Wireless Carriers' 9-1-1 Caller Location Accuracy Performance Report

CRTC Staff Report of Initial Results

22 January 2016

This CRTC staff report is for information purposes only, and is based on information provided to the CRTC by wireless carriers.

1. Purpose

In an effort to improve the location accuracy for wireless enhanced 9-1-1 (E9-1-1) calls, the Canadian Radio-television and Telecommunications Commission (CRTC) established a monitoring process[1] whereby wireless carriers are required to periodically report on various indicators that reflect their performance in providing wireless E9-1-1 caller location information to the public safety answering points (PSAPs). The CRTC also established minimum thresholds that wireless carriers must meet, and target thresholds that wireless carriers should aspire to meet. In addition, wireless carriers are required to meet the minimum yield, which is the minimum percentage of successful wireless E9-1-1 caller location coordinates provided to a PSAP from a given number of valid wireless E9-1-1 location requests during the reporting period.

The CRTC determined that to facilitate the monitoring process, Commission staff would aggregate the wireless carriers' results and submit reports on the wireless carriers' initial and follow-up results to the CRTC Interconnection Steering Committee's Emergency Services Working Group (ESWG). Since the information provided by the wireless carriers to the CRTC is designated confidential, this would enable the ESWG, which includes wireless carriers, 9-1-1 network providers, PSAPs, and other 9-1-1 subject-matter experts, to review and analyse the aggregated results and provide recommendations, as appropriate, to the CRTC.

2. Executive Summary

The aggregated results for wireless carriers for 1 May to 31 July 2015 indicate that at the national, provincial, and PSAP level, wireless E9-1-1 location systems generally exceeded the minimum thresholds and minimum yield during the reporting period. They also often exceeded the target threshold. There were only a few isolated instances in which wireless carriers did not meet the minimum thresholds and minimum yield in some PSAP serving areas. These wireless carriers provided their analysis of their results and reasons why they were unable to meet them. The main reasons provided were as follows:

i) wireless carriers had a small sample size of 9-1-1 calls made in the PSAP serving areas in question, and the results were therefore not statistically representative;

ii) some of the PSAPs are located in areas where the wireless carriers had very few cell sites, which limited the performance of their network-based location determination technology, whenever the 9-1-1 caller did not have a Global Positioning System (GPS)-enabled mobile handset;

iii) wireless carriers were unable to exclude test calls that were conducted during the reporting timeframe, which may have negatively affected their results; and

iv) some of the PSAPs had not properly configured their internal systems, which negatively impacted the wireless carrier's results.

[1] For more information on this monitoring process and how it was developed, please see Appendix 1.

The wireless carriers in question indicated that they expected their results in most of these instances to be above the minimum thresholds and minimum yield during the next reporting period, since most of the issues that negatively affected their results would be resolved. They also indicated that they expect that as the projected penetration of Assisted GPS-enabled[2] mobile handsets among their customer base increases, more accurate 9-1-1 caller location information would likely be provided.

The wireless carriers stated that they would continue to work with 9-1-1 network providers and PSAPs to resolve the issues that adversely impacted their location accuracy performance results.

As per the monitoring process, the ESWG is to review the aggregated results and accompanying information provided in this report and provide recommendations, as appropriate, to the CRTC.

3. Introduction

Effective access to emergency services is critical to the health and safety of citizens, and is an important part of ensuring that Canadians have access to a world-class communication system. Accordingly, the CRTC is continuously looking for ways in which emergency telecommunications services can be improved.

As part of this effort, the CRTC, working with 9-1-1 stakeholders, established an annual monitoring process in which it will monitor wireless carriers' 9-1-1 caller location accuracy performance (referred to hereafter as "the monitoring process").[3] The monitoring process involves the ongoing measurement and compilation of wireless carriers' 9-1-1 caller location accuracy performance results based on E9-1-1 calls made by their subscribers. This process will enable the CRTC and 9-1-1 stakeholders to observe any progress made within the industry, and carriers to compare their own results with other wireless carriers and against the industry average.

