Managing Priorities in LTE Networks

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Ensuring public safety users and apps get the service they need in congested networks

Have you ever sat in a vehicle in a heavy traffic jam, with no one going anywhere? Even though you are on a multi-lane highway, its 'transmission capacity' can drop to almost zero. The same can happen in a high capacity mobile network if many people are watching videos in the same cell, or sending videos and pictures to their social media accounts from an event.

Existing narrowband public safety networks, such as TETRA and Tetrapol, have sophisticated mechanisms to manage many simultaneous call requests. They have, for example, pre-set priorities for users and groups, emergency calls and preemptive prioritized calls. In general, group communications with a trunked radio system is a very efficient way to share radio resources among many users.

LTE offers many ways to manage traffic load

What about mobile networks based on standard 3GPP LTE technology? Can they be used for critical communications, such as push-to-talk (PTT) or mission critical video? For public safety operations, it's vital that communications work properly without interruptions, particularly during emergencies or large public events.

Although LTE has mechanisms to manage traffic in a congested network, these are not often used in consumer networks. Hence, all subscribers are treated equally and get best-effort service. This works fine when there is more capacity than subscribers use. But when the load increases significantly, all subscribers suffer from low-quality service in heavily loaded cells.

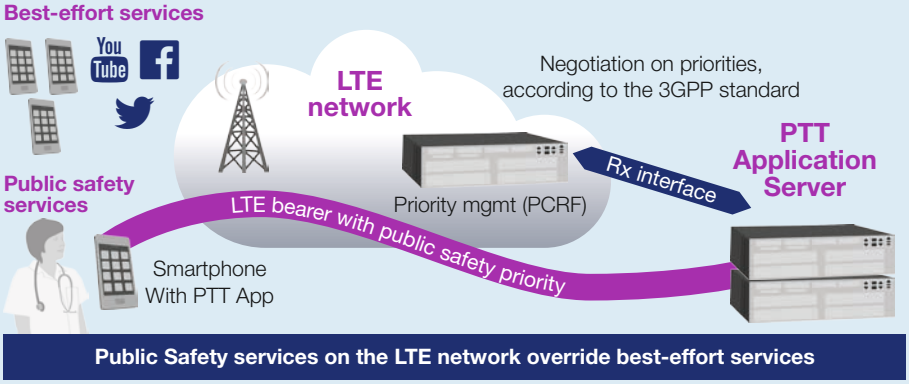
LTE traffic management mechanisms are based on priorities. If there are adequate resources available, all subscribers get the capacity they want. However, when the load exceeds the available capacity, priorities come into play. For the most critical subscribers or applications, the highest priority must be assigned. These users get the capacity they need. Consequently, less critical users or applications have lower priority and less capacity.

The first level of LTE prioritization is **Access Class Barring**, used to manage the signaling overload on the base station (eNodeB). An Access Class is defined for each subscriber. For regular subscribers, access classes are 0-9, while for first responders a special access class 14 can be used. During overload, Access Class Barring can be triggered in selected areas. Regular users are barred from the network, while public safety users get the services they need. Service limitation is active only in the selected areas.

Public safety users can also be assigned a higher **Allocation and Retention Priority** (ARP). When network resources are limited, public safety users and services can preempt the bearers of other users.

A special LTE prioritization for emergency situations is **Multimedia Priority Service** (MPS), which is a mechanism to ensure a call can be connected end-to-end, for example, if a first responder must reach a regular user.

Figure 1. PTT Application Server integrated into an LTE network



PTT server to control public safety priorities

The user plane level (e.g. PTT calls or video streams) prioritization is defined by the **QoS Class Identifier** (QCI) parameter. QCI defines certain technical values for data bearers, e.g. delay, packet loss and bit rate targets. 3GPP release 12 defines special QCI values for public safety users. For example, QCI 65 is for Mission Critical PTT voice and QCI 69 is for Mission Critical Signaling.

The LTE standard defines the interface between application servers and the LTE network function, which controls the priorities (QCI values) of different applications and subscribers. The interface is called Rx and the controlling function is named Policy and Charging Rules Function (PCRF). The architecture conforms to the LTE standard defined by 3GPP.

Figure 1 illustrates a 3GPP compliant configuration on which there is a PTT application integrated with an LTE network and with its PCRF function. PTT users on the LTE network get higher priority services than regular subscribers, ensuring a better service level for public safety PTT users.

The support for priorities must be end-to-end, so that all elements between the user device and PTT application server need to support LTE priorities. Figure 2 illustrates how the negotiation for the QoS (Quality of Service) takes place between a PTT application server and an LTE network by using the Rx interface.

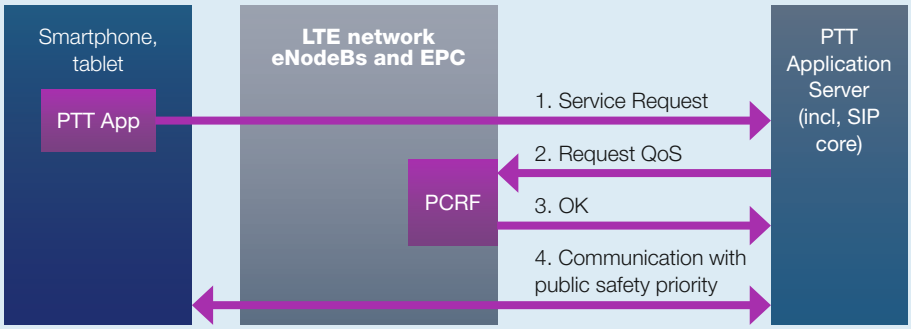
A PTT solution must support priority management

Prioritization capabilities to ensure proper services for public safety subscribers are among the key elements of 3GPP mission critical communication standardization. By allocating higher priorities for public safety users, we can ensure that first responders get PTT, video and other services even in the most challenging situations. With the same priority or without any prioritization, all users get the same service level and in the worst case, no one is served.

When considering a PTT solution for public safety on an LTE network, the following issues are worth reviewing:

- **PTT solution supports LTE prioritization and preemption at different layers**
- **The solution conforms to 3GPP standards**
- **Priorities can be assigned freely depending on the network configuration and the application portfolio according to 3GPP standards**
- **Priority management is supported end-to-end, from the user device up to the application server**

Figure 2. QoS negotiation between PTT Application Server and LTE network



Are you thinking about a push-to-talk (PTT) solution over LTE? You should remember the following:

- PTT solution should support priorization and pre-emption on all LTE layers
- PTT solution must conform to 3GPP standards
- It should be possible to set priorities according to network configuration and according to application
- Management of priorities should be possible through-out: from the user's device all the way to the application server.

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