Expanded Prioritization for VoLTE/Emergency Calls

This chapter describes the StarOS support for the Expanded Prioritization for VoLTE/Emergency Calls feature on the P-GW, SAE-GW, and S-GW.

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Feature Description

The National Security/Emergency Preparedness (NS/EP) Next Generation Network (NGN) Priority Services (NGN-PS) (formerly called NGN Government Emergency Telecommunications Service (GETS)) is a set of voice, video and data services that are based on services available from public packet-switched Service Providers. The NS/EP NGN-PS provides priority treatment for a Service User's NS/EP communications and is particularly needed when the Service Providers' networks are impaired due to congestion and/or damage from natural disasters (such as floods, earthquakes and hurricanes) and man-made disasters (such as physical, cyber or other forms of terrorist attacks).

The DSCP marking of control message from P-GW and S-GW was based on associated egtpc-service configuration.

For control message belonging to eMPS session or containing Allocation and Retention Priority (ARP) associated with eMPS profile, the DSCP marking is based on eMPS profile configured DSCP value.

As part of this enhancement, support is also added for marking of certain GTP-C message at the P-GW and S-GW for priority treatment as defined in the Government Industry Requirements (GIR) NS/EP NGN.

Relationships to Other Features

Bulkstats for GTP-C Messages by ARP Value: The S-GW/P-GW will generate peg counts of the total number of received GTP-C messages containing an ARP, chosen from the set of values allocated for NS/EP NGN-PS use, for a specified interval (in minutes). This peg count is administered at the S-GW/P-GW level.

To prevent throttling of GTP-C messages corresponding to eMPS PDNs or messages containing ARP from set of configured ARP(PL) reserved for NS/EP NGN priority service, following configuration are to be considered:

1. **Load Overload control**

   In overload control profile, the set of ARPs reserved for NS/EP NGN-PS use for eMPS services should also be defined under **throttling-behavior exclude** and **self-protection-behavior exclude** CLI commands. This will ensure that incoming GTP-C messages for eMPS PDN or containing ARP from set of reserved ARP for eMPS use are not throttled. Example of configuring Load Overload configuration:

   ```
   configure
     gtpc-overload-control-profile profile_name
       throttling-behavior { earp { 1...15 } * } { exclude }
       self-protection-behavior { earp { 1...15 } * }  { exclude }
       end
   ```

2. **For Prioritized handling of calls under Congestion condition**

   ARP reserved under NS/EP NGN-PS for eMPS services is recommended to be configured under following congestion control CLI command. This will ensure that new call requests are not throttled during congestion condition defined by the **congestion-control** CLI command at context level:

   ```
   configure
     context context_name
       egtp-service service_name
         gtpc allow-on-congestion arp arp_value
         end
   ```

3. **GTP-C RLF Throttling**

   - If GTP-C RLF Throttling feature is enabled, then **gtpc overload-protection egress throttling-override-policy** CLI command should be configured with ARP(PL), reserved for NS/EP NGN-PS use, for eMPS services to bypass RLF throttling.
   - If GTP-C RLF Throttling for incoming messages is configured using **gtpc overload-protection ingress msg-rate** *message_rate* CLI command, then eMPS related messages can get throttled. Currently, there is no bypass policy for incoming RLF throttling.

Important Any existing features which works on ARP (PL) configurations will continue to work as before irrespective of whether ARP values configured are same as reserved under NS/EP NGN-PS for eMPS services. If existing features need to work with eMPS requirements, then same ARP (PL) values should be configured as reserved NS/EP NGN-PS for eMPS services.

Licensing

The DSCP marking capability requires that a valid license key be installed. Contact your Cisco Account or Support representative for information on how to obtain a license.

How It Works

GIR Document References

The following table describes the requirements of this feature as per the GIR document.