As part of the monitoring process, the CRTC also established wireless location performance minimum and target thresholds. Each wireless carrier is required to meet the minimum threshold and is to aspire to reach the target threshold. In addition, wireless carriers are required to meet the minimum yield, which is the minimum percentage of successful wireless E9-1-1 caller location coordinates provided to a PSAP from a given number of valid wireless E9-1-1 location requests during the reporting period. The results contained in this report are to be used by ESWG to review the minimum and target thresholds as appropriate.

The CRTC also required all wireless carriers, on an ongoing basis, to monitor their network accuracy performance, perform integrity testing and validation of their wireless network(s), and maintain (e.g. calibrate, upgrade, and validate) their location determination equipment.

[2] Assisted-GPS (A-GPS) location technology is a mobile handset-based position location technology, through which readings are taken from GPS satellites and nearby cellular base stations (towers), with the help of a location server on the network, to determine the location of a caller.

[3] For more information on the monitoring process and how it was developed, please see Appendix 1.

Wireless E9-1-1 location technology

Wireless carriers in Canada have deployed advanced commercially available location systems based on GPS and network-based technologies. Specifically, carriers use Assisted-GPS, in combination with network-based technologies, such as Advanced Forward Link Trilateration (AFLT)[4] and Cell ID + Round Trip Time (CI-RTT)[5], which is considered by the industry to be the best location technology available on the market.

However, all existing location determination technologies have limitations; consequently, they are only able to provide high location accuracy results in certain situations, and not consistently in all scenarios. Further advances in location determination technology are required to substantially increase wireless E9-1-1 location accuracy in all scenarios, given that numerous factors impact the accurate determination of a wireless E9-1-1 caller's location. These factors include the following:

- environment (e.g. weather and tree cover)
- physical geography (e.g. urban/rural, surrounding tall buildings, underground, or terrain)
- situational (e.g. the 9-1-1 caller is indoors, outdoors, in motion, or stationary)
- mobile handset ("handset") characteristics (e.g. GPS capability, battery charge, and signal strength)

Terminology used in this report

The following are some of the key terms used to describe wireless location information and parameters.

a. Estimated latitude and longitude coordinates
These are the latitude and longitude coordinates that indicate the estimated location of a wireless E9-1-1 caller, which are provided by wireless carriers to PSAPs during a wireless E9-1-1 call.

b. Uncertainty value (Uncertainty)
Uncertainty, which is expressed in metres, is a location system parameter that indicates the outer limits of the area around the latitude and longitude coordinates of a wireless handset. Uncertainty can be used by emergency responders to estimate the possible radius of a search area, if a 9-1-1 caller is not located at or near the latitude/longitude

[4] AFLT is a network-based technology used to determine a caller's location, through which the handset measures signals from nearby cellular base stations (towers), which are then used to triangulate an approximate location of the handset.

[5] CI-RTT is another network-based technology used to determine a caller's location that also relies on measurements of signals from nearby cellular base stations (towers) to triangulate an approximate location of the handset.

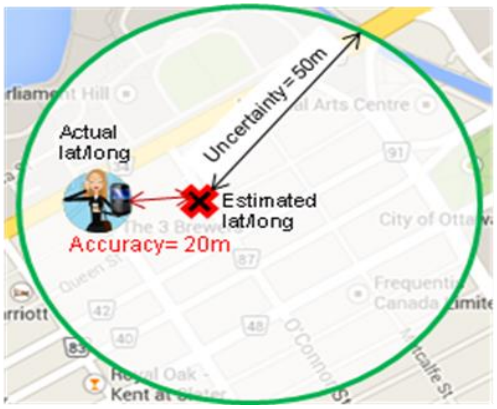
coordinates provided. The Uncertainty varies with each wireless E9-1-1 call. The lower the Uncertainty, the better.

