

# Commercial Wireless Networks and Priority Access For Public Safety

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## The Lawyers Told Me To Say This

**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

**Police dispatchers and command center personnel**

**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)



Private narrowband radio network



**Commercial Wireless Carrier (3G/4G)**

**Public safety intranet data network**



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

**Internet and PSTN**



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



# 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)
  - Wireless Priority Service (WPS) – Priority voice-band wireless service offering HPC (2004)
- 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>
  - 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

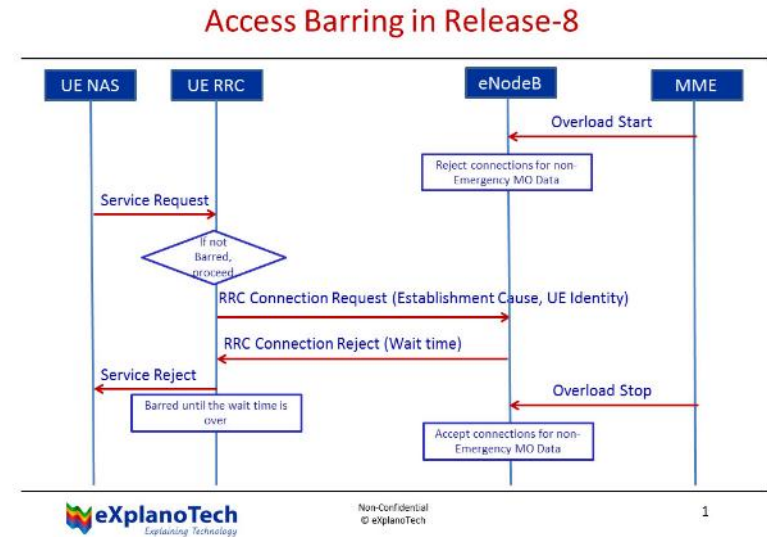


The image shows a simulated GETS calling card interface. At the top, there is a blue header with the text "Government Emergency Telecommunications Service" in white. To the left of the text is a circular seal featuring an eagle with wings spread, perched on a globe, surrounded by the words "FEDERAL BUREAU OF INVESTIGATION" and "DEPARTMENT OF JUSTICE". Below the header is a red horizontal bar. In the center, a white box with a blue border contains the 12-digit PIN "1234 5678 9012". Below the PIN box, there are two labels: "Name:" and "Organization:", both in blue text, followed by empty input fields.



# 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

UNITED TSA Pre✓ Premier Access

MZJSRD 4A 128  
UR1214 EDEK9R4D

CARL/JEFFREY  
UA-\*\*\*\*\*533, Premier Gold, Star Alliance Gold

Denver to Seattle/Tacoma

UA1214	GATE	BOARDING BEGINS	SEAT
<b>DEN-SEA</b>	NOT YET ASSIGNED	<b>9:33 PM</b>	<b>4A</b>
THU 10 JUL 2014		Boarding Ends: 9:53 PM	Window
		Flight Departs: 10:08 PM	First
		Flight Arrives: 11:59 PM	PM

Confirmation: MZJSRD  
eTicket 01674605846966

BOARDING GROUP 1

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:
  - Videoconferencing
  - Streaming video/audio download
  - Application acceleration



- Best-Effort does not perform reordering of packets.
- DiffServ differentiates between flows and assigns policies to those flows.
- IntServ makes a strict bandwidth reservation for an application.





# 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



# Q&A

