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Bandwidth aggregation for multiple interface node
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Abstract

This document describes the support of bandwidth aggregation for a mif node. By introducing bandwidth aggregation, a mif node can use the multihomed interfaces to achieve bandwidth enhancement, traffic steering and improved reliability.

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1. Introduction

In residential networks, home gateway devices with more than one uplink interfaces are used for flexible deployment, bandwidth aggregation and reliability purposes. For example a home gateway device may have both fixed and cellular access network interfaces.

In some rural area with relatively good cellular network coverage whilst fibre resources are limited, this kind of device offers extremely low-cost and fast deployment for broadband users. As fibre or cable infrastructure reaches these users, the fixed network interface can be used as a means of bandwidth aggregation or provide higher reliability.

In contrast, as the access bandwidth gap between the fixed and cellular networks is getting closer, it is also attractive for current fixed network users to consider using cellular network resource as a way to increase the total access bandwidth, or at least to boost the access bandwidth for some particular bandwidth-greedy services (i.e.HD video call). This is considered helpful when the legacy access infrastructures (i.e. old MMF fibre, coax cable) are not able to provide enough bandwidth and the network upgrade is not feasible due to environmental or cost issues. For example, some urban area using conventional ADSL for broadband services can use the cellular network to achieve higher bandwidth.

In mif, the network configurations received by different interfaces are associated with individual MPvDs. MPvD labels the node-scoped configurations so that the conflict issues stated in ([RFC 6418]) are avoided. Since the network configuration related to a certain interface is well maintained by MPvD, an application can choose the

MPvD to use according to certain node policies if any interface is preferred. Hence, it would be very interesting that MPvD can provide link information (i.e. bandwidth, quality and cost), so that an application can choose accordingly given that the network configuration is valid for corresponding connection.

1.1. 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].

2. Terminology and Abbreviations

The terminology and abbreviations used in this document are defined in this section.

- o ISP: Internet Service Provider. A traditional network operator who provides internet access to customers.

- o VSP: Virtual Service Provider. An service provider who typically provides over-the-top services including but not limited to Internet of Things services (IoT).

3. Bandwidth aggregation for a mif node

A mif node can use multiple interfaces for bandwidth aggregation purposes. General scenarios are the cases when fixed connection acts as a means of bandwidth enhancement for cellular access point and vice versa. In addition, if congestion exists on one of the interfaces, the mif node should be able to steer the traffic to the preferred link with lighter traffic to achieve improved network performance.

As seen in Figure 1, a multihomed gateway is connected with 2 ISPs via fixed and cellular interfaces. Two individual MPvDs are established for these two links. The traffic can be distributed to these two interfaces according to specific node and application policies. This forms the basic system model for bandwidth aggregation of a mif node.

```
                     <----Fixed internet MPvD----------->
                                      _____             _____
         +-------------------+       (     )           (     )
         |        +-------+  |    __(       )       __(       )
         |        |       |  |   (    ISP1   )     (  Internet )
         |        | Fixed +------------------------             )
         |        |  -IF  |  |   (_         _)     (_         _)
         |        |       |  |    (       _)        (       _)
         |        +-------+  |     ( ____)           ( ____)
         |           |       |
         | +---------+--+    |
         | | Traffic    |    |
         | +---------+--+    |
         |           |       |        _____             _____
         |        +-------+  |       (     )           (     )
         |        |       |  |    __(       )       __(       )
         |        |  Cell |  |   (    ISP2   )     (  Internet )
         |        |  -IF  +------------------------             )
         |        |       |  |   (_         _)     (_         _)
         |        +-------+  |    (       _)        (       _)
         +-------------------+     ( ____)           ( ____)

                     <----Cellular internet MPvD--------->
```

Figure 1

3.1. Bandwidth aggregation for general purposes

More and more services are provided by ISP and VSPs nowadays. As an example, in addition to providing basic internet services, traditional ISPs tend to provide services like IPTV and VoD to increase revenue. Also, VSPs are also seeking opportunities to provide attractive IoT service such as home security. More services require more bandwidth.

There is no doubt that the cutting-edge fibre and coax cable technology has enabled broadband services measured by gigabit/s at a reasonable cost. However, ISPs can only provide such high-quality internet access to places with newly deployed infrastructures and it may take a long time for a customer to be reached by the upgraded transport resources. In contrast, cellular network provides much better coverage and potentially access bandwidth comparable with the fix network. Hence, a multihomed device with both fixed and cellular connections provides a competitive way for ISPs to solve the problem of inadequate bandwidth for some subscribers.

For a mif node, the fixed and cellular network interfaces have individual MPvDs distributed by ISPs. It is worth to mention that

these MPvDs may be maintained by different ISPs since one can have multiple fixed connections and cellular connections with various ISPs. The subscribers should be able to set different priorities for these MPvDs as they like. For instance, ISPs may provide different access network packages but the cellular access is normally more expensive compared with the fixed broadband. Hence, subscriber may want to use the cheapest fixed network for most of the time and only to activate the more expensive one or the cellular interface when there is occasionally need for bandwidth-boost. Moreover, this bandwidth aggregation ability enabled by MPvD also make it possible for ISPs and VSPs to provide more flexible services such as time-variant price packages and bandwidth boosting plan for targeting subscribes.

3.2. Application-specific traffic-steering

Some applications may have preferences on what network link to be used. For example, download may want to use an interface with the lowest cost and reasonable bandwidth, whereas live video streaming application may want to use the most reliable and high speed connection. New services provided by VSPs such as remote surgery and HD video conference call may also consider network latency as an important factor. These make the selection of interface critical since an improper choice may cause the failure of the application. Hence, it is extremely interesting if the interface can identify itself for the applications, where the most reasonable choice can be made.

MPvD currently identifies the interfaces with the associated network configuration. It would be interesting if the network status and quality information such as available bandwidth, latency and cost etc. can also be maintained by MPvDs so that an application can make the choice accordingly.

3.3. Network reliability

Another interesting scenario for MPvD to support bandwidth aggregation is to increase network reliability by providing protection connections. Given that a master interface and a protection interface can by identified by MPvD, a PvD-aware node should be able to trigger a switching between interfaces and tell the application to re-establish its connection.

4. MPVD support of bandwidth aggregation

The MPvD should be able to identify the following network status and quality information of the associated interface:

- o Available bandwidth: The guaranteed bandwidth, assured bandwidth and best-effort bandwidth of the associated interface

- o Link cost: The cost of the link measured by the ISP price plan

- o Latency: The latency of link associated with the corresponding interface

The network status and quality information should be updated by the ISP or VSP who maintains the corresponding MPvD. Applications should have access to these information.

5. IANA Considerations

This memo includes no request to IANA.

6. Security Considerations

TBA

7. References

7.1. Normative References

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