Requirement No.	Description
R-127	[202] The S-GW shall transmit with priority a GTP-C “Downlink Data Notification” message or a GTP-C “Create Bearer Request” message or a GTP-C “Update Bearer Request” message, any of which contains an ARP chosen from the set allocated by the Service Provider for use by NS/EP NGN-PS.
R-130	[204] The S-GW shall mark for priority treatment the S11 “Create Session Response” message from the S-GW to the MME which contains request to establish a bearer or bearers with an ARP corresponding to an NS/EP NGN-PS call/session.
R-132	[205] The S-GW shall mark for priority treatment the S11 “Create Bearer Request” and S11 “Update Bearer Request” messages from the SGW to the MME which contains an indication that a UE currently has an established/updated bearer or bearers for NS/EP NGN-PS service.
R-134	[206] In the case where the S5/S8 Interface is GTP-based, the S-GW shall mark for priority treatment the S5/S8 “Create Session Request” message from the S-GW to the PDN-GW which contains an indication that a UE will establish a bearer or bearers for NS/EP NGN-PS.
R-137	[207] In the case where the S5/S8 Interface is GTP-based, the S-GW shall mark for priority treatment the S5/S8 “Create Bearer Response” and “Update Bearer Response” messages from the S-GW to the PDN-GW which contain an indication that a UE currently has established / updated a bearer or bearers for NS/EP NGN-PS.
R-143	[213] In the case where the S5/S8 Interface is GTP-based, the PDN-GW shall mark for priority treatment the S5/S8 “Create Session Response” message from the PDN-GW to the S-GW which contains a request to establish a bearer or bearers with an ARP corresponding to an NS/EP NGN-PS call/session.
R-146	[216] In the case where the S5/S8 Interface is GTP- based, the PDN-GW shall mark for priority treatment the S5/S8 “Create Bearer Request” and “Update Bearer Request” messages from the PDN-GW to the S-GW which contain an indication that a UE currently has an established/updated bearer or bearers for NS/EP NGN-PS.

Configuring Expanded Prioritization for VoLTE/Emergency Calls

The following section provides the configuration commands to enable the feature.

Configuring eMPS Profile and its Associated Attributes

At Configuration Mode level, CLI command option is introduced to define an eMPS profile and its associated attributes like:

- **eARP configuration**: This configuration is used for marking a bearer/PDN as an eMPS.
- **DSCP configuration**: This configuration is used at S-GW/P-GW to mark various outgoing GTP-C messages associated with an eMPS PDN with configured DSCP marking.

```
configure
   [ no ] emps-profile emps_profile_name -noconfirm
   [ no ] earp { [ 1...15 ] { [ 1...15 ] { [ 1...15 ] } } }
   [ no ] dscp-marking dscp_value
   end
```

Notes:

- **emps-profile** *emps_profile_name*: Configures eMPS profile for defining attributes of an eMPS session. The *emps_profile_name* is a string of size from 1 to 63.
- **earp**: Configures a maximum of 3 eARP priority level (PL) values so that sessions with configured eARP priority values can be marked as eMPS sessions.
- **-noconfirm**: Creates a new eMPS profile without prompting for confirmation.
- **dscp-marking** *dscp_value*: Specifies the DSCP value to be applied to eMPS sessions. The *dscp_value* is a hexadecimal number between 0x0 and 0x3F.
- Maximum of 3 eARP values can be configured under an eMPS profile. The above CLI syntax provides flexibility to configure one or more (max 3) eARP values in a single command. For example:

  earp 1 2 3

  -Or-

  earp 4
- The latest set of eARP values configured will overwrite the previous configuration. For example: Invoking below two commands in sequence will configure only eARP value 4.

  earp 1 2 3

  earp 4
- eMPS profile name should be unique and is treated case insensitive across context.
- The **no earp** command can be used to disable all configured eARP values. However, this will not delete the corresponding eMPS profile. The **no emps-profile** *emps_profile_name* CLI command will delete the profile.

- Warning message: When **no** of a non-existent eMPS profile is executed, a warning message is displayed. For example:

```
no emps-profile xyz
eMPS Profile : xyz does not exist
```

  There will be no warning message if **no** of an un-configured eARP is executed.

