

## High Cost Performance Measures System Compliance Calculations

This document provides a description of how the PMM system calculates carrier compliance with the various components of the Performance Measures Order (<https://docs.fcc.gov/public/attachments/DA-18-710A1.pdf>). The examples are intended to illustrate the calculations to allow carriers and consultants to understand the process and calculations with a goal of assisting them in successfully meeting the requirements of the Order. Further details about the Performance Measures process can be found on the USAC website (<https://www.usac.org/high-cost/annual-requirements/performance-measures-testing/>).

### **Subscriber Samples**

The number of subscribers required to be tested is defined in the Performance Measures Order in Paragraphs 34 – 40. Carriers must identify which locations reported in the High Cost Universal Broadband (HUBB) portal have active subscribers and report those subscribers to the Performance Measures Module (PMM) system. The PMM system randomizes the carrier provided subscribers list by state and obligated speed tier.

Note: Carriers in programs without entries in HUBB will have to follow a different process, which will be communicated in the future.

Carrier sample sizes are based on the number of subscribers reported for each state and obligated speed tier. Carriers with over 500 subscribers in a specific state and obligated speed tier must test 50 random subscribers selected by the PMM system. Carriers with 50 or fewer subscribers in a specific state and obligated speed tier must test 5 random subscribers selected by the PMM system. For carriers with 51 to 500 subscribers in a specific state and obligated speed tier, the PMM system will select a random sample of subscribers equal to 10% of the total subscribers reported for that state and obligated speed tier.

The PMM system makes available the appropriate samples to the carrier for download and testing. Carriers are required to submit test results for all subscribers in each sample. The PMM system tracks the number of test results submitted for each sample and subscriber.

### **Sample Size Submitted Calculation**

The PMM system calculates Sample Size Submitted using the following logic. Given the carrier's determined sample size, at least 1 test record of each type (Download, Upload and Latency) must be submitted for each subscriber in the sample. The PMM system tracks this for all 3 categories, Download, Upload and Latency individually. The lowest percentage of the 3 categories is used as the Sample Size Submitted percentage for pre-testing. For full testing, where performance calculations

determine overall compliance, the Sample Size Submitted percentage is a component in determining the overall compliance level.

For example, a carrier has a sample size of 50, it submits download test records for all 50 subscribers (50/50=100%) and it also submits upload test records for all 50 subscribers (50/50=100%). However, it only submits latency test records for 49 of its 50 subscribers, (49/50=98%). Each test type will have a separate sample size calculation. For a carrier in pre-testing, the Sample Size Submitted percentage would be 98% the lowest percentage of the 3 categories. For a carrier in full testing, when PMM calculates the Download, Upload and Latency it adds in zero records for missing subscribers (as well as missing records). The compliance level is based on the actual speed and latency compliance calculation rather than the sample size.

### **Subscriber Replacement Adjustment**

The Sample Size Submitted calculation is modified based on the carrier's Subscriber Replacement activity during the quarter using the following logic. Performance measures test results are expected for subscribers active for the duration of the quarter. Test results not submitted for subscribers active for the duration of the quarter are counted against the carrier's Sample Size Submitted calculation, (**Invalid**). Performance measures test results are not expected for subscribers that were replaced during the quarter and thus not part of the sample when the testing occurred, (**N/A**). Performance test results are not expected for replacement subscribers who were added to the sample during the quarter (to replace existing subscribers), (**Valid**). In calculating the Sample Size Submitted percentage, the denominator is reduced by the number of **Valid** replacement subscribers. If the carrier provides test data for a portion of the **Valid** replacement subscribers, those are added back to the denominator. The PMM system maintains a randomized list of each carrier's subscribers. When a carrier requests to replace a subscriber, PMM will select the next random subscriber from the available list and provide it to the carrier for testing.

Note: Carriers MUST request a replacement through the PMM system during the quarter in which they determine that the subscriber needs to be replaced or the PMM system will treat the lack of results as **Invalid** rather than **N/A**. Also, carriers' quarterly subscriber replacements will be tracked by the PMM system and are subject to evaluation by the High Cost Verification team. Carriers should maintain records to substantiate each subscriber replacement.

