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March 2022

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Recommended Citation

Telang, Mahesh, "Optimized Emergency Call Handling in NR-5G Only Mode Without Emergency Call Support", Technical Disclosure Commons, (March 30, 2022)

https://www.tdcommons.org/dpubs_series/5032



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OPTIMIZED EMERGENCY CALL HANDLING IN NR-5G ONLY MODE WITHOUT EMERGENCY CALL SUPPORT

Abstract

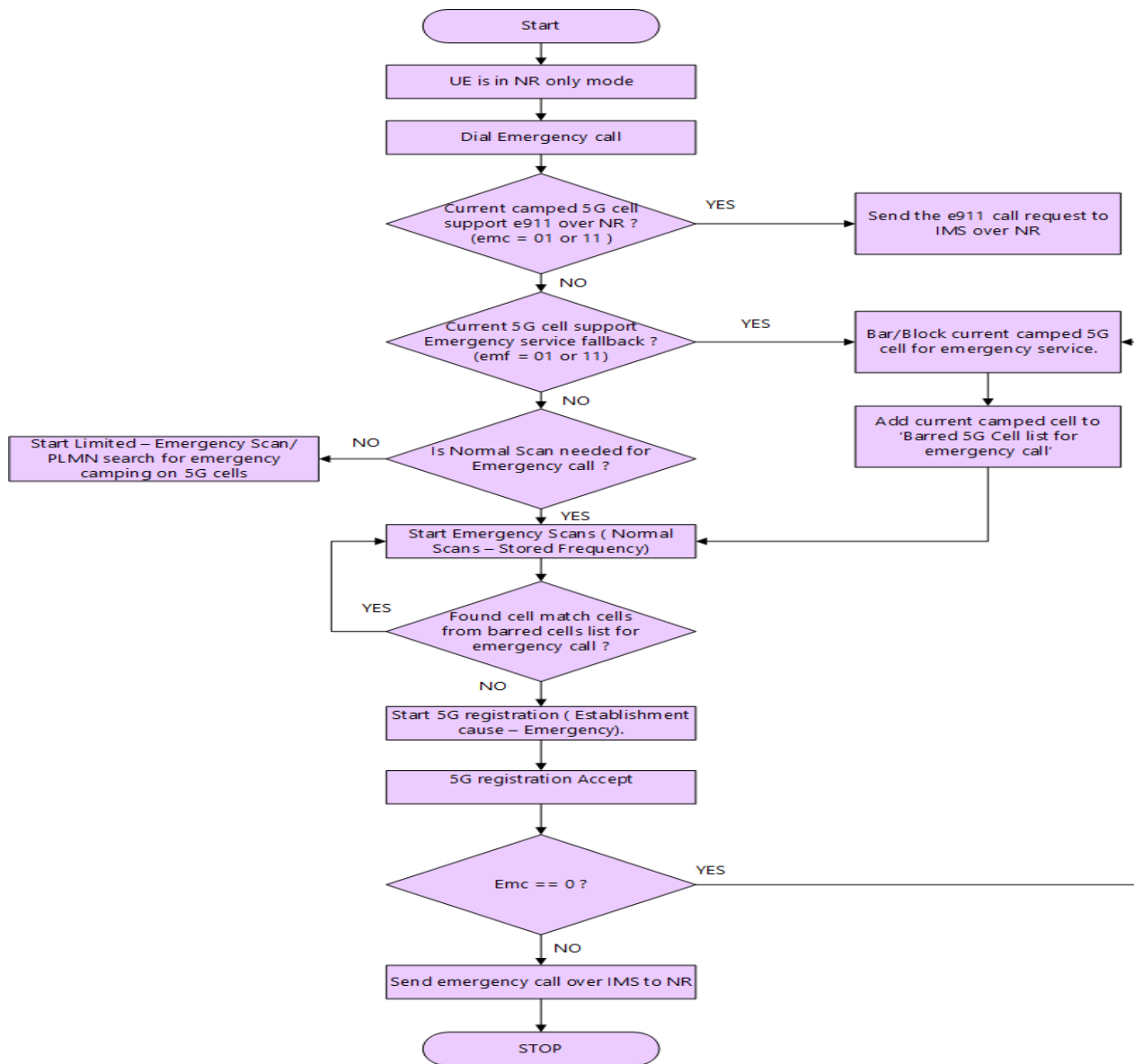
To enhance reliability for emergency calls, some networks, such as New Radio 5G Communication (NR5G) networks, provide multiple ways to originate emergency calls, and in particular provide an emergency call fallback (ES-FB) service. However, under some user equipment (UE) configurations and conditions, the ES-FB service is not available, potentially delaying the emergency call. When the UE is in a configuration or condition where ES-FB is potentially available, the UE searches for a network cell that supports emergency service over the IP Multimedia Subsystem (“IMS”), thereby enhancing the speed and reliability of emergency calls.

