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Differential Charging on Non-Standalone 5G Networks

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ABSTRACT

In non-standalone architecture (NSA), a migration path to 5G, there is no easy way for a billing module to differentiate 5G data from LTE data, since most messages and attributes are by design kept identical to LTE. This disclosure describes techniques to enable a serving/PDN-gateway (SPGW) node to simulate a change in radio access technology (RAT) based on the IP ranges of the radio nodes. Online, RAT-based charging for data subscribers in the 5G NSA network can thereby be supported by the SPGW. The techniques have minimal impact on the overall ecosystem. In particular, other core or radio nodes need no modifications. There is minimal performance impact on the SPGW. Online charging is supported with the same features as available to communication service providers (CSPs) today.

KEYWORDS

- Differential charging
- Radio access technology (RAT)
- RAT-based charging
- RAT detection
- 5G network
- Non-standalone Architecture (NSA)
- Communication service provider (CSP)
- Serving gateway (SWG)
- Premises distribution network (PDN)
- Serving/PDN-gateway (SPGW)
- Serving gateway (SGW)
- Packet network data gateway (PGW)
- Evolved packet core (EPC)
- Policy and charging rules function (PCRF)

BACKGROUND

GSMA has released an interim migration path to 5G, known as non-standalone architecture (NSA). Of multiple NSA deployment options, many communication service providers (CSPs) have chosen NSA option-3x, which enables gradual build-out of a 5G network while using the existing packet core network nodes with minimal or no changes. A challenge with NSA option-3x is that there is no easy way for the billing module to differentiate 5G data from LTE data, since most messages and attributes, especially, the radio access type (RAT), are by design kept identical to LTE.

While an option-3x evolved packet core (EPC) can somewhat non-disruptively split the data bearer on a 5G base station, it has difficulty in effectively reporting usage based on radio access technology (RAT). An added complexity is that a solution should optimally work without any major changes in the core nodes, as that is a design goal of the NSA option-3x architecture. While some original equipment manufacturers (OEMs) provide custom traffic-separation logic in the mobile management entity (MME), changes to the billing module are required to either support 5G parameters (RAT Type = NR) or mimic the same in some other node.

DESCRIPTION

This disclosure describes techniques to enable a serving/packet data network (PDN) gateway (SPGW) node to simulate a change in radio access technology (RAT) based on the internet protocol (IP) ranges of the radio nodes. Online, RAT-based charging for data subscribers in a 5G NSA network can thereby be supported by the SPGW.

Differential charging for the evolved packet core (EPF) can be achieved as follows.

1. Detect the 5G RAT at the serving gateway (SGW).
2. Propagate the detected 5G RAT from SGW to the packet network data gateway (PGW).

3. Pass the detected RAT information to the policy and charging rules function (PCRF).

4. Determine policy and quota information.

The above are illustrated in Fig. 1 and described in greater detail below.

