AT&T does not currently offer a QoS Solution on our commercial wireless network. AT&T is assessing LTE QoS capabilities but cannot comment on what if any future offers may be.
Public Safety Wireless Communications Today

Private two-way radio systems for "mission critical" Push To Talk voice with dispatchers or other police units.

Broadband cellular data connection from police vehicle to connect police laptops, fingerprint scanners and other data devices (non-"mission critical" since police can fall back to private radio for most tasks).

Cellular devices for PSTN calling, non-mission-critical Push To Talk, e-mail and other applications.

Connections to public safety databases (Wanted lists, license plate and fingerprint databases, etc.)

© 2012 AT&T Intellectual Property. All rights reserved. AT&T and the AT&T logo are trademarks of AT&T Intellectual Property.
What Are QoS and Priority, and Why Do You Need Them?

• Definitions
  • Priority: managing which users get access to the network if there is congestion
  • Quality of Service (QoS): establishing minimum/maximum service quality parameters (throughput, latency, jitter, “guaranteed” levels, etc.)

• Why does public safety have an interest in QoS and priority?
  • All networks have bottlenecks and are potentially subject to congestion
  • All commercial networks are designed to handle maximum “every day” usage, not “worst case scenario” usage
  • Increased usage of social media and reliance on mobile communications means that in a disaster/emergency situation, consumer usage will be high
The History of Telecommunications QoS and Priority

• Federally planned, managed and funded initiative
  • Established in 1963
  • Overseen today by DHS Office of Emergency Communications (OEC)

• Voice priority services:
  • Secure Routing Arrangement Service (SRAS) – Special customer service (1986)
  • Telecommunications Service Priority (TSP) – Priority provision / restoration of telecom services (i.e., transport, service) (1990)
  • Government Emergency Telecommunications Services (GETS) – Priority voice-band wireline service offering HPC (1994)

• Data priority services:
  • None today; under discussion with carriers and NS/EP community since 2008
  • Under-utilized resource today for public safety
WPS Approved Users and Priority Levels (1-2)

• Priority 1. Executive Leadership and Policy Makers
  • The President of the United States, the Secretary of Defense, the Secretary of Homeland Security, selected military leaders
  • State governors, lieutenant governors, cabinet-level officials responsible for public safety and health
  • Mayors, county commissioners

• Priority 2. Disaster Response/Military Command and Control
  • Federal emergency operations center coordinators, e.g., Manager, National Coordinating Center for Telecommunications, National Interagency Fire Center, Federal Coordinating Officer, Federal Emergency Communications Coordinator, Director of Military Support
  • State emergency services director, National Guard Leadership, State and Federal Damage Assessment Team Leaders
  • Federal, state and local personnel with continuity of government responsibilities
  • Incident Command Center Managers, local emergency managers, other state and local elected public safety officials
  • Federal personnel with intelligence and diplomatic responsibilities
WPS Approved Users and Priority Levels (3-5)

• Priority 3. Public Health, Safety and Law Enforcement Command
  • Federal law enforcement command
  • State police leadership
  • Local fire and law enforcement command
  • Emergency medical service leaders
  • Search and rescue team leaders
  • Emergency communications coordinators

• Priority 4. Public Services/Utilities and Public Welfare
  • Army Corps of Engineers leadership
  • Power, water and sewage and telecommunications utilities
  • Transportation leadership

• Priority 5. Disaster Recovery
  • Medical recovery operations leadership
  • Detailed damage assessment leadership
  • Disaster shelter coordination and management
  • Critical Disaster Field Office support personnel
What Is Wireless Priority Service?

- Access to WPS and GETS are managed through the DHS OEC
  - [https://www.dhs.gov/requesting-gets-and-wps](https://www.dhs.gov/requesting-gets-and-wps)
  - Request service through your agency POC
- Provides priority queuing for cellular voice calls
- Supported by all major US carriers
- Features
  - Elevates the user’s Access Class above the ranges used by normal users
  - Puts the user in queue for the next available voice channel on that cell tower
  - Low monthly cost, per-minute use fees
- Limitations
  - Voice-only – no equivalent service for data today
  - Does not currently work with VoLTE
  - Some features may differ between CDMA and GSM carriers
  - FCC limitations on the number of WPS users who can be supported on a single tower simultaneously
GETS User Experience