c. Confidence level

Confidence, which is expressed as a percentage, indicates the likelihood that the 9-1-1 caller is located at the latitude and longitude coordinates provided, and within the possible location area defined by the Uncertainty. The Confidence level is fixed for all wireless E9-1-1 calls, since the CRTC requires wireless carriers to provide a 9-1-1 caller's location with a 90% Confidence level.[6]

d. Accuracy

Accuracy is defined as the difference between the estimated latitude and longitude coordinates (lat/long in the diagram below) of the calling handset and its actual latitude and longitude coordinates at the time the 9-1-1 call was placed. Accuracy is measured in metres (m). The smaller the number, the better the location accuracy performance.



e. 30-second timer to provide location

The CRTC requires wireless carriers to provide a 9-1-1 caller's location within 30 seconds of a wireless E9-1-1 call.[7] If the wireless carrier is not able to determine the location within 30 seconds, it is required to provide the 9-1-1 call taker with a response indicating that the 9-1-1 caller's location could not be determined.

f. Minimum yield

Yield is defined as a percentage of successful wireless E9-1-1 caller location coordinates provided to a PSAP from a given number of valid wireless E9-1-1 location requests during the reporting period. In order to ensure that wireless carriers' location systems

[6] See Telecom Regulatory Policy 2009-40.

[7] See Telecom Regulatory Policy 2009-40.

are providing wireless E9-1-1 caller location information for as many 9-1-1 calls as possible, all wireless carriers' are required to meet a minimum yield of 95% or higher.[8]

A number of factors could lead to wireless carriers' location systems not being able to determine a 9-1-1 caller's location. In these situations, wireless carriers inform 9-1-1 call takers that the location could not be provided. These include situations in which the location system exceeds the 30-second timer.

The rest of this report will provide information about: the methodology used for measuring, evaluating, and aggregating wireless carrier location accuracy performance; the aggregated wireless carriers' results with accompanying charts and tables in the Appendix; and a summary of the analysis provided by wireless carriers of their results.

4. Methodology for measuring, evaluating, and aggregating wireless carrier location accuracy performance

a. Using Uncertainty to measure location accuracy performance

The limitation of measuring accuracy is that it is not feasible to measure the accuracy of the location of a real life wireless E9-1-1 caller provided to the PSAP, as this would require emergency responders to record the exact location they discovered the incident or caller. Emergency responders indicated it would not be acceptable to do so when responding to emergencies, as they would necessarily be focused on providing assistance and not on taking accuracy location measurements. In addition, there is no process established between PSAPs and emergency responders to report back any measurements and correlate those measurements with each 9-1-1 call made. Consequently in the monitoring process, Uncertainty is used to monitor wireless carriers' overall location accuracy performance.

While Uncertainty is not the same as accuracy, the Uncertainty generated by wireless carriers' location systems is, nonetheless, a good proxy for accuracy. This is because Uncertainty is over a large sample size statically related and proportional to accuracy. The lower the Uncertainty, the higher the accuracy.

The benefits of measuring and monitoring Uncertainty are as follows: Uncertainty results constitute real-time/live results as seen by 9-1-1 call takers for each 9-1-1 call, where the calculation is possible. These real-time measurements can therefore provide indicators of potential location determination degeneration (e.g. after system upgrade or modification). This approach also enables PSAPs to collect and analyze 9-1-1 call information to determine whether Uncertainty measurements fall within the best practices range or minimum thresholds, and if not, PSAPs can work directly with wireless carriers to take immediate actions to improve accuracy.

Therefore, the monitoring process and the results in this report are based on E9-1-1 calls made by wireless carriers' subscribers. Consequently, the results reflect real-world scenarios, including calls made both indoors and outdoors, calls made from handsets that may or may not

[8] See Telecom Decision CRTC 2014-662.

have GPS capabilities, as well as the use of different types of network technology and location determination systems.

b. Minimum and target thresholds

The CRTC has established wireless location accuracy performance minimum and target thresholds for all wireless carriers.[9] Each wireless carrier has to meet a minimum threshold and aim for the target threshold, measured by the percentage number of times the Uncertainty provided with location information for wireless E9-1-1 calls, had an Uncertainty of less than 150 m and less than 1000 m in each PSAP area they served, (see Table 1 below). These two Uncertainty values indicate wireless carriers' performance relative to the low (less than 150 m) and high end (less than 1000 m) of the spectrum of expected Uncertainty values.

