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LIVE STREAMING OPTIMIZER AT UPF USING INTELLIGENT APPLICATION AND FLOW DETECTION

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ABSTRACT

With Mobile Edge Computing (MEC) in 5G, the User Plane Function (UPF) has moved closer to the end user. This movement, however, has not eliminated the latency incurred to cover the hops to reach the Application Function (AF).

As a result, the internet protocol (IP) core design is of utmost consequence, so that content may be reached with minimal hops. This would imply that service providers would need to incur heavy costs redesigning networks from legacy technology to next generation 5G technology.

A path to this overhaul is needed. The solution presented herein may allow service providers to continue using their legacy infrastructure for streaming while at the same time supporting 5G performance. The solution is directed to algorithms to detect live streaming candidates for live streaming optimization and replicate the same content.

DETAILED DESCRIPTION

As described in various standards, the User Plane Function (UPF) is responsible for being the network element that has access to the Application Function (e.g., Internet, streaming).

With the proposed solution, a Live Streaming Optimizer (also referred to herein as "LSO") is implemented within the UPF using application and flow detection.

FIG. 1, below, is a schematic block diagram illustrating a conventional implementation of a live streaming use case in a 5G network.

In such an implementation, when users launch a streaming application, the 5G core network creates an end-to-end bearer for each user. As such, the same content is fetched multiple times from the Application Function (AF) for different users by the same UPF.

This would lead to a lot of duplicate traffic on the IP core infrastructure for the Service Provider, and therefore more cost.

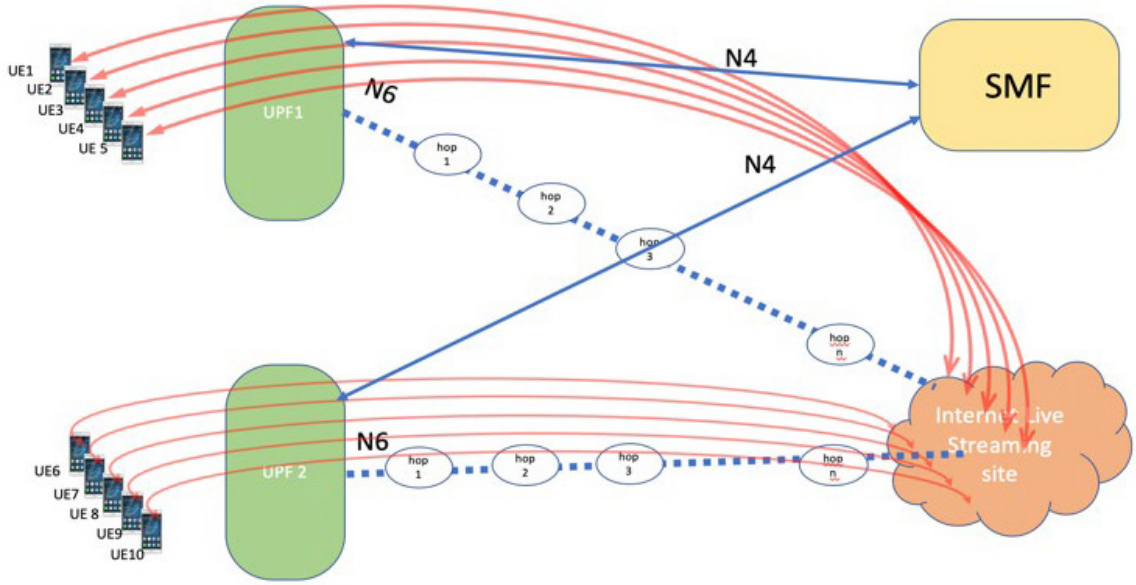


Figure 1

The solution proposed herein introduces a new functionality on the 5G core (Session Management Function (SMF) and UPF) to intelligently detect streaming applications for a user and replicate the flows to a large number of users viewing the same content, within the same UPF. Further, to ensure quality of experience (QoE), the proposed solution may also provide a mechanism to select an optimal session/flow that would be a contender for replication, and may include triggers to start, stop, and modify the live streaming optimizer functionality. The proposed solution thus may be employed to reduce the overhead on the IP core due to downloading of same content multiple times.

FIG. 2, below, is a schematic block diagram illustrating the live streaming optimizer and conventional operation in UPF.

