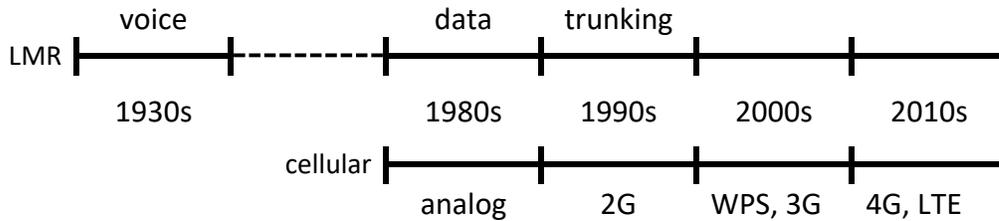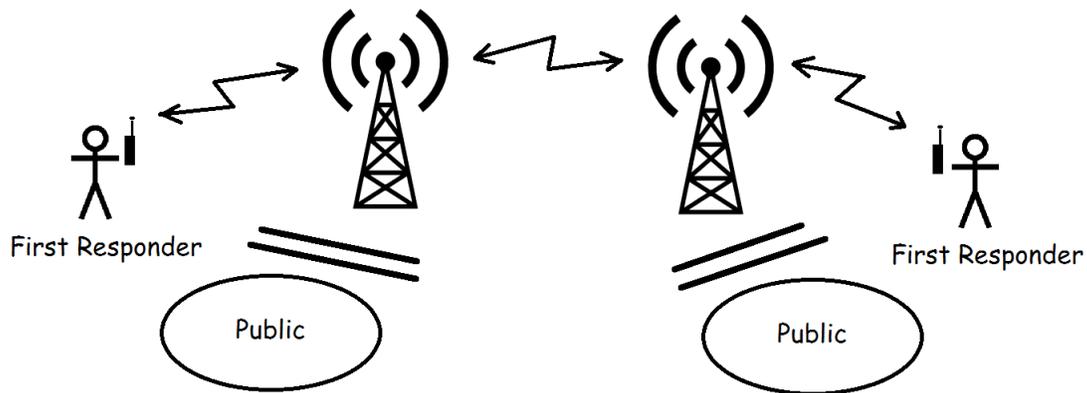# Priority and Preemption in Public Safety Communications

In the world of public safety communications, the words *priority* and *preemption* do not have universal definitions. The word *priority* does convey a general expectation: "I get access before others do." The same goes for preemption: "I get access right now, even if it requires that others are denied service until I'm done."

One reason there are no universal definitions is the arrival of cellular systems, especially LTE:

Land Mobile Radio (LMR)

Priority is assumed in public safety LMR systems. Priority is built in because public safety LMR systems are members-only systems. There is no *other* group of users, i.e., the general public, contending for service:
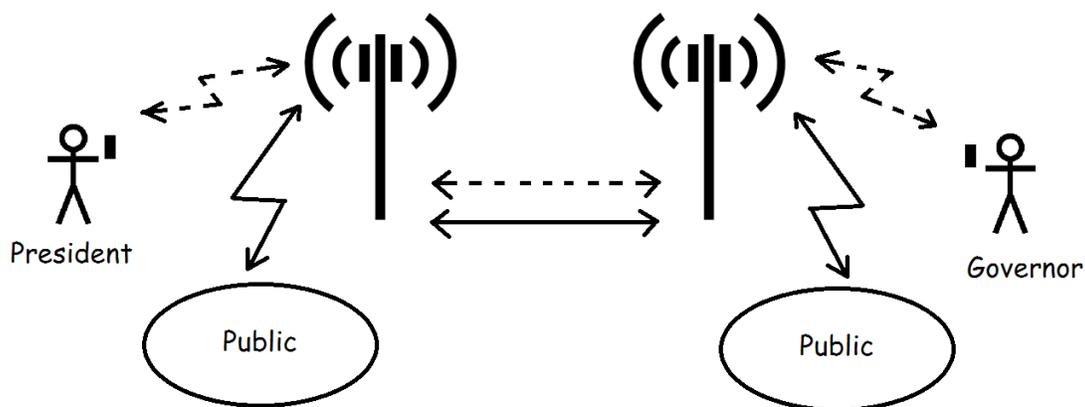

Preemption in LMR is well known and a critical function. Typically, a special button on a radio provides instant, ruthless preemption for emergencies, because "people could die" if it were not for that special button.

For LMR, preemption means: (1) If the network has open resources at this moment, I get instant ownership of those resources. (2) If the network has no open resources at this moment, I get instant ownership of someone else's resources; they get ruthlessly denied service on the system. This preemption exists for a short period of time, such as 10 seconds for emergency voice, or until the radio is reset by the user for normal use.

Wireless Priority Service (WPS)

WPS is the cellular version of the landline Government Emergency Telecommunications Service (GETS). GETS was implemented in the late 1960s, and WPS was implemented in the early 2000s. They are intended to be used for voice communications during an emergency or crisis when the landline networks (GETS) or the cellular networks (WPS) are congested. These services are not preemption services; they are best-effort priority access to services. For example, GETS was designed to provide a 90% call completion rate when call volume is eight times normal capacity.