The minimum and target thresholds are segregated based on whether the PSAPs in question are large metro[10] or small/rural PSAPs[11] (see Table 1 below). This is because of the difference in the performance of location systems in each of those types of areas, due to factors including the environment (e.g. weather and tree cover), physical geography (e.g. urban/rural, surrounding tall buildings, underground building floors, and type of terrain), and situational factors (e.g. the 9-1-1 caller is indoors, outdoors, in motion or stationary).

Table 1: Wireless E9-1-1 location accuracy minimum and target thresholds

Thresholds established		**Threshold categories**			
		Uncertainty <150 m for rural/small PSAPs	**Uncertainty <150 m for Large metro PSAPs**	**Uncertainty <1000 m for rural/small PSAPs**	**Uncertainty <1000 m for Large metro PSAPs**
% number of times location info from E9-1-1 calls provided by a wireless carrier, was below Uncertainty level in threshold category	**Minimum threshold**	33%	33%	60%	72%
	Target threshold	48%	48%	74%	86%

Note: The target thresholds are based on the mean Uncertainty measurements. These are the initial minimum and target thresholds, and will be reassessed and fine-tuned over time as necessary, for example, as location determination technologies evolve and improve.

[9] See Telecom Decision CRTC 2014-662.

[10] Large metro PSAPs serve areas that are census metropolitan areas, which encompass a very large urban area (known as the urban core), together with the adjacent urban and rural areas that have a high degree of social and economic integration with the urban core. A metropolitan area has an urban core population of at least 100,000, based on the last census.

[11] Small/rural PSAPs serve areas with an urban core population of less than 100,000, because it is either a mostly rural area or a small urban area.

The initial national minimum and target thresholds were set by the CRTC based on the recommendations of wireless carriers, PSAPs, and other 9-1-1 stakeholders in the CRTC interconnection Steering Committee (CISC) Emergency Services Working Group (ESWG). Each wireless carrier is required to meet the minimum thresholds and to aim to reach the target thresholds. The results in this and future reports will be used to assess whether the minimum and target thresholds should be reviewed.

Consequently, the minimum and target thresholds will enable (i) carriers to compare their own performance relative to the minimum and target thresholds and the industry average, (ii) the CRTC, wireless carriers, and PSAPs to observe any progress made within the industry, and (iii) the CRTC to reassess the minimum and target thresholds as necessary to improve performance. Therefore, in the long run the monitoring process will ensure that wireless carriers location systems are able to provide the most accurate 9-1-1 caller location possible. This will be beneficial to the health and safety of Canadians, as it will enable emergency responders to quickly go to the location of an emergency and provide the needed assistance.

c. Methodology to aggregate wireless carriers' results

Wireless carriers are required to report to the CRTC the percentage of location requests from wireless E9-1-1 calls, where the location Uncertainty value provided to the PSAP was below the various Uncertainty values, in the minimum and target threshold categories in Table 1 above, for each PSAP that provides wireless E9-1-1 service in the wireless carrier's serving territory. The wireless carriers are also required to aggregate their results on a provincial and national basis. The wireless carriers' initial results are based on their data collected over the three-month period of 1 May to 31 July 2015.

In February 2016, the wireless carriers are also required to submit to the CRTC follow-up reports with their results, based on data collected between 1 August 2015 and 31 January 2016. Thereafter, the wireless carriers are required to submit reports annually by the end of February of each year for the data collected in the preceding year.

CRTC staff has aggregated all of the wireless carriers' initial results to show their combined performance at the national, provincial, and PSAP levels. CRTC staff compiled aggregated tables, histograms, and normal distribution charts of the results for each minimum and target threshold category. These tables and charts show the national distribution of all the location accuracy performance results reported by all wireless carriers, and their performance compared to the minimum and target thresholds (see Appendix 2). In the two cases where there were only one or two wireless carriers in a PSAP serving area, this information could not be provided in an aggregated form that would maintain the confidentiality of the information. As a result, the aggregated results at the PSAP level for these two PSAPs are not included in Appendix 3 of this report.