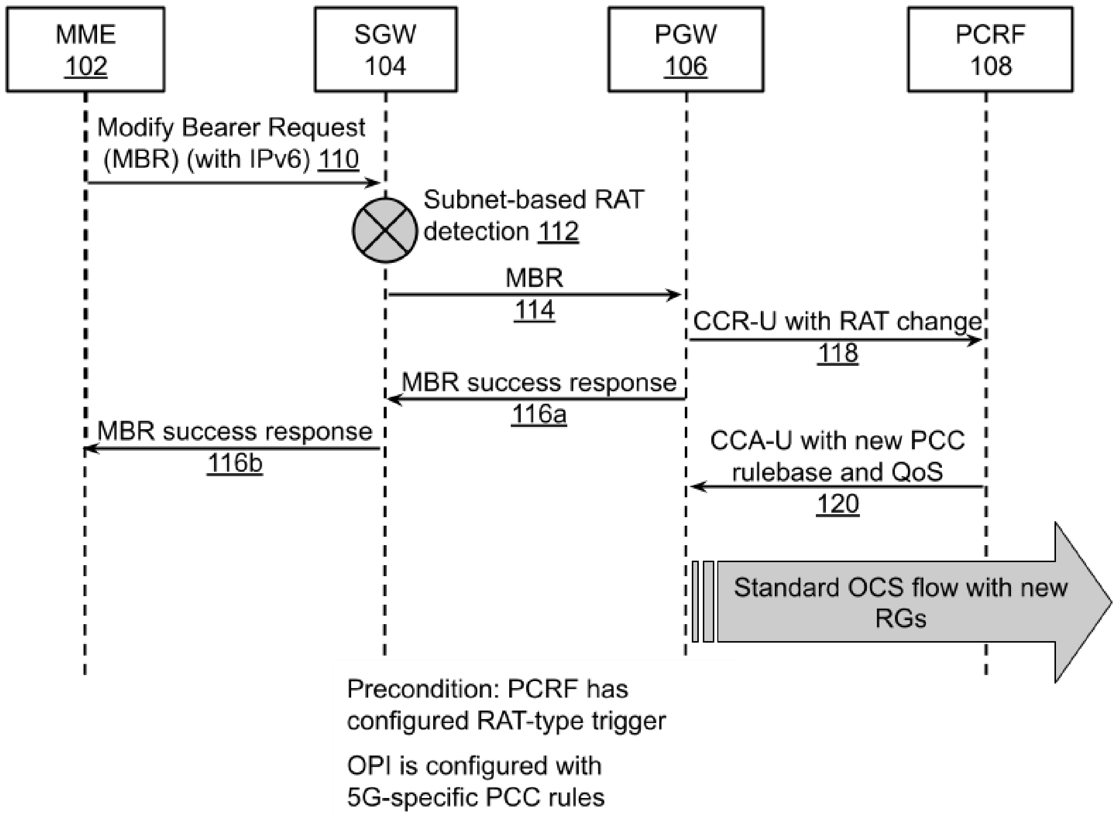

Fig. 1: Differential Charging on Non-Standalone 5G Networks

Fig. 1 illustrates differential charging on non-standalone 5G networks, in particular, the flow of information between a mobile management entity (MME, 102), a serving gateway (SGW, 104), a PDN gateway (PGW, 106), and a policy and charging rules function (PCRF, 108).

Detect the 5G RAT at the serving gateway

When a “modify bearer request” (MBR) message transmitted by the MME is received by the SGW with a specific IPv6 address (110) it is taken that the associated node-B (base station) is a gNB (next-generation node-B). The SPGW maintains a list of subnets (with an upper limit to the number of subnets) to determine if the cell is an evolved node-B (eNB) or a gNB.

Propagate the detected 5G RAT from SGW to PGW

At the SGW, the subnet is used to detect the RAT (112). A custom element in the MBR message that specifies the RAT-type information can be used to send 5G RAT information from the SGW to the PGW (114). The PGW responds with an MBR success response (116a) sent to the SGW, and the SGW responds with an MBR success response (116b) sent to the MME.

Pass the detected RAT information to the online charging system (OCS)

If the PCRF has configured the RAT-type trigger on the EPC, a CCR-U message (credit control request: update) is generated towards the PCRF (118) on the Gx interface - an interface used to send rule-provisioning and traffic-plane information between the policy/charging rules and enforcement functions (PCRF and the PCEF). This initiates a flow that enables the PCRF/IN to send a new rule base (120). The actual RAT-type value can be configurable.

Determine policy and quota information

Rules related to the new rule base are statically provisioned. The communication service provider (CSP) provides the rules and RG values to be provisioned. New quota is received on the Gy interface - an interface between the PGW and the Online Charging Server/System (OCS) in the form of a CCA-U (credit control answer: update) message (120).

Some advantages of the described techniques include:

- CSPs can use existing prepaid/online charging solutions and retrofit it for 5G billing.
- The provision of the custom RAT value enables CSPs to continue using billing solutions below 3GPP release 14, e.g., for nodes that do not yet support new RAT types for 5G.

- The simplified and isolated nature of the described techniques provides CSPs with the flexibility to implement different policy enforcements in a manner similar to current LTE networks.
- The techniques do not impact performance and do not require additional hardware support on the SPGW.

The techniques have minimal impact on the overall ecosystem. In particular, other core or radio nodes need no modifications. Online charging is supported with the same features as available to CSPs today.

CONCLUSION

This disclosure describes techniques to enable a serving/PDN-gateway (SPGW) node to simulate a change in radio access technology (RAT) based on the IP ranges of the radio nodes. Online, RAT-based charging for data subscribers in the 5G NSA network can thereby be supported by the SPGW. The techniques have minimal impact on the overall ecosystem. In particular, other core or radio nodes need no modifications. There is minimal performance impact on the SPGW. Online charging is supported with the same features as available to communication service providers (CSPs) today.

REFERENCES

1. "5G Implementation Guidelines: NSA Option 3 - Future Networks" available online at https://www.gsma.com/futurenetworks/wiki/5g-implementation-guidelines/ accessed Mar 2, 2023.