- There will be a warning and confirmation message when existing profile is deleted:

```
This operation will result in deletion of this eMPS Profile.
Are you sure? [Yes|No]:
```

- Maximum of 64 different eMPS profiles can be configured.

Associating an eMPS Profile with P-GW Service

The commands illustrated below associates an eMPS profile to P-GW service.

```
configure
  context context_name
    pgw-service service_name
      associate emps-profile emps_profile_name
      end
```

Notes:

- **no associate emps-profile**: Disables the feature.
- **emps-profile** *emps_profile_name*: Associates an eMPS profile with the P-GW service. The *emps_profile_name* is a string of size 1 to 63.
- The eMPS profile name in input is treated as case insensitive.
- By default, no eMPS profile is associated with pgw-service.
- For SAE-GW associated P-GW service, the eMPS profiles should be same as configured in associated S-GW service. In case of any discrepancy, it will be reported in the **show configuration error** CLI command output.

Associating an eMPS Profile with S-GW Service

The commands illustrated below associates an eMPS profile to S-GW service.

```
configure
  context context_name
    sgw-service service_name
      associate emps-profile emps_profile_name
      end
```

Notes:

- **no associate emps-profile**: Disables the feature.
- **emps-profile** *emps_profile_name*: Associates an eMPS profile with the S-GW service. The *emps_profile_name* is a string of size 1 to 63.

- The eMPS profile name in input is treated as case insensitive.
- By default, no eMPS profile is associated with sgw-service.
- For SAE-GW associated S-GW service, the eMPS profiles should be same as configured in associated P-GW service. In case of any discrepancy, it will be reported in the **show configuration error** CLI command output.

Monitoring and Troubleshooting the Expanded Prioritization for VoLTE/Emergency Calls

This section provides information regarding show commands and/or their outputs in support of this enhancement.

Show Command(s) and/or Outputs

show emps-profile { all | name <emps_profile_name> }

The above CLI command is introduced to see a particular or all eMPS profile(s) configured with its associated attributes. Also, the output of an existing **show config [verbose]** CLI command is modified to reflect an eMPS configuration:

- **earp configured**: <earp_value>
- **dscp-marking configured**: <dscp-value>

These CLI commands can be used to verify if the configuration is appropriate.

show pgw-service { name <name> | all }

The output of this command is modified to reflect the eMPS profile associated with the P-GW service:

- **eMPS Profile Name** : <emps_profile_name>

Important Maximum of one eMPS profile can be associated with P-GW service at a time; the latest configuration will overwrite the previously associated configuration.

show sgw-service { name <name> | all }

The output of this command is modified to reflect the eMPS profile associated with the S-GW service:

- **eMPS Profile Name** : <emps_profile_name>

Important Maximum of one eMPS profile can be associated with S-GW service at a time; the latest configuration will overwrite the previously associated configuration.

show subscribers pgw-only full all

The output of this command is modified to reflect whether the session is eMPS or not. For example:

```
Username: 0123456789@username
 Subscriber Type   : Visitor
 Status            : Online/Active
 State             : Connected
 Connect Time      : Wed Sep  7 07:02:49 2016
 Auto Delete       : No
 Idle time         : 00h00m08s
 MS TimeZone       : n/a                    Daylight Saving Time: n/a
 Access Type: gtp-pdn-type-ipv4             Network Type: IP
 Access Tech: eUTRAN                        pgw-service-name: pgw_service
 Callid: 00004e21                           IMSI: 123456789012341
 MSISDN: 0123456789
 Interface Type: S5S8GTP                    Low Access Priority: N/A
 TWAN Mode: N/A
 eMPS Bearer: Yes
 Emergency Bearer Type: N/A
 IMS-media Bearer: No
```