Throughout this document the following example will be used to illustrate the various calculations. A carrier has a sample size of 50 subscribers. During the quarter, 2 subscribers drop service and are replaced.

To illustrate the Subscriber Replacement adjustment, using the example above, a carrier has a sample size of 50. During the quarter, 2 subscribers drop service and are replaced by the carrier, providing them with 2 new subscribers. At the filing deadline, the carrier submits the following:

- Full test results for 46 subscribers in its original sample

- No test results for 2 subscribers in its original sample

**Subscriber Replacement Example**

Original Sample Size	50
Less Replacements (Valid)	- 2
Expected Subscribers to be tested	48
Tests Received Original Sample	46
Tests Missing from Original Sample (Invalid)	2
Total Tests Received	46
Total Tests Expected	48
Sample Size Percentage Calculation	95.83% (46/48)

**Speed (Upload / Download) Calculations**

The PMM system calculates Speed compliance as specified in the Performance Measures Order. Per Paragraphs 28 through 30, carriers are required to conduct 1 speed test per hour between 6 pm and 12 am local time for 7 consecutive days each quarter. Speed tests for all subscribers in the sample must be completed during the same testing period (7 days). Per Paragraph 28, if the carrier defers a test due to cross-talk, the carrier must initiate the first test within the first 15 minutes and continue at one-minute intervals until the speed test can be run or the one-hour test window ends. Per Paragraph 51, 80% of speed tests must be at or above 80% of the obligated speed tier, (i.e.; 10/1). PMM calculates and compiles the speed test results for all subscribers in the sample based on the data submitted by the carrier to determine their performance relative to the requirements. Upload and Download speed compliance are calculated separately.

**Speed Test Statuses**

Carriers submit speed test data records with one of 3 Test Statuses, which are listed below:

- Test Status 1 – Successful Test  
These are tests that were successfully completed and are used to calculate the carrier’s speed performance. Successful Tests include tests that both Pass and Fail the speed test performance requirements.
- Test Status 2 – Unsuccessful Test due to Crosstalk  
These are tests that could not be completed successfully due to crosstalk and are not used to calculate the carrier’s speed performance. However, they are used to determine if the carrier submitted all required test data.  
Note: Carriers’ Unsuccessful Crosstalk Tests are tracked by the PMM system and are evaluated by the High Cost Verification team.

- Test Status 3 – Unsuccessful Test due to Other / Failed Test

These are tests that could not be completed successfully and are not used to calculate the carrier's speed performance. However, they are used to determine if the carrier submitted all required test data.

Note: Carriers' Unsuccessful Other Tests are tracked by the PMM system and are evaluated by the High Cost Verification team.

### **Expected Speed Test Results**

Per Paragraphs 28 through 30, 42 Download Speed Test records are required for each subscriber for the testing period:

1 test per hour for 6 hours (6pm – 12am) for 7 days = 42 records ( $6 * 7 = 42$ ).

The same number (42) of Upload Speed Test records are also required for each subscriber for the testing period. These speed test records can be any of the Test Statuses listed above, (1, 2 or 3).

The total number of Speed Tests required of the carrier (Download and Upload) is determined by multiplying 42 by the expected number of subscribers tested. The number of subscribers tested is adjusted based on the expected sample size and Subscriber Replacement logic discussed above.

For example, for a carrier in testing with a sample size of 50 and no replacements for the quarter, the expected number of speed tests would be:

- 50 subscribers \* 42 expected download test records per subscriber = 2,100
- 50 subscribers \* 42 expected upload test records per subscriber = 2,100
- Total Expected Speed Test Records = 4,200

If the carrier had 2 Valid Subscriber Replacements during the quarter, the expected number of test results would be adjusted as follow:

- 48 subscribers \* 42 expected download test records per subscriber = 2,016
- 48 subscribers \* 42 expected upload test records per subscriber = 2,016
- Total Expected Speed Test Records = 4,032

### **Missing Speed Test Results**

If a carrier does not submit speed test records for all subscribers in its sample that were active for the testing period, the PMM system will count the missing subscribers' speed tests as zeros (0's) and factor those into the calculation of the 80/80 speed performance calculation.