In addition, CRTC staff has calculated the weighted average of the combined results of all wireless carriers at the national, provincial, and PSAP levels. The weight used in calculating the weighted average was the reported number of times location information was successful provided to PSAPs, as a result of wireless E9-1-1 calls.

5. Summary of wireless carriers' aggregated results and their analyse of their results

The wireless carriers indicated that their results show that, at the national, provincial, and PSAP levels, their wireless E9-1-1 location systems often exceeded the minimum and target thresholds.

There were only a few instances in which wireless carriers did not meet the minimum threshold in some PSAP serving areas. The following are the analysis and explanations provided by wireless carriers regarding those instances, as well as the aggregated results of all wireless carriers' submissions.

a. Minimum and target thresholds

Table 2 below illustrates the aggregated results[12] of all wireless carriers on a national and a provincial basis. The results indicate that the wireless carriers exceeded the minimum and target thresholds on a provincial level in all but two cases, one in the province of Saskatchewan for the threshold category of less than 1000m for small/rural PSAPs and one in New Brunswick for the threshold category of less than 1000m for Large Metro PSAPs.

Table 2: Aggregated national and provincial results for all wireless carries for each minimum and target thresholds category indicating the percentage of location results from E9-1-1 calls reported and the percentage Yield

	Uncertainty <150 m for rural/small PSAPs	**Uncertainty <150 m for large metro PSAPs**	**Uncertainty <1000 m for rural/small PSAPs**	**Uncertainty <1000 m for large metro PSAPs**	**Successful locate count for all wireless carriers**	**Locate failure count for all wireless carriers**	**% Yield**
Minimum threshold	33%	33%	60%	72%			95%
Target threshold	48%	48%	74%	86%			
National	**68%**	**65%**	**81%**	**90%**	**1570053**	**41702**	**97%**
British Columbia	65%	65%	76%	87%	211961	3744	98%
Alberta	68%	67%	79%	88%	195996	3719	98%
Saskatchewan	53%	61%	71%	91%	46093	2622	95%
Manitoba	77%	69%	85%	90%	49316	1930	96%
Ontario	69%	65%	86%	91%	553003	9001	98%
Quebec	70%	64%	82%	94%	463913	19995	96%
New Brunswick	65%	64%	76%	80%	19903	316	98%
Nova Scotia	61%	65%	75%	88%	26070	343	99%
Prince Edward Island	62%		77%		3800	32	99%

The wireless carriers' aggregated results on a per-PSAP basis indicate that the wireless carriers exceeded on an aggregated basis the minimum threshold for all PSAPs. In most cases, the wireless carriers also exceeded the target threshold on a per-PSAP basis. A detailed breakdown of the aggregated results, by PSAP, is available in Appendix 3.

As indicated in Table 3 below, there were only four instances, or 0.5% of all instances, in which wireless carriers individually did not meet the minimum threshold in three PSAP serving areas.

[12] Results were reported by each wireless carrier on a national, provincial, and per-PSAP basis. These results were then aggregated for all wireless carriers.

To respect the confidentiality of the information they provided, these PSAPs will be referred to in this report as PSAP A, PSAP B, and PSAP C.

Table 3: The number and percentage of instances in which wireless carriers' results were below the minimum and target thresholds

	Uncertainty <150 m for rural/small PSAPs	Uncertainty <150 m for large metro PSAPs	Uncertainty <1000 m for rural/small PSAPs	Uncertainty <1000 m for large metro PSAPs	% Yield
Minimum threshold	0	1 or 0.5%	2 or 1%	1 or 0.5%	37 or 9.3%
Target threshold	4 or 2 %	4 or 2 %	32 or 30%	44 or 36%	

Of the four instances reported in which the wireless carriers did not meet the minimum thresholds, two instances occurred in the serving area of PSAP A, one in the serving area of PSAP B, and one in the serving area of PSAP C.