Background

UE, such as smartphones, should successfully support the initiation and connection of emergency calls. Users expect emergency calls to connect to the network in the shortest time possible with stable service so that prompt contact with a Public Safety Answering Point (“PSAP”) can be achieved. In order to provide fast and reliable emergency call services, NR5G networks provide two ways to originate an emergency call: an e911 service over the network using IMS (e.g., via a Voice Over NR (“VONR”) capability) and an e911 service using ES-FB. However, when the UE is configured to communicate in NR-Only or 5G-Only mode, even though the communication network may indicate EMF support to the UE in a registration message, ES-FB can only be performed and be successful when LTE (4G “Long Term Evolution”) is part of the operating mode. If LTE is not part of the operating mode, then if the UE tries to perform an ES-FB, then the procedure will likely fail and add to the overall delay of the emergency call.

Description

The handling of emergency calls depends on the operating mode and configuration of the UE. Certain preconditions must be satisfied for the UE to establish communication when configured in NR-Only mode as presented in Fig. 1 below:



When the operating mode of the UE is configured as NR-Only mode and an emergency call is initiated, if the network determines that access on the current 5G cell does not support emergency service over IMS (i.e., VONR with EMC=0), then the UE will start emergency scans

for full service by indicating a bit to a Public Land Mobile Network (“PLMN”) selection module or 5GS Mobility Management (“5GMM”) module indicating that the UE is in NR-Only mode.

Next, the UE determines whether the currently accessed cell supports Emergency Services Fallback. If so, the UE then sends a “cell_block/cell_bar” request using the New Radio-Radio Resource Control (“NR-RRC”) network communication protocol with the cause specified as “Emergency cell with EMF support only.” NR-RRC will maintain a list of 5G cells that are blocked for emergency calls. The UE will then send a PLMN Search request to the 5G RRC (“5G Radio Resource Control”) with emergency call pending.

The UE will skip camping on cells that are barred by 5GMM and only camp on other cells which support emergency service by checking SIB1 (“System Information Block”) and then send a cell indication to 5GMM (“5G Mobility Management”). Upon receiving the cell indication, the UE will then send a “Registration Request” message to the network with the establishment cause set as ‘Emergency’. After the network reports a “Registration Accept” message, the UE will check the 5GS Network Feature Support IE of the received Registration Accept message to check if “Emergency services fallback” is supported (i.e., EMC bit set to 0 or not). If “Emergency services fallback” is not supported, then the 5GMM module should mark the registration as a failure and report a “scan failure” message to the PLMN selection module. 5GMM will also send a blocked/barred cell for emergency service to the NRRC.

Once the PLMN Selection module receives the registration failure with the cause determined as “EMC not supported in NR-Only mode” then the PLMN selection module will continue its PLMN selection procedure in accordance with the 3GPP spec 23.122/38.304 for emergency calls. When a new PLMN Search request is issued by 5GMM to 5G RRC, 5G RRC will skip the blocked cell and try to communicate on another emergency service supported cell.

This procedure will continue until a cell which supports emergency service is found. And, once an emergency capable cell is found, the emergency call will be directed to the network.

After the emergency call is ended, either of two different approaches can be followed. First, 5GMM will send an unblock/unbar request to RRC (“Radio Resource Control”) to unblock the cells barred for emergency cell. Second, 5GMM will transmit an emergency call end notification to NR-RRC. NR-RRC can then unbar the cells blocked for emergency calls so the UE can perform a re-selection or use IRAT (“Inter-Radio Access Technology”) to access these cells as needed. If a new emergency call originates in the NR-only mode, and if an emergency scan is requested, then the barred cells will be skipped for emergency registration for the duration of the emergency call.

In addition to the above, when the operating mode of the UE is changed from NR-Only to other modes, such as NR+LTE or NR+LTE+GSM+WCDMA, 5GMM will send a separate “Clear-Barred-Cell-List-for-Emergency call” request to RRC to unblock the cells barred for emergency cell. NR-RRC will then clear the list of 5G cells barred for emergency call.

References

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2. 3GPP spec 23.122/38.304.
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4. International Patent Publication No. WO 2021/0887162.
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