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INNOVATIVE POLICY ENFORCEMENT IN A 5G/CUPS NETWORK USING HEADER ENRICHMENT

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ABSTRACT

Today, content providers are looking to offer personalized services to their subscribers. However, they are restricted by a lack of control over the policies that may be enforced for such subscribers within a mobile operator's network. To address such challenges, techniques are presented herein that introduce an in-band communication mechanism between a content provider and an operator's network. Such a facility enables the content provider and the operator to tailor their services while reaping benefits in terms of reduced capital expenditures (CapEx) and operating expenses (OpEx), avoiding multiple signaling hops, and simplifying subscriber policy management.

DETAILED DESCRIPTION

In a 3rd Generation Partnership Project (3GPP) fourth-generation (4G) and/or fifth-generation (5G) environment with Control and User Plane Separation (CUPS), policy enforcement is performed through a Policy Control Function (PCF)/Policy and Charging Rules Function (PCRF) by installing policy rules on a Session Management Function (SMF)/control plane (CP). Such policy rules are then propagated to a User Plane Function (UPF)/user plane (UP) in order to install the associated Packet Detection Rules (PDRs) and thus drive the traffic treatment on the UP/UPF.

For purposes of illustration, consider a case where a content provider would want to drive such policies by requesting special treatment for traffic for specific users within the operator's network depending upon their subscription profiles or under special offers. Figure 1, below, depicts elements of a typical call flow that would follow for such a use case.

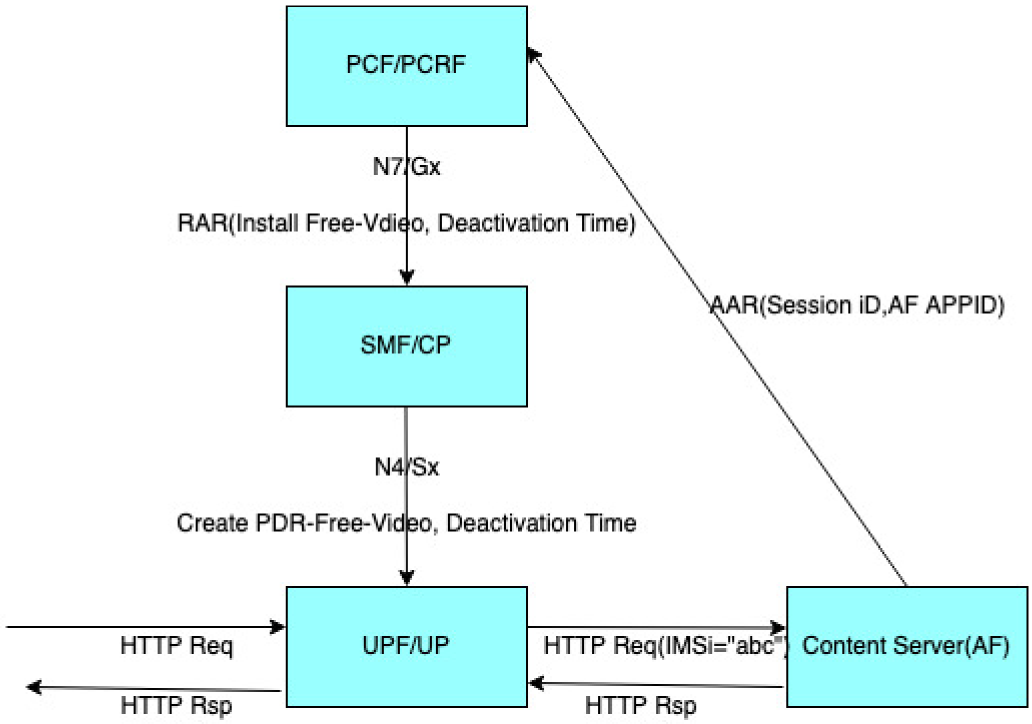

Figure 1: Illustrative Call Flow

The illustrative flow that is presented in Figure 1, above, encompasses a number of steps.

First, a Hypertext Transfer Protocol (HTTP) request arrives at a UPF/UP where the UPF/UP enriches the HTTP header by adding subscriber metadata. A content server then derives the subscription information from the subscriber metadata and accordingly triggers a policy request to the PCF/PCRF through an external interface. In the above example, an Authorization Authentication Request (AAR) is sent out over the Rx interface to trigger policy installation.

Upon receiving the AAR, the PCF/PCRF installs the appropriate rules on the SMF/CP to apply special treatment to such traffic for that subscriber. In turn, the SMF/CP installs the PDRs with a set deactivation time. Finally, the UPF/UP begins treating the traffic as defined by the policy for that subscriber until the policy timer expires.

As described and illustrated above, to support the identified use case specific interfaces (such as an Rx interface) need to be maintained in the network topology. Additionally, the approach that was depicted above involves messaging across multiple interfaces for enforcement of the policy.

