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TECHNIQUES TO FACILITATE POLICY DRIVEN CONVERSION OF UNICAST 5G SESSIONS TO MULTICAST

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ABSTRACT

Video consumption continues to increase for 4G/5G mobile networks, which can result in heavy costs to mobile and radio access networks. Currently, there are limited mechanisms that can monitor how much throughput and how many subscribers are involved in a particular telecast. Presented herein are techniques through which video/telecast sessions can be detected and transformed to broadcast communications, which can lead to savings in both mobile and radio access networks.

DETAILED DESCRIPTION

In today's 4G/5G mobile network environments, video consumption is growing and, in many instances, the same video/telecast (live telecast/live streams) is sent across millions of mobile subscribers using unicast streams. This can result in a heavy cost to the mobile and radio access networks. From analysis of application traffic involving Advanced Direct Connect/Peer-2-Peer (ADC/P2P) protocols for various network profiles, including top network operators, it is found that nearly 50%-70% of mobile network traffic involves video/telecast events.

Say, for example, that subscriber-1 attaches to a mobile network for telecast-1, subscriber-2 attaches for telecast-1, and so on till, the number of subscribers receiving telecast-1 reaches a relatively large number, say, approximately 50,000 subscribers. In this example, if each of these subscribers consumes 0.5 Megabits per second (Mbps) per user equipment (UE), then there is an aggregate 250 Gigabits per second (Gbps) of data transfer being consumed in the network.

Currently there are limited mechanisms that provide for the ability to monitor how much throughput and how many subscribers are involved in a particular telecast. However, if such information is available then the network can trigger a UE to switch to multicast/broadcast communications, thereby providing a savings on both Internet Protocol (IP) network and radio network resources. Considering the example cited earlier, the calculated 250 Gbps consumes not only radio network resources but also consumes the IP network resources, while the telecast by itself is 1 Mbps. Thus, the 250 Gbps of radio resources + 250 Gbps of IP backhaul resources could be reduced to 0.5 Mbps/RAN and 0.5Mbps * IP paths when utilizing a multicast tree involving, say, 100 paths at approximately 50 Mbps per path. Thus, multicast/broadcast communications for such telecasts could lead to network optimizations in which the approximately 500 Gbps could be reduced to approximately 100 Mbps.

Presented herein are techniques through which an intelligent algorithm can be used to detect and transform video/telecast communications to broadcast communications, thus saving resources in the mobile network and the radio access network (RAN). In particular, Figure 1, below, illustrates example details through which this proposal provides for the ability to convert unicast streams detected in a mobile network to multicast communications based on a policy-driven algorithm that takes into consideration multiple features, such as ADC/P2P and multicast protocols.

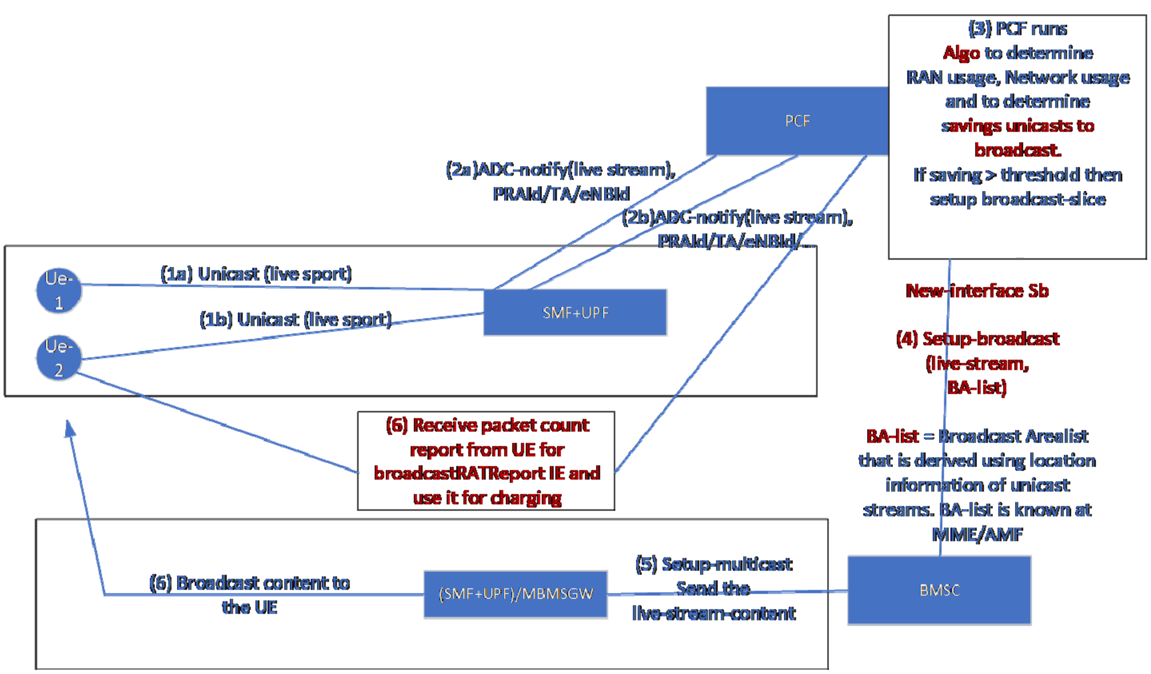

Figure 1: Unicast to Multicast Conversion Architecture

Consider an operational example, as illustrated in Figure 1, through which techniques of this proposal may be discussed. For example, as shown at (1a) and (1b), consider that multiple UE's start to watch a live event (e.g., a live sporting event, etc.). Consider that ADC capabilities on the User Plane Function (UPF) detect that the UEs are requesting live video streams and reports the detected events to the Session Management Function (SMF) for each UE session. Thereafter, as shown at (2a) and (2b), the SMF sends notifies the Policy Control Function (PCF) regarding the ADC information for each UE session.

