification module to modify the cluster
   partition of the network for further investigation. The network
   configuration can be immediately modified in order to perform a
   new partition of the network but only for the cluster with bad
   performance. In this way, the problem can be localized with
   successive approximation up to a flow detailed analysis. This is
   the so-called "closed loop" performance management.

6. Classification of NMI

In this section, we divide the network measurement intent into static
NMI and dynamic NMI according to different requirement
characteristics.

6.1. Static NMI

   Static NMI refers to the measurement purposes remain unchanged and is
   independent of the network state/external environment. Static NMI
   can be translated into determined network performance indicator
   values, such as concrete delay values, network bandwidth occupancy,
   throughput and so on.

   Because the static NMI can be translated into the measurement of the
   determined network performance parameters, the whole process is
   relatively simple and error-prone, and only needs to verify whether
   the measurement results meet the requirements.

6.2. Dynamic NMI

   Dynamic NMI refers to the measurement purpose remains unchanged but
   the measurement process changes dynamically according to the network
   state/external environment. Dynamic NMI can also be translated into
   the measurement of determined network performance parameters,
   however, the values of network performance parameters will change
   with the changes of network states and external environment.

   For example, the measurement of busy network performances mentioned
   in the previous. Although the corresponding network parameters for
   judging whether the network is busy are determined, the corresponding
   network parameters have different values according to different
   network states and external environments.

   Due to the dynamic nature of dynamic NMI, its processing process is
   more complex than static NMI. It is not only necessary to verify the
   accuracy of demand analysis, but also to verify whether the final
   measurement results meet the requirements.

7. Summary

   This memo introduces the network measurement intent, and give an
   example of network measurement of busy network performances. On the
   basis of existing intent drafts, this memo can be used as a use case
   for IBN.

8. Security Considerations

   TBD.

9. IANA Considerations

   This document has no requests to IANA.

10. References

10.1. Normative References

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10.2. Informative References

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