

Policy Control



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Recall that the UPF does the work of a PDU session, and that the SMF give the UPF the tools needed for that job: packet detection rules (PDRs).

Policy control includes control of which PDRs the SMF places in the UPF. The entity that makes the decision of which PDRs the SMF shall place in the UPF is the policy control function, PCF.

Decision is an important word here; the PCF does not passively store policies and send them to the SMF; the PCF is intended to be the place where the 5G core is made self aware, and where external applications can influence policy, and where the logic of deciding on which policies to use is run.

Where packet detection rules come from

PCC stands for policy and charging control. This document is about the policy side of PCC. ITU regulations do not require 5G system to have PCC systems, but does prescribe how those systems work should operators choose to use them. In particular, it describes how the information used to create a set of packet detection rules that comprise a SDF template can get to the SMF.

Definition: A PCC rule is collection of information that an SMF can use to make a SDF template.

PCC rules are translated into a set of packet detection rules in the SMF.

Definition: A predefined PCC rule is a PCC rule that has been configured into the SMF, and thus does not need to be given to the SMF by another NF.

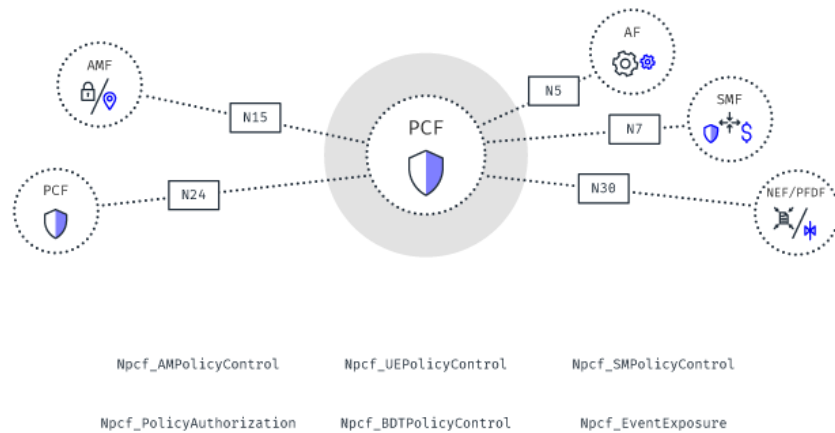
Predefined PCC rules can be arbitrarily detailed; they can go so far as to inspect packets beyond their headers. This is called deep packet inspection, DPI. PCC rules that are not pre-configured in the SMF do not have this level of freedom.

Definition: A dynamic PCC rule is a PCC rule delivered from the PCF to the SMF over the N7 reference point.

The PCF can be equipped with the ability makes decisions about which dynamic PCC rules to send to the SMF. The following sections detail the allowed contents of dynamic PCC rules, and the mechanisms by which the PCF can make informed decisions resulting in PCC rules.

Advisors of the PCF

The PCF can obtain information from other network functions that is relevant to making policy decisions. To obtain this information, the PCF can either subscribe to events in a NF or make one-off requests for information.



- AMF (access and mobility management function) provides information about UE location
- PCF can inform itself
- AF (application function) also informs the PCF of how to create PCC rules for an SDF for an application. An AF is the mechanism by which an application a UE is accessing can communicate with the core. This communication is so important in the design of the 5G core that it has a designated reference point; N5 is the designated reference point for applications to communicate with the PCF. This reference point is for use only by operator trusted AFs.
- SMF provides to the PCF information gathered in the UPF, including notification that packets that do not fit into any SDF have been detected, and usage reports for each application.
- NEF (network exposure function) can be used to allow untrusted application functions to provide information to the PCF.
- CHF (charging function) provides information on a subscriber's spending limit status; if a user has paid for 3MB of access to an app, and used all 3MB, then the PCF can send a PCC rule that leads to the SMF creating a filter to block packets for that application.
- UDR (user data registry) provides information about a user's subscriptions; if a user does not have a subscription for an application then the PCC rule can contain a filter to block packets for that application.
- AN (access network) provides the PCF information about which type of access technology is used (5G NR or WiFi etc) and optionally about radio resources, which might be affected by the PCF's decision.

