



Public Safety Communications Research
(PSCR)

QoS Information

Department of Commerce – Boulder Labs

LTE Functionality

- Priority services, the ability to pre-empt users and Quality of Service are all crucial to a public safety broadband network.
 - LTE as a standard has more control over this Quality of Experience (QoE – includes QoS, Priority, Pre-emption), than any other previous wireless broadband technology
- Since most of these features within 3GPP have never been commercially deployed and the way in which public safety will use them is unique – it is crucial to understand what LTE can provide.
 - QoS needs to be consistent, quick and automated
 - Some implementations/rules may be static and others may need to be dynamic
 - Requires multiple interfaces and node support for end-to-end support
 - Policy control, billing, intra/inter network roaming, application level
 - NCS, 3GPP, IETF all have documented QoS at various levels but there is limited information of how to tie these all together
 - Demo network will investigate various PCC architectures and implementations to meet public safety requirements.

Network Features & Goals

- End Goal is to create recommendations for a standardized national framework to ensure consistent QoS and interoperability
- Demonstrate local and national QoS network architectures
 - QoS schemes for intra-network roaming (public safety to public safety)
 - QoE schemes for inter-network roaming (public safety to commercial service providers)
- Develop additional guidelines for end-to-end QoS support
 - Ue to Ue & Ue to Application for HPLMN and VPLMN roaming cases
 - Applications and bearers - how they interact with the network
 - Application servers
 - Backhaul
 - Intra & Inter network connections
 - Integration into NGN/GETS

700 MHz SoR QoS Compliance

Requirement	Text	Nationwide QoS Framework
5.6 R1	The network shall be configured to provide the priority and Quality of Service (Section 5.6.4) management required by the requirements contained within this document in order to meet or exceed those requirements.	✓ Partial. See 3GPP QCI.
5.6 R2	The Public Safety Broadband Licensee and DBL shall establish an appropriate service and priority framework and process that maps service and priorities to the appropriate class of service parameters that are defined in this requirements document (Section 3.4).	✓
5.6 R3	The DBL shall identify and document the configuration parameters for the deployed broadband technology to provide the specified classes of service for the public safety services and applications.	✓ QCI and ARP framework parameters
5.6 R4	The QoS metrics and priority levels must be configurable by an appropriately authorized administrator dynamically.	✓
5.6 R5	A plan shall be submitted to the PSBL by the DBL for correcting network performance where QoS requirements are not being adequately met.	N/A
5.6 R6	Public safety users that are in their "home" area shall have a higher priority than users that are not in their "home" area.	✓

700 MHz SoR QoS Compliance – cont'd

Requirement	Text	Nationwide QoS Framework
5.6.1 R1	Priority service shall allow for different levels of service to be defined based on the given role of a user. The levels of priority shall accommodate priority access to the radio access network and priority access to resources in the core network.	✓
5.6.1 R2	Public safety requires 50% or a minimum of 8 access priority levels based on the number of priority levels available in the radio access network technology. These public safety priority levels are the highest levels available, over and above those levels available to commercial users.	✓
5.6.1 R3	The highest priority level shall be reserved for use by public safety for emergency communications, e.g. an emergency button.	✓
5.6.1 R4	The remaining priority levels shall be determined by public safety control.	✓
5.6.1 R5	The DBL shall be able to distinguish between public safety traffic and commercial user traffic.	✓ Can be solved with ACB & ARP mapping
5.6.1 R6	Public safety requires priority allocation of RAN and Core resources, including (but not limited to) RAN access channels, paging channels, and traffic channels.	✓ Access Class Features support this
5.6.1 R7	Public safety shall never be blocked by commercial users in accessing the radio access network. For example, a separate public safety control channel may be needed to satisfy this requirement.	Carrier Negotiation & Access Class
5.6.1 R8	The network shall provide an appropriate priority to 9-1-1 calls that may use public safety priority treatment.	N/A for PSST Spectrum See NGN/GETS slides



Example ARP Mapping

Role-based Mapping		Organization-based Mapping		Application-based Mapping	
Role	ARP Priority Class	Organization	ARP Priority Class	Application	ARP Priority Class
Chief	High	Emergency Management	High	Dispatch	High
Captain	High	Police/Fire	High	Video	High
Lieutenant	Medium	EMS	Medium	Telephony	Medium
Officer	Low	Parking Enforcement	Low	Web Browsing	Low

Hybrid and other mapping schemes are also possible.