show subscribers saegw-only full all

The output of this command is modified to reflect whether the session is eMPS or not. For example:

```
Username: 0123456789@username
 SAEGW Call mode   : Co-located
 Subscriber Type   : Home
 .
 .
 .
 MSISDN: 0123456789
 TWAN Mode: N/A
 eMPS Bearer: Yes
 MS TimeZone       :                     Daylight Saving Time: n/a
 MEI               : 1122334455667788    Accounting mode      : GTPP
```

show pgw-service statistics

The output of this command is modified to display the eMPS PDN statistics information. For example:

```
PDNs By Emergency-Type:
 Emergency PDNs:
  Active:               0    Setup:            0
   Authentic IMSI:      0    Authentic IMSI:   0
 .
 .
 .
eMPS PDNs:
  Current Active:                  1       Cumulative Activated:   1
  Cumulative De-activated:         1
IPv4v6 PDN-Type Received with DAF False :         0
```

Where:

- **Current Active**: Increments when any PDN is setup as an eMPS PDN or upgraded to eMPS PDN. Decrements when an eMPS PDN is released or when it degrades to a non-eMPS PDN.
- **Cumulative Activated**: Increments when any PDN is setup as an eMPS PDN or upgrades to an eMPS PDN.

- **Cumulative De-activated**: Increments when an eMPS PDN is released or when it degrades to a non-eMPS PDN.

show saegw-service statistics all function pgw

The output of this command is modified to display the eMPS PDN statistics information. For example:

```
PDNs By Emergency-Type:
 Emergency PDNs:
  Active:              0    Setup:            0
   Authentic IMSI:     0    Authentic IMSI:   0
 .
 .
 .
eMPS PDNs:
  Current Active:                  1      Cumulative Activated:   1
  Cumulative De-activated:         1
IPv4v6 PDN-Type Received with DAF False :         0
```

Where:

- **Current Active**: Increments when any PDN is setup as an eMPS PDN or upgraded to eMPS PDN. Decrements when an eMPS PDN is released or when it degrades to a non-eMPS PDN.
- **Cumulative Activated**: Increments when any PDN is setup as an eMPS PDN or upgrades to an eMPS PDN.
- **Cumulative De-activated**: Increments when an eMPS PDN is released or when it degrades to a non-eMPS PDN.

show saegw-service statistics

The output of this command is modified to display the eMPS statistics for PGW-Anchored/SGW-Anchored PDNs associated with the saegw-service. For example:

```
PDNs By Emergency-Type:
 Emergency PDNs:
  Active:              0    Setup:            0
  Released:      0
 .
 .
 .
eMPS PDNs:
 Colocated PDNs:
  Current Active:                  1      Cumulative Activated:   1
  Cumulative De-activated:         0
 PGW-Anchor PDNs:
  Current Active:                  1      Cumulative Activated:   1
  Cumulative De-activated:         0
 SGW-Anchor PDNs:
  Current Active:                  1      Cumulative Activated:   1
  Cumulative De-activated:         0
```

The above statistics information are further classified based on SAE-GW call types:

- **Colocated eMPS PDNs**: It reflects the eMPS PDN statistics information for collapsed PDNs.
- **PGW-Anchor eMPS PDNs**: It reflects the eMPS PDN statistics information for PGW-Anchor PDNs.

- **SGW-Anchor eMPS PDNs**: It reflects the eMPS PDN statistics information for SGW-Anchor PDNs.

Where:

- **Current Active**: Increments when any PDN is setup as an eMPS PDN or upgraded to eMPS PDN. Decrements when an eMPS PDN is released or when it degrades to a non-eMPS PDN.
- **Cumulative Activated**: Increments when any PDN is setup as an eMPS PDN or upgrades to an eMPS PDN.
- **Cumulative De-activated**: Increments when an eMPS PDN is released or when it degrades to a non-eMPS PDN.