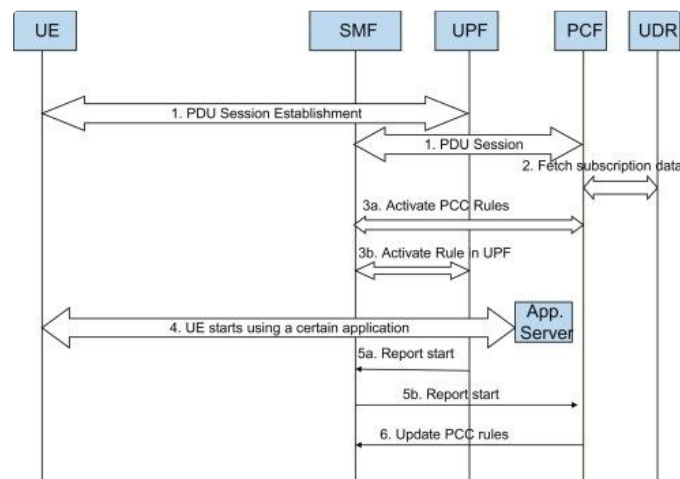
Information in Dynamic PCC Rules

Dynamic PCC rules need to contain enough information for the SMF to create the packet filters that constitute a SDF template. In particular they contain

- identifying information for packets belonging to the SDF (could be address, domain name, or other features)
- gating status, determining if the UPF shall forward the packets or drop the packets
- order in which to apply the filters, in case multiple filters apply to the same packet
- QoS information for the SDF
 - 5QI
 - QoS notification control, which determines if the core should be notified if the access network can no longer support the requested QoS parameters.
 - Bit rates for the SDF
 - Uplink and downlink maximum bit rate for the SDF
 - uplink and downlink guaranteed bit rate for the SDF
 - reflective QoS indicator, which indicates that the same QoS parameters should be used in the uplink and downlink direction, communication needed to set up the two QoS flows.
 - Indicator of if the RAN should be notified when the core can no longer support the guaranteed flow bit rate.

- charging data for the SDF
 - charging method, which can be
 - offline for collecting metrics about usage as it is used, and then generating a bill at the end of a billing cycle
 - online for requiring authorization for use, and therefore needing some kind of pre-paid component like
 - direct debiting (charging for a service immediately when the service is started) or
 - unit reservation (charging for an amount of use before use begins, and refunding for unused portion upon completion of service/session).
 - charging key, which allows the CHF to decide which tariff (tax) to apply
 - sponsor ID, for allowing someone other than the user of the application to pay for use of the application
 - measurement method, which can be data volume, session duration, the previous two combined, or event based.
- usage monitoring control information
 - monitoring key, whereby SDFs with the same monitoring key can be grouped together for any needed reason; perhaps two SDFs belong to the same application, perhaps one sponsor is set up to pay for the use of multiple applications, perhaps one sponsor is set up to pay for use of an application by multiple users...
 - traffic steering identifier, which steers traffic toward an edge computing host
 - data network access identifier, which is an identifier for the target data network
 - N6 routing info, which is the address the uplink packets should be sent to on the data network, including the case where the uplink packets should be sent to an edge data center.

Because dynamic PCC rules, sent to the SMF by the PCF after a PCC decision is made, contain this information, the SMF has the information it needs to create an SDF. That SDF is a collection of packet detection rules (PDRs) that the SMF can create, update, or delete in the UPF as needed. This is the mechanism by which informed policy is made, policy informs session management, and session management gives the UPF tools for 5G core user plane functionality.



Policy Control Request Triggers

Policy Control Request Triggers

PCRPRTs are events in the SMF that trigger the SMF to send a request to the PCF for a PCC rule for a session. Examples of such events are:

- the UPF is experiencing congestion,
- SMF has been notified of change of location of the UE (by the AMF)
- the UPF is experiencing congestion,

- SMF has been notified of change of location of the UE (by the AMF)

Charging Events

If the user has run out of credit for the application in use the UPF must stop routing packets for the application. The SMF must come to know that credit has run out. To do this, each PDU session is assigned a CHF instance and a connection is maintained between the SMF and CHF, the SMF sends the CHF usage reports, and the CHF calculates a `policy counter status`. When the policy counter status changes to indicate that credit has run out, the CHF sends the PCF a spending limit report.