The PCF can execute an algorithm, as generally illustrated at (3) and discussed in further detail below, to determine if a threshold is reached for the particular video stream based on either the number of UEs accessing the stream, certain bandwidth usage information, and/or any other parameters, as may be applicable. Once the threshold is reached, the PCF utilizes a new interface with a Broadcast-Multicast Service Centre (BMSC) in an Evolved Packet Core (EPC) to trigger multicast communication of the video stream, as generally illustrated at (4) of Figure 1.

Thereafter, the BM-SC triggers a control-plane Multimedia Broadcast Multicast Service Gateway/Packet Data Network (PDN) Gateway (MBMSGW/PGW-c) to setup the multicast stream, which in turn will program the UPF with the multicast session, as generally illustrated at (5). The PCF can inform the PGW to switch the sessions for the UEs to utilize a multicast communication session utilizing a DIAMETER Re-Authorization Request command. The PGW can then inform the UEs, via General Packet Radio Service (GPRS) Tunneling Protocol (GTP) Protocol Configuration Option (PCO) parameters, sent in update bearer request communications, to switch their communications from the unicast stream to the broadcast/multicast stream. Upon receiving update bearer request, each UE can switch to the broadcast/multicast stream, thereby facilitating conversion of the individual streams into one broadcast/multicast stream.

Recall the PCF algorithm, noted above at (4), which may be further described as follows. In one example, consider that broadcast discount tokens can be offered to UEs as part of smart contract subscription plans. A smart contract store can be configured for the Unified Data Management (UDM)/Unified Data Repository (UDR) entity, which can be accessed and assessed for the unicast to multicast conversion algorithm utilized by the PCF.

During operation, UEs subscribed to the smart contract can provide an asynchronous notification to the core network (PCF) consenting to unicast to broadcast conversions within the mobile core network/EPC in which the notification includes the IP address of the broadcast/multicast leader server for the EPC, such as the BMSC, which can be centrally located.

When a given UE detects the start of a unicast stream, the UPF can detect the stream and notify the SMF, which may include information such as stream utilization bandwidth (e.g., 400Mbps, etc.). It is to be understood that stream utilization bandwidth for each UE may vary depending on whether a given UE is utilizing Wi-Fi, 4G, or 5G communications. The SMF notifies the Policy Control Function (PCF) regarding the ADC information, and the stream utilization for each UE session. The PCF downloads the smart contract for the specific broadcast/multicast (Note: the PCF gets to know the broadcast/multicast content-ID via the ADC notification from UPF->SMF->PCF)from the UDM/UDR and runs its algorithm to determine the cost of unicast and make a decision as to whether to switch from Unicast to broadcast/multicast for that broadcast/multicast. Based on the output of this algorithm the PCF will notify the BMSC over a new interface to initiate the unicast to broadcast/multicast conversion/switch. The PCF algorithm for the UEs based on the smart contract and UE location, is as follows:

1. Map UE location to broadcast locations;
2. Multiply broadcast token from smart contract to stream utilization;
3. Add results to a bucket representing broadcast location;
4. Repeat steps 1-3 for a configurable duration;
5. Add the total across all buckets from step 3 (following the configurable duration);
6. Compute broadcast savings as:

   (Broadcast cost in mbps for application * number of RAN based on broadcast areas) / (value in step 5);

7. If the result of step 6 satisfies the threshold, the BMSC switches the unicast communications to a broadcast communication.

Although current 3GPP standards provide for MBMS or evolved MBMS (eMBMS) communications, there is currently no standards-based mechanism that provides for the ability to detect that a specific content consumption (i.e., unicast content consumption) is high for certain RAN tracking areas or network locations and, based on such detection, trigger a switch for unicast traffic to multicast traffic, or vice-versa. Further, 3GPP standards-based MBMS/eMBMS mechanisms do not provide for the ability to facilitate a path switch from unicast to broadcast communications based on policies from core network, or vice versa.

Still further, unicast streams typically originate from the Internet and broadcast/multicast communications are provided via the BMSC, however, there are currently no standards-based mechanisms defined for detecting high resource usage by unicast streams (for consuming broadcast-content) or for providing a policy-driven technique to switch between unicast to broadcast/multicast communications, and vice-versa.

Accordingly, the techniques of this proposal may result in a significant reduction in network bandwidth usage from current levels for IP communications between the core mobile network and the RAN, as well as for communications within the RAN itself. As 3GPP standards-based mechanisms lack the ability to detect/determine which locations such a broadcast would optimize resources, techniques herein further provide a new concept of broadcast areas through which network and RAN resources can be optimized.