These services can only be used by National Security and Emergency Preparedness (NS/EP) personnel in five categories: (1) Executive leadership and policy makers (e.g., the President of the United States and members of Congress); (2) Disaster response/military command and control; (3) Public Health, safety, and law enforcement command; (4) Public services/utilities and public welfare; and (5) Disaster recovery.

WPS applies only to telephone services and is implemented by, and interoperable among, multiple service providers. The priority provided by WPS should not be confused with the priority functions defined in LTE standards, which refer to packet data services. WPS-type service for packet data remains a work in progress, with conflicting viewpoints among carriers.

If WPS is upgraded to provide a FirstNet-like service, specifically for packet data, carriers need to prove that high-traffic use by first responders is something the carrier networks can handle. Congestion within WPS should be anticipated and the ability to accommodate the additional data needs to be proven.

FirstNet and Evolving Definitions

When the Nationwide Public Safety Broadband Network (NPSBN) program was first conceived, it was believed that the NPSBN would be a private wireless network on Band 14 and be used only by first responders. At that time, public safety expectations for *priority* and *preemption* matched those in private LMR systems.

By the time the law was written in 2012, things had changed. A key tenant of the legislation that created FirstNet was financial sustainability. Beyond the initial $7B of funding, FirstNet was required to implement a business model that did not rely on additional Federal funding sources, either for construction or operation of the network. The legislation therefore supported use of the public safety Band 14 spectrum through dual use: public safety users would have *priority* use of the network, while excess capacity could be used for commercial purposes. For *preemption*, the legislation referred to the Interoperability Board Report's recommended minimum technical requirements, which included: "Preemption is an essential function in the NPSBN to allow appropriate management of the system resources, especially during emergencies."
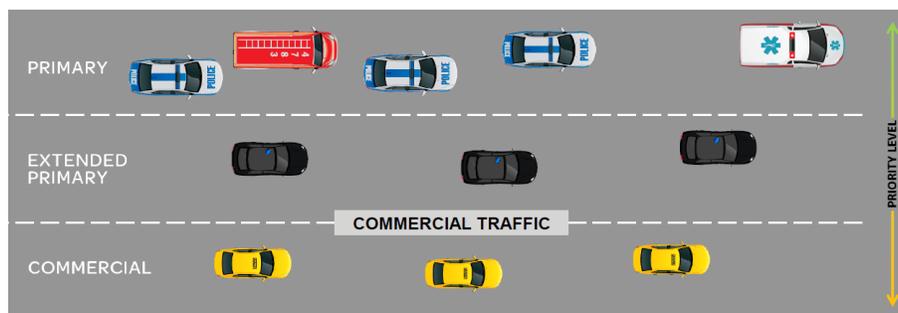
When the contract was awarded to AT&T in 2017, things became more complicated. The NPSBN is not a standalone network that welcomes commercial users. The NPSBN is AT&T's commercial network that welcomes FirstNet users. AT&T agreed to implement FirstNet services on a shared network, giving public safety users *priority* and *preemption* on its commercial LTE network. FirstNet provided to every state and territory a State Plan that specified that Band 14 would be deployed on a selected basis and not nationwide, which differed from the initial vision that Band 14 would be primarily used by first responders. It is in this context that we have to view the notions of *priority* and *preemption* as offered by FirstNet/AT&T.

LTE (Long Term Evolution) in General: Priority and Preemption

In LTE, **priority** refers to a communication session that is already in progress. It is an issue for getting a communication session <u>started</u>. When there is contention for access, users with higher priority get moved to the front of the line.

In LTE, **preemption** refers to a communication session that is already in progress, and a user with higher priority being able to "bump" others off the session. Carriers face significant barriers (risks, costs, and regulations) to implementing ruthless preemption, and it remains an unknown how AT&T/FirstNet plans to implement preemption.

FirstNet/AT&T used a transportation analogy as a visual aid to describe priority and preemption:

Cars on a highway represent users on an LTE network. Higher priority is represented as permission to ride in the fast lane. Preemption is represented as forcing cars to exit and travel on an alternative highway (e.g., an alternate frequency band on the AT&T wireless system). This analogy is useful in describing generalities about special treatment for first responders; however, it also can lead to misinterpretations. More accurately, priority is mainly associated with who gets to move to the head of the line for access.

A more appropriate analogy than car travel might be air travel. Priority would be represented by TSA Precheck, which allows users to get quicker access to the terminal. It is essentially a fast pass that allows users to bypass others waiting for access. Preemption would be represented by the side effect of overbooking: sometimes people must get off the plane. Carriers know that in LTE, as in airplanes, commercial customers can become extremely angry if they are booted off the service, regardless of the reason why.

LTE in Detail: Priorities and Guarantees

LTE is a set of international standards, some complete and some evolving, for broadband wireless networks that, if used, make carrier networks interoperable. LTE standards development had two key goals: deliver higher data rates and utilize Internet Protocol (IP) standards.