The wireless carriers that reported these four instances indicated that the following factors impacted their ability to meet the minimum and target thresholds:

i. In the PSAP serving areas in question, the wireless carriers had a small sample size of 9-1-1 calls made; therefore, the results do not provide a statistically accurate reflection of the wireless carriers' 9-1-1 location systems' accuracy performance. The wireless carriers indicated that their overall results show that in cases where there is a much larger sample size, such as in other PSAP serving areas, at the provincial and national levels, their results exceeded the minimum thresholds, and often the target thresholds.

ii. The wireless carriers also indicated that some of these PSAPs are located in areas where the wireless carriers have very few cell sites, with extensive distance between cell sites. This means that the wireless carriers' ability to use network-based methods to determine location was limited. This is particularly a concern in cases where the 9-1-1 caller does not have a handset that could determine location using handset-based A-GPS technology and had to rely on network-based methods.

iii. A vast majority of the wireless E9-1-1 calls made were delivered to those PSAPs without the benefit of A-GPS. One of the wireless carriers indicated that despite the fact that A-GPS is its primary 9-1-1 location determination technology, and that most of its subscribers have A-GPS-enabled handsets, for PSAP A, only 11% of 9-1-1 callers' locations were determined using A-GPS, and 23% for PSAP B. According to the wireless carrier, this indicates that most its subscribers that called 9-1-1 callers in PSAP A's serving area do not have A-GPS-enabled handsets.

b. Yield of the successful provision of wireless E9-1-1 caller location to PSAPs

The results submitted by the wireless carriers indicate that the aggregated national and provincial Yields were above the 95% minimum yield. At a per-PSAP level, wireless carriers were able to successfully provide wireless E9-1-1 callers' location including latitude and longitude co-ordinates, for more than 95% of valid location requests from wireless E9-1-1 calls, to all but six PSAPs. For the wireless carriers that fell below the 95% minimum yield, the results

were close to the minimum yield for five PSAPs, with a 94% aggregated Yield result, and for the other PSAP, with a 91% aggregated Yield result (see table in Appendix 3).

Wireless carriers also submitted that in 32 instances (or 8% of all instances) in which the wireless carriers did not individually meet the 95% minimum yield in a PSAP serving area. In most of these instances, the Yield results were close to 95% or above 90%.

The wireless carriers that did not meet the 95% minimum yield submitted the following explanations:

i. Most commonly, major network and system upgrades were being undertaken by either the wireless carriers, the PSAPs, or the 9-1-1 network providers within the measurement period. This resulted in (i) a much-higher-than-usual number of test calls to 9-1-1, which the wireless carriers submitted could not be filtered from live 9-1-1 calls and which were included in the wireless carriers' results as errors, and (ii) the minimum yield not being met in some PSAP serving areas where the testing was being conducted.

ii. In many instances, PSAPs had improperly configured computer-aided dispatch (CAD) systems for testing and implementation of the In-call Location Update (ICLU) feature[13]. Some PSAPs CAD software was configured to automatically make an ICLU request, with the timer well below the 35-second minimum time interval after the previous location request. Any locate requests sent within the 35-second time interval would potentially result in an error, whereby the 9-1-1 location information is not provided 9-1-1 call taker, and therefore negatively affects wireless carriers' yield results. ICLU is set-up for manual ICLU requests by the 9-1-1 call taker, configuration of automatic ICLU requests is not supported, and cause a significant number of error messages.

iii. In some instances, the wireless carriers had a small sample size of 9-1-1 calls made in a particular PSAP's serving area. The results were therefore not a statistically accurate reflection of the performance level.

6. Conclusion

In general, the results indicate that wireless carriers are meeting, and often exceeding, both the minimum and target thresholds at the national, provincial, and PSAP levels.

For the isolated instances in which individual wireless carriers did not meet the minimum thresholds and minimum yield in a particular PSAP's serving area, the wireless carriers have provided explanations as to why they were unable to meet a minimum threshold.