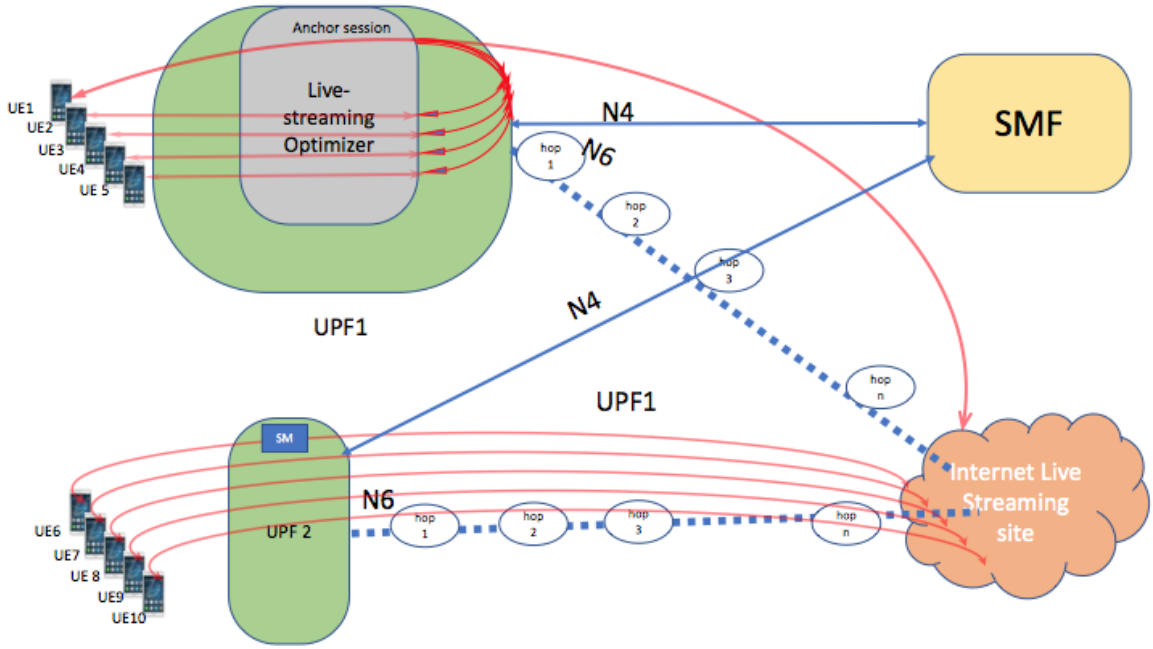


Figure 2

Sample Use Case:

Consider a UPF where there are multiple users watching a particular live streaming site. The intelligent Live Streaming Optimizer detects this scenario. When the number of users is more than a particular threshold, then this functionality may be automatically turned on. Similarly, when the number of users is less than a particular threshold, then this functionality may be automatically turned off. The Live Streaming Optimizer may then select a set of sessions that can be used as anchor sessions, replicate the content from those sessions, and copy it to the bearers of all other sessions that are watching the same live stream.

Activation of Live Streaming Optimizer within a UPF:

In order to enable the live streaming optimizer functionality within a UPF, a configurable parameter, "min_streams_for_optimization," may be set to a predetermined value.

Once the UPF detects that the number of users connected to a particular live streaming site crosses the threshold value of "min_streams_for_optimization," the live streaming optimizer functionality may be activated. Once the number of users connected

to a particular live streaming site drops below the value "min_streams_for_optimization," the functionality may be deactivated.

Anchor session selection:

At any given time when the live streaming optimizer feature is activated on a UPF, a minimum of three anchor sessions may be selected by the live streaming optimizer. The live streaming optimizer uses the content from these anchor sessions and copies it to the bearers of all other sessions that are watching the same live streaming content.

If any one of the anchor session disconnects, then the Live Streaming Optimizer may select another session as an anchor session to maintain the number of anchor sessions.

The selection criteria for an anchor session may be based on the combination of QoE of the session and the duration that the session is active.

