

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

In the Matter of )  
 )  
Spectrum Policy: )  
 )  
Solicitation of Public Comment ) ET Docket No. 02-135  
by the Spectrum Policy Task Force )  
 )  
 )  
 )  
To: The Commission )

**COMMENTS OF  
Statewide Wireless Network  
New York State Office for Technology  
6C Executive Park Dr.  
Albany, NY 12203-3716**

July 8, 2002

# Appendix 1

**Annex A of the PSWAC Operational Requirements  
Subcommittee Final Report  
pp. 76 (150) - 81 (155)**

- Note 1: In regard to references herein to TIA TR8.8, that task group is now identified as a full engineering subcommittee - TIA TR-8.18 Wireless Systems Compatibility Subcommittee, whose principal work product is Telecommunications Systems Bulletin TSB-88 and its subsequent updates.
- Note 2: The term DAC, which is not defined and only appears in several places in Annex A, would appear to be a typographical error that should read DAQ - Delivered Audio Quality, a term that is herein described in some detail.

**ANNEX A - OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS QUALITY**

**SECTION I: Audio and Data Transmission**

**Audio Quality**

A method of quantifying audio quality has been developed by the Telecommunications Industry Association (TIA) in conjunction with the Institute of Electrical and Electronics Engineers (IEEE), and published in a TIA report entitled “A REPORT ON TECHNOLOGY INDEPENDENT METHODOLOGY FOR THE MODELING, SIMULATION AND EMPIRICAL VERIFICATION OF WIRELESS COMMUNICATIONS SYSTEM PERFORMANCE IN NOISE AND INTERFERENCE LIMITED SYSTEMS OPERATING ON FREQUENCIES BETWEEN 30 AND 1500 MHZ”, April 29, 1996.

The principal metric involves recipient understanding and whether or not repetition is required. The metric is called Delivered Audio Quality and consists of a 5 point scale. The lowest value is one, referring to the worst case where the message is unreadable and therefore unusable. The highest is five, where speech is easily understood, no repetition is necessary and noise or distortion components are not introduced in the communications channel. The intermediate values range in the ease of understanding and the frequency of repetition required as well as the nuisance contribution of noise and distortion components introduced along the way.

The basis of understanding uses the equivalent intelligibility of a TIA test value for static receiver sensitivity called SINAD. This refers to a ratio of signal to noise and distortion. These values are subjective and will have variability amongst individuals as well as configurations of equipment and distractions such as background noise. They are intended to represent the mean opinion scores of a group of individuals, thus providing a target for evaluation.

The following table from the report sets out the target equivalency between DAQ (Delivered Audio Quality) and TIA SINAD measurements.

Delivered Audio Quality	Subjective Performance Description	SINAD Equiv. Intelligibility
1	Unusable, Speech present but unreadable	<8dB
2	Understandable with considerable effort. Frequent repetition due to Noise/Distortion	12 dB

Delivered Audio Quality	Subjective Performance Description	SINAD Equiv. Intelligibility
3	Speech understandable with slight effort. Occasional repetition required due to Noise/Distortion	17 dB
3.4	Speech understandable without repetition. Some Noise/Distortion	20 dB
4	Speech easily understood. Occasional Noise/Distortion	25 dB
4.5	Speech easily understood. Infrequent Noise/Distortion	30 dB
5	Speech easily understood.	>33 dB

Values less than three (3) transition quickly so no intermediate definitions exist. Values greater than three (3) contain intermediate steps. The specific value of 3.4 was derived from a specific Federal Government design criterion. Different radio bandwidths and modulations require different ratios of signal versus the combined disruptive effect of noise and interference. Additional details are available in the report. In paragraph 3.4.1 of the TIA TR8.8 report referenced above, it states:

The goal of DAQ is to determine what mean  $C/(I+N)$  is required to produce a subjective audio quality metric under Raleigh multipath fading. The reference is to FM analog radio SINAD equivalent intelligibility. That is a static analog measurement so the Table 1 description (see the table above) has been provided to provide a cross reference.

... (Channel Performance Criterion) CPC requirements would normally specify either a 3 or 3.4 DAC at the boundary of a protected service area.

Radio systems for public safety should be designed to provide the users with a DAQ of 3.4 so that over the vast majority of the coverage area speech is easily understood.

An equivalent to DAC can be derived for digital systems. It is related to the Bit Error Rate (BER). However, the DAC - BER relationship depends on the specifics of the error correction algorithm, vocoder and related performance of the particular digital platform.

The report also includes methodologies to allow system design, specification, and verification of desired audio quality levels for a given reliability percent of the coverage area. Procurement specifications should detail the desired DAQ and the percentage of the service area that must achieve the required DAQ as well as the acceptance testing methodology to be used.

#### Data Performance

Additional studies are required in this area, including video. Data performance impacts system loading due to retries (repetition). The length of the data file and whether or not acknowledgments are utilized effect the overall system loading. We encourage TIA to continue its efforts to include data and video in this or a similar report.