First, some definitions:

GBR – Guaranteed Bit Rate. Dedicated network resources, e.g., packets, are allocated so that a service is guaranteed its data will be delivered at a certain rate.

Non-GBR – No dedicated network resources are allocated. Data is delivered on a best-effort basis.

Priority – Rank within the queue for access to the network.

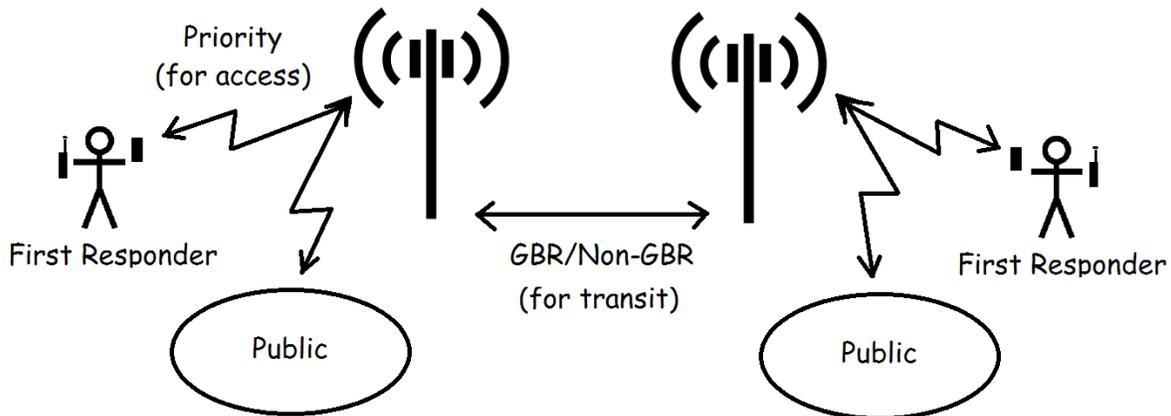This brings us to the evolving LTE table that defines who gets what:

Service	(Access) Priority	(Transit) Guarantee
Mission critical delay sensitive signaling	0.5	Non-GBR
Mission critical PTT voice	0.7	GBR
IMS Signaling	1	Non-GBR
VoIP Call	2	GBR
Non-mission critical PTT voice	2	GBR
Online gaming	3	GBR
Video Call	4	GBR
Video streaming	5	GBR
Mission critical data	5.5	Non-GBR
Video, TCP based services	6	Non-GBR
Voice, video, interactive gaming	7	Non-GBR
Video, TCP based services	8	Non-GBR

There actually are two kinds of priority specified in the above table. The first is access priority. The Priority for a service determines what order you stand in line for the next available communication session to be accepted and managed by the carrier. The second is transit priority: GBR or non-GBR. Returning to the air travel analogy, GBR is flying with a reservation and Non-GBR is flying standby.

The unanswered question is: can any commercial GBR service, such as video streaming, be temporarily stopped while they are on the network? Statements by FirstNet/AT&T seem to indicate the answer is, or will be, Yes; however, proof and descriptions of how are elusive.

Understanding LTE for public safety

Public safety agencies understand LMR systems. However, agencies deciding to adopt FirstNet, need to understand LTE systems. Familiarity with smartphones is not enough. The AT&T solution accepted by FirstNet is represented by the overlaid arrows in the diagram below. First responders are being asked to share a popular and evolving wireless network with the public.

The phrase "mission critical" in LTE should <u>never</u> be confused with "public safety grade" in LMR. In the future, public safety leaders should always view the phrase "mission critical" as the name of a standard, not as a description of a service.

For first responders to understand how LTE will work for public safety, FirstNet/AT&T needs to present and explain the LTE table as it relates to priority and preemption. The following questions to ask FirstNet/AT&T would be helpful:

- When I arrive at the site of a public disaster, and many civilians are using their smartphones on the AT&T network, how will my <u>voice call</u> be treated?
    - Will I always get GBR service?
    - What determines whether my call will be treated as a "VoIP call" or a "Mission critical PTT voice" call?
    - What level of congestion is required before people using online gaming and video streaming will have their GBR transit status throttled back to a Non-GBR? If not, why not?

- When I arrive at the site of a public disaster, and many civilians are using their smartphones on the AT&T network, how will my <u>data connection</u> be treated?
    - Will my data, which I consider mission critical, get GBR? If not, why not?
    - Will I get access priority that puts me ahead of any civilian trying to connect for online gaming or for streaming video?
    - Is Skype treated as video streaming?

The special case of online gaming and video streaming

As LTE tables that specify priority have evolved, the presence and GBR status of online gaming and video streaming have remained the same. Both have the potential to use significant bandwidth.

First responders should, at a minimum, be shown that, during an emergency, a local commercial customer's need to score well while playing *Warcraft* will <u>always</u> be lower priority (for both access and transit) than a local first responder's need to communicate during the emergency.

If video streaming means services like Netflix, then first responders should also be shown that, during an emergency, a local commercial customer's need to watch *House of Cards* in HD will <u>always</u> be lower priority (for both access and transit) than a local first responder's need to communicate during the emergency.