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Requirements for IP/MPLS network transmission interruption duration
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Abstract

The transmission performance of IP/MPLS network affects upper layer services and networks, but there is no consensus in the industry on transmission interruption for IP/MPLS network up to now. This memo studies requirements for the interruption duration criteria in several service scenarios.

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1. Introduction

Today's IP/MPLS network is widely used as a bearing network to carry diversified packet switched services. The transmission qualities of these services are closely related to the performance of bearing layers, as network failure, delay, congestion and other abnormities will inevitably bring about service interruption and user perception degradation. However, there is no consensus in the industry on transmission interruption for IP/MPLS network up to now. This memo studies relationships between service performance and transmission interruption duration in several scenarios, and is intended to reach a list of requirements for these interruption duration criteria.

2. Services and Performance Criteria

Services delivered by IP/MPLS network have different transmission quality requirements, thus introduce different performance criteria for the bearing IP/MPLS network. In this section we will describe concerns on IP/MPLS network interruption duration from aspects of four kinds of service scenarios, namely Softswitch, LTE backhaul, VPN and IPTV.

2.1. Softswitch

From the softswitch point of view, the IP bearing nature imposes certain influence to the service quality. Especially when speech is delivered by IP, the communication quality of voice is impaired, and in turn makes higher requirements for the transmission performance of IP bearing layer. There are mainly two network design principles to be considered when carrying softswitch voice services: the bearing network should guarantee the communication quality of voice carried by IP is as good as that of voice carried by TDM, and the communication quality can still be satisfied when a network failure occurs, causing transmission interruption and network convergence. This part will mainly focus on three communication quality criteria

and their influence factors and causes to give requirements for softswitch and IP bearing networks.

2.1.1 Connection Failure

Connection failure is used to describe the circumstance where a phone call fails to establish after initiated by a subscriber due to network faults. In the practical network, the connection failure rate is mainly associated by the factors as follows:

(1) Interfaces, including Nc, Mc and interface connecting MSS and SG.

(2) Message timer of state machine. If a timeout takes place, the state machine releases signaling messages, producing a connection failure. In China Mobile's network, the BICC timer is configured to 10~15 seconds and DTAP timer about 15 seconds.

(3) Detected duration of interface coupling interruption.

(4) Bearing network convergence time.

If the configured timing duration of a state machine is shorter than the detected duration of interface coupling interruption, then although interface coupling may not be broken off, connection failure is still possible to occurs due to message timeout. If the coupling interruption duration is shorter than IP routing convergence time, the coupling is considered broken off by SCTP, hence message loss at interface between MSS and SG as well as interface Nc results in massive connection failure, and new calling request cannot be satisfied because of interface Mc breakoff. In this case, the connection failure rate can be calculated as

Connection Failure Rate = (IP Convergence Time + Coupling Restoration Time) * CAPS / BHCA.

However, if the coupling interruption duration is longer than IP routing convergence time, then the coupling is considered normal by SCTP, and data will be retransmitted. Although this may cause buffer overflow leading to connection failure, the connection failure rate is possible to achieve approximately zero if buffer is big enough.

From the analysis above and practical operation experience, the requirements for softswitch and IP bearer are as follows: the detected duration of SCTP interface coupling interruption should be shorter than the state machine message timer, and this duration is further recommended to be no longer than 6 seconds in order to maintain detection sensitivity; the interruption duration of IP bearer network should be as short as possible to avoid softswitch connection failure during the IP layer interruption period, and this duration is further recommended to be no longer than 5 seconds.

2.1.2 Call Cut-off

Call cut-off is referred to the abnormal release during a phone call due to reasons other than intentional release by any of the parties involved in the call. The call cut-off rate is related with:

(1) Interfaces, including Nc and interface connecting MSS and SG.

(2) Detected duration of interface coupling interruption.

(3) Bearing network convergence time.

If the detected duration of interface coupling interruption is shorter than IP routing convergence time, established phone calls will be released once interruption of interface Nc or interface connecting MSS and SG is detected. In the case of coupling breakoff, call cut-off rate can be calculated as

Call Cut-off Rate = (CAPS * Call Duration) * Busy Hour Coupling Breakoffs / BHCA.

While if the coupling is not interrupted, the call cut-off rate can be approximately zero.

In conclusion, the SCTP coupling should be guaranteed during IP layer interruption to avoid interface breakoff alert. The requirements for softswitch and IP bearer are the same as those related to connection failure.

2.1.3 Connection Delay

The connection delay from a call initiation by a calling party to

PLMN should be no longer than 4 seconds. This delay is affected by factors below:

(1) RRC connection setup delay (irrelevant to whether service is carried by IP or not).

(2) Core network signaling interaction delay. The message number at interface Nc/Nb is 6, and is 8 (calling side) or 16 (called side, in case of IP-IP) at interface Mc. Each message is with a delay of no longer than 50 milliseconds. Calling message delay at interface Nc is no longer than 300 milliseconds. If long distance call is made though CMN, the message delay is to be increased by transmission delay of 5 msec/km and CMN process delay. So the message delay is likely to be 400 milliseconds.

(3) IP bearing network QoS and load.

The connection delay is influenced by the delay criterion defined in the IP bearing network QoS, and is raised by delay, jitter, packet loss caused by network overload. In addition, if the configured detected duration of interface coupling interruption is too long, the SCTP sensitivity to the retransmitted messages after packet loss will be decreased, which increases connection delay.

Connection delay is generally expressed as

Connection Delay = (IP convergence time + RRC connection setup delay + Signaling Interaction Delay),

and is no longer than 4 seconds. So the IP network in normal working state should be constrained within a certain range of load to ensure that delay is shorter than 50 milliseconds, while in interruption state the IP convergence time should be no longer than 3 seconds to ensure that connection delay is shorter than 4 seconds.

From the analysis of IP/MPLS performance according to the three criteria above, we suggest the transmission interruption duration of IP/MPLS network for softswitch service should be no longer than 3 seconds.

2.2. LTE Backhaul

It is to be further analyzed.

2.3. VPN

It is to be further analyzed.

2.4. IPTV

It is to be further analyzed.

3. Security Considerations

TBD

4. IANA Considerations

It is no necessary to request new IANA code in the draft.

5. Acknowledgements

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6. Normative References

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