For example, a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements with no valid performance test data for the quarter, therefore the PMM system expects download speed test records for 48 subscribers. If the carrier only provides download speed test records for 47 subscribers, the PMM system will add 42 zero (0) test results to the other 1974 ( $47 * 42 = 1974$ ) download speed test

records prior to calculating the 80/80 download speed performance. This same process is applied to upload speed performance.

**Missing Subscriber Download Example**

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Download Speed Tests	2,016 (48 * 42)
Download Speed Tests Submitted	1,974 (47 * 42)
Zero Download Speed Tests Added to Calculation	42
Total Download Speed Tests	2,016

Additionally, if a carrier does not provide all of the required speed test records for each subscriber, the PMM system will count the missing speed tests as zeros (0's) and factor those into the calculation of the 80/80 speed performance calculation.

For example, a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements with no performance test data for the quarter, therefore the PMM system expects download speed test records for 48 subscribers. If the carrier provides download speed test records for all 48 subscribers, but not the required 42 records for each subscriber, the PMM system will add zero (0) test results to the other test results prior to calculating the 80/80 download speed performance. This same process is applied to upload speed performance.

**Missing Download Records Example**

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Download Speed Tests	2,016 (48 * 42)
Download Speed Tests Submitted	2,000
Zero Download Speed Tests Added to Calculation	16 (2016 – 2000 = 16)
Total Download Speed Tests	2,016

**Speed (Upload / Download) Score Calculations**

The PMM system calculates the Speed Score (Upload and Download) using the following logic.

Obligated Speed Tier

Obligated Speed Tier is used by the PMM system to measure the speed performance for a particular subscriber. Obligated Speed Tier is defined as the required speed (upload / download) for a particular location based on the program requirements. This may differ from the carrier reported speed tier for a particular location in HUBB. For example, CAF Phase 2 carriers have an Obligated Speed Tier of 10/1 Mbps (10 Mbps download, 1 Mbps upload). However, a CAF Phase 2 carrier may report that a location

was deployed at a higher speed tier, (i.e.; 25/3). The PMM system tests the speed performance based on the Obligated Speed Tier (10/1) rather than the Reported Speed Tier (25/3). Carriers in programs with obligations in multiple speed tiers have the Obligated Speed Tier set by the system for locations reported in HUBB through a cascading logic beginning with the highest qualifying speed tier until the obligation in that speed tier is met, then moving on to the next lower speed tier.

### Speed Score and Compliance Calculations

All successful speed test records (test status 1) are checked against the Obligated Speed Tier for the sample for both Upload and Download. Per [Paragraph 51](#), Upload and Download Speeds should be at or above 80% of the Obligated Speed Tier for the sample.

For example, a carrier with an Obligated Speed Tier of 10/1, would need to provide Download speed test records meeting or exceeding 8 Mbps (10 Mbps \* 80%) in order for that test result to **Pass**. Similarly, the carrier would need to provide Upload speed test records meeting or exceeding 0.8 Mbps (1 Mbps \* 80%) in order to **Pass**. Speed test records (Download and Upload) that are less than the required thresholds (8 Mbps and 0.8 Mbps) are considered **Failed**.

The Download Score Calculation is determined by dividing the number of Passing Download records by the sum of the Passing Download records plus the Failing Download records plus any Missing Download test records. In order to Pass the Performance Measures Order requirements within [Paragraph 51](#), the Download Score must be greater than or equal to 80%.

Continuing with the example where a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements with no valid performance test data for the quarter, the PMM system expects download speed test records for 48 subscribers. The carrier only provides download speed test records for 47 subscribers, the PMM system will add 42 zero (0) test results to the other 1,974 (47 \* 42 = 1974) download speed test records prior to calculating the 80/80 download speed performance. For this example, of the 1,974 download speed tests submitted, 1,920 **Pass** and 54 **Fail**.

In order to convert the Download Score to the Download Compliance Percentage, the Download Score is divided by 80%, since 80% of the download tests must meet the download performance requirement. The Download Compliance Percentage is capped at 100% and is compared to the table in [Paragraph 64](#) (and included below) to determine the Compliance Level.

