Commercial Wireless Networks and Priority Access for Public Safety

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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.
- **Internet and PSTN** service for police vehicles.
- **Public safety intranet data network** for police dispatchers.
- **Connections to public safety databases** (Wanted lists, license plate and fingerprint databases, etc.).
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**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)
- No current data priority services
- 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
• 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 or zero monthly cost, per-minute use fees

• Limitations
  • Voice-only – no equivalent service for data today
  • VoLTE support plans under development
  • 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/WPS 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 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
Primary Standards-Based LTE QoS Capabilities In Detail

• QCI (QoS Class Identifier): A scalar that defines bearer level packet forwarding treatment.

• 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.
(Over) Simplifying the LTE Quality of Service Model
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
Commercial LTE Quality of Service Offerings In-Market Today

• AT&T Dynamic Traffic Management

• Verizon Private Network Traffic Management
AT&T Dynamic Traffic Management – Public Safety

AT&T Dynamic Traffic Management with Commercial Connectivity Services enables:

- Passing class of service markings between wireless and wireline networks including AT&T Virtual Private Network for an end-to-end solution.
- Prioritizing critical data from your mobile endpoints all the way to your cloud-based applications with AT&T NetBond.
- Enabling primary and backup wireless 4G LTE routers to use Differentiated Services (DSCP).
- No limit on throughput rate for prioritized data.
The Hidden Problems With QoS and Priority

1.) User experience: QoS functions more like an insurance policy than a “speed boost”

2.) Dilution: the more users and applications are “special,” the less special they become
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