Detection of candidate sessions for Live Streaming Optimization:

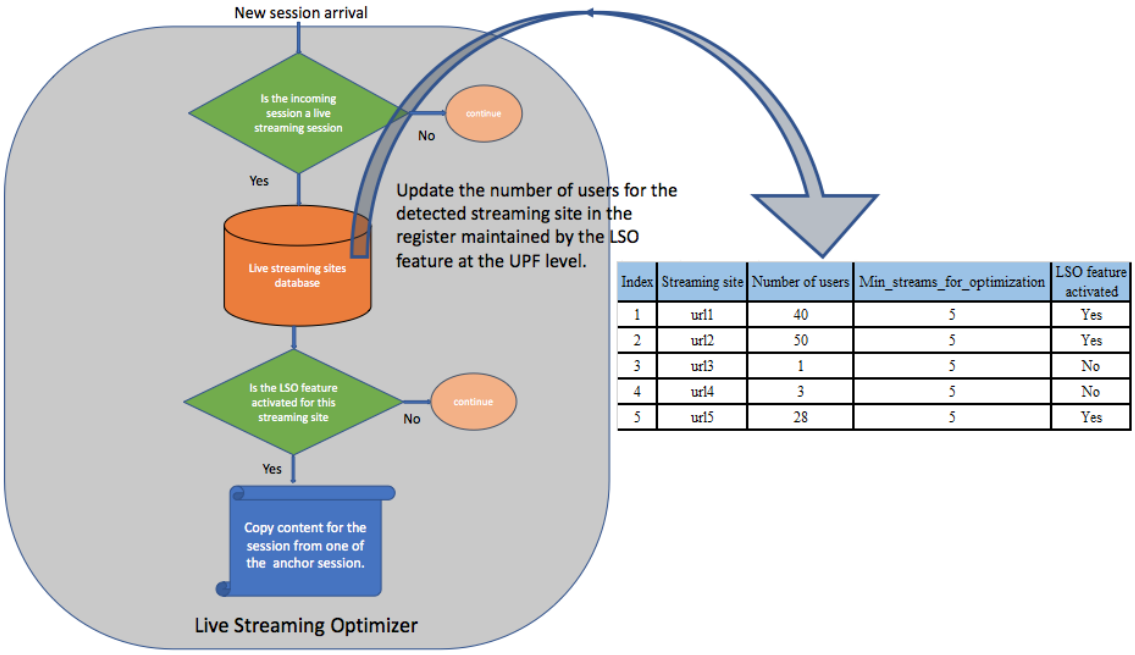
FIG. 3, below, is a flow diagram illustrating candidate session detection for live steaming optimization. In other words, FIG. 3 is a flow diagram illustrating how a session is chosen as a candidate for live streaming optimization.

Upon arrival of a session(s), the deep packet inspection is performed on the session(s) to determine whether it is a live streaming session.

The UPF may maintain a register for live streaming sites and the number of users that are using a particular live streaming site.

Based on the configuration of the "min_streams_for_optimization," it may be determined whether the LSO feature should be activated against a particular live streaming site.

If the LSO feature is activated, then for the new sessions, the content may be copied from one of the anchor sessions.



Index	Streaming site	Number of users	Min_streams_for_optimization	LSO feature activated
1	url1	40	5	Yes
2	url2	50	5	Yes
3	url3	1	5	No
4	url4	3	5	No
5	url5	28	5	Yes

Figure 3

In summary, 5G technology enables numerous applications that may need higher throughput. Moreover, video streaming has gained tremendous popularity since 4G and will likely continue to be in demand in future. Video streaming may have a use case of Live Streaming, in which millions of users are watching the same content at the same time. With better speeds, QoE for live streaming is expected to improve. However, service providers would typically need to over-provision their networks to handle such a surge in traffic, which on other days/during other times may not be utilized at all, leading to increases in capital expenditures (CapEx).

The solution proposed herein may address problems associated with the Live Streaming use case by improving the UPF so as to, for example, prevent a sudden spike in resource needs due to millions of subscribers downloading the same content at the same time. Thus, investments/costs to over provision network(s) may be saved.

The proposed solution introduces a new functionality on the 5G core (SMF and UPF) to intelligently detect live streaming applications for a user and replicate the flows to a large number of users viewing the same content, within a region.

The proposed solution may be most useful if the UPF is distributed and the Live Content or Internet Peering is still centralized. In such a scenario, the proposed solution

may help the transition phase as SPs make content more distributed along with UPF and have a combined strategy for the same.

The proposed solution may be employed to help service providers to continue using their legacy infrastructure for streaming while at the same time supporting 5G performance and reducing backhaul usage due to similar traffic being used by multiple users.