• Priority queuing – not ruthless pre-emption

• Using mobile?
  • Dial *272 and destination number or GETS access number (recommended): (710) 627-4387

• Using PSTN, BVoIP?
  • Dial GETS access numbers – (710) 627-4387 (primary #) and various toll-free numbers supported by AT&T, VZ, and Sprint

• Listen for “bong” tone

• Enter 12 digit GETS calling card PIN

• Enter the destination number

• Wait for distant end ring or message
  • Up to 6 minutes (worst case) depending on transport availability affected by congestion and equipment impairment
Wireless Access Classes and Their Use

• Specifies a user’s priority for connecting to the network

• Standards exist for Access Class assignments:
  • 0-9 Normal Use
  • 10 Emergency Use (911)
  • 11 Mobile Operator Use
  • 12-14 WPS/Special Priority Use
  • 15 Mobile Operator Use

• Can be used to establish priority

• Can be used to block specified classes (Access Class Barring)
The Evolution of Wireless QoS Capabilities

• Earlier generations of wireless technology were “voice-first” – circuit switched bearers
• Data was added to GSM as Circuit Switched Data with 9.6 kbps capabilities in “1G”
• Progressed to 200-400 kbps in “2G” then 1.5-3 Mbps in “3G”
• Supported voice prioritization but data standards were not designed with differentiated services in mind
• LTE changes all this – it’s a data network “under the hood” with voice as an application over the packet switched network
• QoS and priority/pre-emption capabilities were designed into LTE from the start
• Supports Access Classes
• Introduces new capabilities such as Allocation Retention Priority (ARP) and QoS Class Identifiers (QCI)
• Guaranteed Bit Rate (GBR) and non-GBR bearers
Standards-Based LTE QoS Capabilities In Detail

- **QCI (QoS Class Identifier):** A scalar that defines bearer level packet forwarding treatment. (see slide 5)

- **ARP (Allocation and Retention Priority):** Defines a priority level used by admission control to decide whether a bearer establishment / modification request can be accepted or rejected due to resource limitations.

- **Two major types of bearers** Guaranteed Bit Rate (GBR) and Non-Guaranteed Bit Rate (Non-GBR):
  - **A GBR bearer**
    - Has a minimum amount of bandwidth that is reserved by the network
    - Always consumes resources in a radio base station regardless of whether it is used or not.
    - Should not experience packet loss on the radio link or the IP network due to congestion.
    - Defined with the lower latency and jitter tolerances that are typically required by real-time services.
  - **A Non-GBR bearer**
    - Does not have specific network bandwidth allocation and is for best-effort services (e.g. file downloads, email, and Internet browsing.
    - Will experience packet loss when a network is congested
    - Does not have a maximum bit rate specified on a per-bearer basis. However, an aggregate maximum bit rate (AMBR) will be specified on a per-subscriber basis for all non-GBR bearers.)

- **ACB (Access Class Barring):** Allows for prevention of selected classes of users from sending initial access messages for load control reasons.

- **AMBR (Aggregate Max Bit Rate):** Per UE-Aggregate MBR allocated to all non-GBR bearers of the same APN.
(Over) Simplifying the LTE Quality of Service Model

Access Class

QCI

ARP Value
Potential Applications For QoS and Priority

• Fine-grained control:
  • By user
  • By application
  • By port/protocol
  • By destination

• Public safety applications:
  • Tiered priority for selected users
  • Emergency call/imminent peril priority
  • “Guaranteed” bit rate for video, CAD or other applications

• Commercial applications:
  • Video conferencing
  • Streaming video/audio download
  • Application acceleration
The Hidden Problem With QoS and Priority

**Dilution**: the more users and applications are “special,” the less special they become
The Potential Benefits of a Private Public Safety Network

• A private network for public safety enables a more fine-grained range of control over QoS and priority/preemption
  • No need to share Access Classes, ARP or QCI values with “regular” users
  • More public safety criteria means more granularity
  • No potential contention with commercial QoS use cases
  • Potential to harmonize a single definition of prioritization across the entire public safety user base

• Potential concerns
  • If there are multiple public safety private networks, they may not mesh in their definitions of priority or ways of implementing it, causing issues in roaming
  • How public safety chooses to implement prioritization and preemption may negatively impact the valuation of Band Class 14 for secondary spectrum use