Continuing the example, the Download Score is 95.24%, which is divided by 80% giving a Download Compliance Percentage of 119.05%, which is adjusted to 100%, Full Compliance.

### Download Score and Compliance Calculation Example

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Download Speed Tests	2,016 (48 * 42)
Download Speed Tests Submitted	1,974 (47 * 42)

Download Records – <b>Pass</b> Download speed $\geq$ 80% of obligated speed tier	1,920
Download Records – <b>Fail</b> Download speed > 80% of obligated speed tier	54
Missing Download Test Records	42
Download Score	$1,920 / (1,920 + 54 + 42) = 95.24\%$ $(1,920 / 2,016 = 95.24\%)$
Download Compliance Percentage	$95.24\% / 80\% (95.24 / .80 = 119.05\% \text{ (capped at } 100\%))$ Full Compliance

The Upload Score Calculation is determined in the same manner using the Upload Obligated speed and Upload speed test records.

Note that only records with Test Status 1 are used to calculate the Download and Upload Speed Scores.

### **Low Latency Calculation**

The PMM system calculates Low Latency compliance as specified in the Performance Measures Order. Per Paragraph 27, carriers are required to conduct 1 latency test per minute between 6pm and 12am local time for 7 consecutive days each quarter. Low Latency tests for all subscribers in the sample must be completed during the same testing period (7 days). Per Paragraph 48, 95% of latency tests must be at or below 100ms (round trip). PMM calculates and compiles the latency test results for all subscribers in the sample based on the data submitted by the carrier to determine their performance relative to the requirements.

### **Latency Test Statuses**

Similar to speed tests, carriers submit latency test data records with one of 3 Test Statuses, which are listed below:

- Test Status 1 – Successful Test  
These are tests that were successfully completed and are used to calculate the carrier’s latency performance. Successful Tests include tests that both Pass and Fail the latency test performance requirements.
- Test Status 2 – Unsuccessful Test due to Crosstalk  
These are tests that could not be completed successfully due to crosstalk and are not used to calculate the carrier’s latency performance. However, they are used to determine if the carrier submitted all required test data.  
Note: Carriers’ Unsuccessful Crosstalk Tests are tracked by the PMM system and are evaluated by the High Cost Verification team.
- Test Status 3 – Unsuccessful Test due to Other / Failed Test  
These are tests that could not be completed successfully and are not used to calculate the carrier’s latency performance. However, they are used to determine if the carrier submitted all required test

data.

Note: Carriers' Unsuccessful Other Tests are tracked by the PMM system and are evaluated by the High Cost Verification team.

### **Expected Low Latency Test Results**

Per Paragraphs 27, 29 and 30, 2,520 Latency Test records are required for each subscriber for the testing period

1 test per minute for 6 hours (6pm – 12am) for 7 days = 2,520 ( $60 * 6 * 7 = 2,520$ )

The total number of Latency Tests required of the carrier is determined by multiplying 2,520 by the number of expected subscribers. The number of subscribers tested is adjusted based on the expected sample size and Subscriber Replacement logic discussed above. These latency test records can be any of the Test Statuses listed above, (1, 2 or 3).

For example, for a carrier in testing with a sample size of 50 and no replacements for the quarter, the expected number of latency tests would be:

- 50 subscribers \* 2,520 latency test records per subscriber = 126,000

If the carrier had 2 Valid Subscriber Replacements during the quarter, the expected number of test results would be adjusted as follow:

- 48 subscribers \* 2,520 latency test records per subscriber = 120,960

### **Missing Latency Test Results**

If a carrier does not submit latency test records for a portion of the subscribers in its sample, subscribers that were active for the testing period, the PMM system will count the missing latency tests as zeros (0's) and factor those into the calculation of the 95% latency performance calculation.

For example, a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements for the quarter, therefore the PMM system expects latency test records for 48 subscribers. If the carrier only provides latency test records for 47 subscribers, the PMM system will add 2,520 zero (0) test results to the other 118,440 ( $47 * 2,520 = 118,440$ ) latency test records prior to calculating the 95% latency performance.