Example NGN GETS – PS ARP Mapping

ARP Value	Priority Class	ETS and WPS namespaces[1]	Non-GBR Bearers		GBR Bearers	
			Can Pre-empt	Vulnerable	Can Pre-empt	Vulnerable
1	Emergency	ets.0, wps.0 (inter-sys session [2] or NGN/GETS roamer [3])	YES	NO	YES	NO
2	High Priority	ets.1, wps.1, ets.2, wps.2 (inter-system NGN/GETS session [2])	YES	NO	YES	NO
3						
4						
5						
6	High Priority Roamer	ets.1, wps.1, ets.2, wps.2 (NGN/GETS roamer [3])	NO	NO	NO	NO
7	Medium Priority	ets.3, wps.3 (inter-system NGN/GETS session [2])	NO	YES	NO	NO
8						
9						
10						
11	Medium Priority Roamer	ets.3, wps.3 (NGN/GETS roamer [3])	NO	YES	NO	NO
12	Low Priority	ets.4, wps.4 (inter-system NGN/GETS session [2])	NO	YES	NO	YES
13						
14						
15	Low Priority Roamer	ets.4, wps.4 (NGN/GETS roamer [3])	NO	YES	NO	YES

[1] = the application function (AF) is responsible for translating RFC4412 EPS, WPS namespaces to Rx Reservation-Priority

[2] = Inter-system NGN/GETS call

Example ARP Mapping

Priority	User groups		Non-GBR bearer		GBR bearer		
			Can pre-empt	Vulnerable	Can pre-empt	Vulnerable	
-	-	-					
1			Yes	No	Yes	No	Reserved for Serving Network
2	1 st responder at home (A)		Yes	No	Yes	No	Priority 1 user non video traffic
3	1 st responder at home (B)		Yes	No	Yes	No	Priority 1 user video traffic Priority 2 user non-video traffic
4	1 st responder at home (C)		Yes	No	Yes	No	Priority 2 user video traffic Priority 3 user non-video traffic
5	1 st responder at home (D)	1 st responder visiting (A)	Yes	No	Yes	No	Priority 3 user video traffic Priority 4 user non-video traffic
6	PS support at home (A)	1 st responder visiting (B)	No	Yes	Yes	No	Priority 4 user video traffic Priority 5 user for non video traffic
7			No	Yes	Yes	No	E911
8	PS support at home (B)		No	Yes	Yes	No	GBR Voice Calls (non-PTT)
9	PS support at home (C)		No	Yes	Yes	No	GBR non-voice and IMS signaling
10	PS other (A)	PS support visiting (A)	No	Yes	No	Yes	Regular subscriber general data IMS signaling
11	PS other (B)	PS support visiting (B)	No	Yes	No	Yes	Voice calls
12			No	Yes	No	Yes	Reserved for Serving Network
13			No	Yes	No	Yes	Reserved for Serving Network
14	Commercial user		No	Yes	No	Yes	Priority 1 Commercial Users non-video traffic
15	Commercial user		No	Yes	No	Yes	Priority 1 Commercial Users video traffic Priority 2 Commercial Users non-video traffic

NGN GETS Vs. Public Safety

- Public Safety use case for QoS is different than NGN GETS
 - Up to 15 priority levels – typically implement 8 w/ multiple pre-emption layers
 - Used in daily operations to shape traffic (prioritize SWAT versus parking meter enforcement)
 - Goes beyond prioritizing users to include specific applications
 - Includes GBR, non-GBR
 - Hybrid of pre-defined QoS values and dynamic control
 - Subset of this available in commercial network (similar to NGN GETS)
- NGN GETS allows 5 Priority levels 1) Executive Leadership & Policy Makers 2) Disaster Response & Military Command & Control 2) Public Health, Safety & Law Enforcement 4) Public Services & Utilities 5) Disaster Recovery
- Users not allowed to Pre-empt other GETS users and cannot be pre-empted.
- Subscribed users can either use IMS (dial *272) or have a dedicated APN (ARP and QCI set accordingly)
- Non-subscribed service users will not explicitly benefit from the above access priority same as in legacy GETS services.

Demo Network Implementations

- Design network to support full End-to-End QoS
- Start with Best effort data (start simple ...):
 - Map default bearer to QCI 8 or 9 [in HSS subscriber profile]
 - Investigate use Aggregate Maximum Bit Rate (AMBR) [in HSS subscriber profile] to create different levels of Best Effort Service
- Determine overall QoS mapping possible in Release 8
- **Develop PCC rules and/or TFTs**
- **Develop test cases and test scenarios**
 - **May include development of test applications/APIs to trigger QoS treatment**

Questions?