To address the types of challenges that were described above, techniques are presented herein that support an in-band communication mechanism to avoid the overhead of maintaining a separate external policy interface. Further, such an approach avoids multiple transactions over various interfaces before a policy may be enforced on a UPF/UP.

While some solutions exist for passing user data to a content provider using header enrichment (e.g., one such solution encompasses enriching a Transport Layer Security (TLS) protocol or Secure Sockets Layer (SSL) protocol header for passing metadata), the techniques presented herein differ from existing solutions by providing control to the content provider, to alter a subscriber’s policies, that is enforced within an operator's network using an in-band mechanism.

In today's mobility world, operators and content providers have a requirement for providing personalized value-added services and subscriptions to customers in order to improve their customer retention and enhance the average revenue per user (ARPU).

In order to meet such a requirement, most operators are entering into partnerships with content providers. However, such content providers need a subscriber's metadata in order to tailor their services to the customer's preferences. The content providers require an ability to specify or alter the policies that are enforced, either for the lifetime of a session or for a specified duration for a particular subscriber in the operator's network. This could be in the form of changing the allocated bandwidth, the free rating of the traffic, or a quality of service.

Such policy enforcement is achieved today by adding an external interface between the content server and the operator's policy server (e.g., an Rx interface between a content server and a PCF/PCRF). Such an approach results in capital expenditures (CapEx) and operating expenses (OpEx) overhead for the operator as well as for the content provider.

Aspects of the techniques presented herein address the above issue by providing an in-band communication mechanism between a content provider and an operator's network, through which subscriber policies may be altered, thus eliminating the need for an external policy interface.

Figure 2, below, depicts elements of a call flow according to aspects of the techniques presented herein and reflective of the use case that was described above.

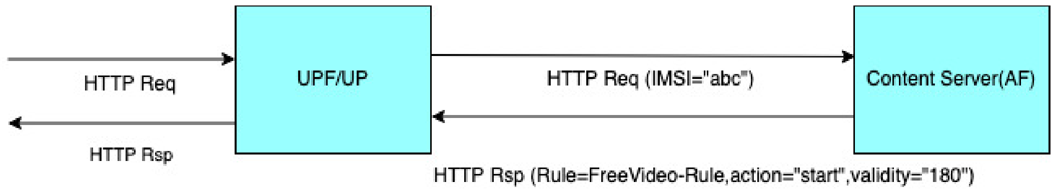

Figure 2: Illustrative Enhanced Call Flow

The illustrative flow that is presented in Figure 2, above, encompasses a series of steps. First, an HTTP request arrives at an UPF/UP where the UPF/UP enriches the HTTP header by adding subscriber metadata (e.g., an international mobile subscriber identity (IMSI), a Mobile Station International Subscriber Directory Number (MSISDN), etc.).

A content server derives the subscription information from the subscriber metadata and identifies the required policy that needs to be enforced for the subscriber in the operator's network. The policy enforcement information is relayed to the operator network by enriching the HTTP response header that is sent to the UPF/UP.

The UPF/UP retrieves the policy information and the validity information from the response and this is translated into a preconfigured policy on the UPF/UP. The UPF/UP strips off the enriched information from the HTTP response header and forwards the HTTP response packet to the user device.

Finally, the UPF/UP determines if the policy indicated by the content provider is in conflict with the policy installed by PCF/PCRF. If not in conflict, it begins enforcing the new policy as desired by the content provider for the lifetime of the session or until the policy validity expires. PCF/PCRF installed policy will always be given precedence over the preconfigured policy at UPF/UP.

According to aspects of the techniques presented herein, the mechanism that was described and illustrated above may be extended for other application protocols such as the WorkSpaces Streaming Protocol (WSP), the Hypertext Transfer Protocol Secure (HTTPS) protocol, the TLS protocol, the SSL protocol, QUIC, etc.

Application of aspects of the techniques presented herein, through which an in-band communication mechanism may be provided between a content provider and an operator, provides a number of benefits.

First, no additional external interface is required between the content provider and the operator, resulting in CapEx and OpEx reductions for the operator and the content provider. Second, for any policy modifications or additions no additional changes are required in a PCF/PCRF thus enabling easier and faster policy deployments for an operator and a content provider. Third, traffic is reduced on the N7 or Gx and the N4 or Sx interfaces for the network operator. Finally, there is an automatic rollback to a subscriber's initially-installed policy following the expiration of a policy validity period.

In summary, techniques have been presented herein that introduce an in-band communication mechanism between a content provider and an operator's network. Such a facility enables the content provider and the operator to tailor their services while reaping benefits in terms of reduced CapEx and OpEx, avoiding multiple signaling hops, and simplifying subscriber policy management.