show sgw-service statistics all

The output of this command is modified to reflect whether the session is eMPS or not. For example:

```
Subscribers Total:
  Active:               0    Setup:            2
  Released:             1
 .
 .
 .
eMPS PDN Statistics:
  Current Active:                   1       Cumulative Activated:    1
  Cumulative De-activated:          0
```

show saegw-service statistics all function sgw

The output of this command is modified to display the eMPS PDN statistics information. For example:

```
Subscribers Total:
  Active:               0    Setup:            0
  Released:             0
 .
 .
 .
eMPS PDN Statistics:
  Current Active:                   1       Cumulative Activated:    1
  Cumulative De-activated:          0
```

show configuration error

System will show configuration errors for following scenarios:

- When different eMPS profiles are configured under pgw-service and sgw-service associated to same sae-gw service. For example:

```
##############################################################
    Displaying SAEGW-Service system errors
##############################################################
Error   : eMPS profile of SGW <sgw-service> and PGW service <pgw_service>
is not same for SAEGW service <saegw-service> in the context <context_name>.
Total 1 error(s) in this section !
```

- When non-existent emps-profile is associated to pgw-service. For example:

```
##############################################################
    Displaying PGW-Service system errors
##############################################################
```

```
Error   : eMPS Profile <emps_profile_pgw> configured for PGW service <pgw_service>
is not present in the system
Total 1 error(s) in this section !
```

- When non-existent emps-profile is associated to sgw-service. For example:

```
##########################################################
    Displaying SGW-Service system errors
##########################################################
Error   : eMPS Profile <emps_profile_sgw> configured for SGW service <sgw_service>
is not present in the system
Total 1 error(s) in this section !
```

Bulkstats for Expanded Prioritization for VoLTE/Emergency Calls

PGW Schema

The following bulk statistics have been added to the P-GW schema as part of this enhancement:

- sessstat-pdn-emps-current-active – The total number of currently active P-GW eMPS PDNs.
- sessstat-pdn-emps-cumulative-activated – The total number of P-GW PDNs that are either setup as an eMPS PDN or upgrades to an eMPS PDN.
- sessstat-pdn-emps-cumulative-deactivated – The total number of P-GW PDNs that were either released or degrades to a non-eMPS PDN.

SGW Schema

The following bulk statistics have been added to the S-GW schema as part of this enhancement:

- sessstat-pdn-emps-current-active – The total number of currently active S-GW eMPS PDNs.
- sessstat-pdn-emps-cumulative-activated – The total number of S-GW PDNs that are either setup as an eMPS PDN or upgrades to an eMPS PDN.
- sessstat-pdn-emps-cumulative-deactivated – The total number of S-GW PDNs that were either released or degrades to a non-eMPS PDN.

SAEGW Schema

The following bulk statistics have been added to the SAE-GW schema as part of this enhancement:

- pgw-anchor-pdns-emps-current-active – The total number of currently active P-GW anchored eMPS PDNs.
- pgw-anchor-pdns-emps-cumulative-activated – The total number of P-GW anchored PDNs that are either setup as an eMPS PDN or upgrades to an eMPS PDN.
- pgw-anchor-pdns-emps-cumulative-deactivated – The total number of P-GW anchored PDNs that were either released or degrades to a non-eMPS PDN.
- saegw-colocated-pdns-emps-current-active – The total number of currently active SAE-GW collapsed eMPS PDNs.
- saegw-colocated-pdns-emps-cumulative-activated – The total number of SAE-GW collapsed PDNs that are either setup as an eMPS PDN or upgrades to an eMPS PDN.

- saegw-colocated-pdns-emps-cumulative-deactivated – The total number of SAE-GW collapsed PDNs that were either released or degrades to a non-eMPS PDN.
- sgw-anchor-pdns-emps-current-active – The total number of currently active S-GW anchored eMPS PDNs.
- sgw-anchor-pdns-emps-cumulative-activated – The total number of S-GW anchored PDNs that are either setup as an eMPS PDN or upgrades to an eMPS PDN.
- sgw-anchor-pdns-emps-cumulative-deactivated – The total number of S-GW anchored PDNs that were either released or degrades to a non-eMPS PDN.