### **Missing Subscriber Latency Example**

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Latency Tests	120,960 ( $48 * 2,520$ )
Latency Tests Submitted	118,440 ( $47 * 2,520$ )



Zero Latency Tests Added to Calculation	2,520
Total Latency Tests	120,960

Additionally, if a carrier does not provide all of the required latency test records for each subscriber, the PMM system will count the missing latency tests as zeros (0's) and factor those into the calculation of the 95% latency performance calculation.

For example, a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements for the quarter, therefore the PMM system expects latency test records for 48 subscribers. If the carrier provides latency test records for all 48 subscribers, but not the required 2,520 records for each subscriber, the PMM system will add zero (0) test results to the other test results prior to calculating the 95% latency performance.

#### Missing Latency Records Example

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Latency Tests	120,960 (48 * 2,520)
Latency Tests Submitted	120,000
Zero Latency Tests Added to Calculation	960 (120,960 – 120,000 = 960)
Total Latency Tests	120,960

#### Low Latency Score and Compliance Calculation

All successful Low Latency test records (Test Status 1) are analyzed to determine the round trip time for the test record. Per Paragraph 48, the PMM Order requires Low Latency to be less than or equal to 100ms round trip.

For example, a carrier would need to provide Low Latency test records less than or equal to 100ms in order for that test result to **Pass**. Low Latency test records that are greater than 100ms are considered **Failed**.

The Latency Score is determined by dividing the number of Passing Latency records by the sum of the Passing Latency records plus the Failing Latency records plus any Missing Latency test records. Per Paragraph 48, in order to Pass, the Latency Score must be greater than or equal to 95%.

Continuing with the example where a carrier in testing has a sample size of 50, but has 2 valid subscriber replacements with no valid performance test data for the quarter, therefore the PMM system expects latency test records for 48 subscribers. The carrier only provides latency test records for 47 subscribers, the PMM system will add 2520 zero (0) test results to the other 118,440 (47 \* 2520 = 118,440) latency test records prior to calculating the 100ms latency performance. Of the 118,440 latency tests submitted, 117,260 **Pass** and 1180 **Fail**.

In order to convert the Latency Score to the Latency Compliance Percentage, the Latency Score is divided by 95%, since 95% of the latency tests must meet the Low Latency performance requirement. The Latency Compliance Percentage is capped at 100% and is compared to the table in [Paragraph 64](#) (and included below) to determine the Compliance Level.

Continuing the example, the Latency Score is 96.94%, which is divided by 95% giving a Latency Compliance Percentage of 102.04%, which is adjusted to 100%, Full Compliance.

Note that only records with Test Status 1 are used to calculate the Low Latency Score.

#### **Low Latency Score and Compliance Calculation Example**

Original Sample Size	50
Less Replacements	- 2
Expected Subscribers to be Tested	48
Expected Latency Tests	120,960 (48 * 2,520)
Latency Tests Submitted	118,440 (47 * 2,520)
Latency Records – Pass Latency ≤ 100ms	117,260
Latency Records – Fail Latency > 100ms	1,180
Missing Latency Test Records	2,520
Latency Score	117,260 / (117,260 + 1180 + 2520) = 96.94% (117,260 / 120,960 = 96.94%)
Latency Compliance Percentage	96.94% / 95% (96.94 / .95 = 102.04% (capped at 100%)) Full Compliance

#### **Compliance Levels and Support Reductions**

Per [Paragraphs 63 – 64](#), Compliance Levels and Support Reductions are based on the lowest of the Download, Upload and Low Latency compliance percentages. Compliance percentages are calculated by the PMM system and evaluated based on the following table from [Paragraph 64](#).

	Qualifying Compliance Percentage X	Required Quarterly Reporting	Monthly Support Withheld
Full Compliance	$X \geq 100\%$	No	N/A
Level 1	$85\% \leq X < 100\%$	Yes	5%
Level 2	$70\% \leq X < 85\%$	Yes	10%
Level 3	$55\% \leq X < 70\%$	Yes	15%
Level 4	$X < 55\%$	Yes	25%

Compliance Levels and Support Reductions are determined by USAC and the FCC and communicated to carriers.