#### SECTION II: Other Quality Considerations

In addition to the quality in technical performance related to voice clarity, other areas of quality may be considered by the public safety users and manufacturers. An integral part of the design and production of public safety radio products and services is the implementation of traditional quality control and quality assurance activities. While each public safety entity has unique user requirements related to quality, the following list gives examples of areas where quality may be an operational requirement. This list is in no way exhaustive, and no effort has been made to establish or suggest numerical recommendations, but gives suggestions of areas in which public safety entities may require a specific quality measurement when designing their systems.

#### Delay:

For terrestrial systems, the maximum amount of system delay should be limited to the following criteria as is stated in the APCO Project 25 Statement of Requirements:

Throughput delay shall be as follows:

- a. Less than 250 msec in direct radio-to-radio communications.
- b. Less than 350 msec in radio-to-radio communications through a single conventional repeater.
- c. Less than 500 msec in radio-to-radio communications within an RF subsystem.

For satellite systems, an additional system delay should be limited to 250 msec.

**Reliability:**

System Failures: What is the mean time between system failures?

System Repair: What is the mean time for system repair?

System Redundancy: If the system fails is there system redundancy?

System Durability: What are the durability test results? (e.g. driven rain or drop test?)

Diagnostics: What methods are in place to monitor and report on degradations prior to failure modes?

**Ergonomics:**

Legibility of Display: Is the display readily readable?

Lighting: Are displays readable in varying ambient light?

Radio Design: Is the radio comfortable to wear and user?

Keypad: Are the buttons big enough? Can the radio be used with gloves?

**After Market Services:**

Repair: Are repair parts and service supported?

Training: Is there training associated with maintenance, repair and use?

**Software Releases:**

Are software upgrades user friendly?

**Field Programmable:**

Program Radio in Field: Can the radio be programmed in the field?

**Throughput:**

Throughput rate: How long does it take to get the communication?

Retry rate: How long does it take to get the retried communication?

**Environmental**

Recycling: Is there a method of recycling batteries?

Is there a method for recycling packaging materials?

Radio Coverage:

In paragraph 3.6.2.2 of TIA TR8.8 it states:

For law enforcement and/or other public safety agencies, it is recommended that the CPC (Channel Performance Criterion) be applied to 97% of the prescribed area of operation in the presence of noise and interference. Law enforcement and public safety systems should be designed to support the lowest effective radiated power subscriber set intended for primary usage. In most instances this will necessitate systems be designed to support handheld/portable operation.

This subcommittee accepts the recommendation of TIA TR8.8. Using Figure 1 of that document, 97% area coverage translates to approximately 90% coverage at the contour representing the fringe of coverage.

**DISCUSSION**

Coverage Area

When describing land mobile performance, two numbers are frequently quoted in percent. The first is the percent area coverage at the fringe contour of the coverage area. In the referenced TR-8.8 document, Figure 1, pp. 7 the relationship between total area coverage and that coverage at the fringe is presented. 95 percent area coverage translates into about 82 percent coverage at the fringe. I do not believe this was the intent of the subcommittee but 95 percent fringe coverage translates to 99 percent area coverage. From TR-8.8, paragraph 5.8, the margin in the design required for each of these is 10.2dB and >14dB respectively. It is my understanding that it was the intent of ORS that the coverage at the total area coverage should be 97 percent. This translates to a fringe coverage of 90% with a total margin of 11.5 dB required to obtain this level of coverage. These numbers are summarized below. In fact, the recommendations of TR-8.8 for public safety in section 3.6.2.2 is for the 97% area coverage as shown above.

% COVERAGE CONTOUR	AREA	MARGIN dB
82	95	10.2
90	97	11.5 < Recommendation
95	99	> 14

Coverage Time and DAC

From TR-8.8, it says “The goal of DAC is to determine what mean C/(I+N) is required to produce a subjective audio quality metric under Raleigh multipath fading .... (Channel Performance Criterion) CPC requirements would normally specify either a 3 or 3.4 DAC at

the boundary of a protected service area.” Percent time availability is usually associated with Raleigh fading. So, by specifying the percentage time parameter and DAC, the ORS was being redundant. Further, it appeared that the members of the subcommittee were applying DAC over the total area of coverage, not at the coverage boundary.

### Safety

Channel Access Time: How long does it take to get an open channel?

### Speaker Identification:

Ability to identify speaker: Can you identify who is speaking?

### Batteries

Battery Life: Do the batteries meet the needs of your organization? (e.g. can they last for an entire shift without recharging?)

### Value

Consistent value: What is the quality per unit dollar?

Alternatively, some public safety entities may view Quality in a more defined structure. In general, all equipment may need to conform to industry standards to be of the highest quality and reliability. All materials should be the best of their respective kinds, free of corrosion, scratches, indentations, or other such defects. The design and construction of the communications equipment should be performed in a neat and craftsman like manner and should be consistent with good engineering practices.