The wireless carriers in question indicated that for most instances, they expected their results to be above the minimum thresholds or minimum yield in the next reporting period, since most of the issues that negatively affected the results would likely be resolved. For example, 9-1-1 network providers and wireless carriers are working with PSAPs to fix the PSAPs' ICLU

[13] A feature that allows 9-1-1call takers to request an updated location information of a wireless E9-1-1 caller. The updated location information enables 9-1-1 call takers to receive the new location of a caller who, for example, is in motion or has changed location, and therefore assist emergency agencies in responding to the emergency.

configuration, in accordance with the way the ICLU feature was designed. Some of the PSAPs have already fixed their CAD systems, and others are in the process of doing so.

For the instances in which the wireless carriers had a small sample size of 9-1-1 calls made by their subscribers in a particular PSAP's serving area, the wireless carriers in question indicated that the results measured over a longer reporting period should show that the wireless carriers' 9-1-1 caller location accuracy performance was above the results.

The wireless carriers in question also indicated that for the PSAPs located in areas where wireless carriers have very few cell sites, with extensive distances between cell sites, they expected that an increase in the penetration of A-GPS-capable handsets would enable them to provide more accurate 9-1-1 caller location information since A-GPS is highly reliable when used in these types of areas.

The wireless carriers indicated that they expect to continue to work with 9-1-1 network providers and PSAPs to resolve the issues that adversely impacted the performance of their 9--1-1 caller location systems or their location accuracy performance results.

The continued monitoring of such results is important to enable wireless carriers to compare their results with the industry average, so that individual carriers may seek to improve their results. Additionally, it will enable the CRTC and 9-1-1 stakeholders to observe the wireless industry's progress in improving the accuracy of the 9-1-1 caller location information delivered to PSAPs.

Pursuant to the monitoring process approved by the CRTC in Telecom Decision 2014-415[14] and Telecom Decision 2015-225[15] , CRTC staff provides this report to the ESWG. The ESWG is to review and analyze the aggregated results and accompanying information provided in this report and provide recommendations, as appropriate, to the CRTC.

[14] Approval of the recommendations set out in CISC Emergency Services Working Group Consensus Report ESRE0064, *Wireless E9-1-1 Phase II Location Accuracy Requirements in Canada*. 16 January 2014.

[15] Approval of the recommendations set out in CISC Emergency Services Working Group Consensus Report ESRE0068, *Wireless E9-1-1 Phase II Location Accuracy – Monitoring Process*. 12 March 2015.

Appendix 1: Establishment of monitoring process

In Telecom Regulatory Policy 2009-40, the CRTC required wireless carriers to implement wireless Phase II enhanced 9-1-1 (E9-1-1) service, wherever wireline E9-1-1 is available across Canada. This new service provided substantial public safety improvements by enabling the transmission to PSAPs of a wireless E9-1-1 caller's location that was much more precise. The wireless E9-1-1 caller's location was to be determined through wireless E9-1-1 location technologies using handset-based GPS or network-based trilateration technologies.

In Telecom Regulatory Policy 2014-342, the CRTC set out its 9-1-1 action plan, which includes key initiatives aimed at enhancing 9-1-1 services. One of these initiatives is to improve the 9-1-1 caller location information provided by wireless carriers to PSAPs.

In Telecom Decision 2014-415, the CRTC approved the CISC ESWG's proposed national minimum and target thresholds that wireless carriers must meet to measure their performance in wireless E9-1-1 caller location accuracy.[16] The CRTC also required all wireless carriers, on an ongoing basis, to monitor their network accuracy performance; perform integrity testing and validation of their wireless network(s); and maintain (e.g. calibrate, upgrade, and validate) their location determination equipment.

The CRTC also requested that the ESWG submit a report for CRTC approval, within six months of the date of that decision, outlining a recommended monitoring process regarding the wireless E9-1-1 caller location accuracy performance of all wireless carriers.

In Telecom Decision 2015-255, the CRTC approved the CISC ESWG's recommended monitoring process that created a standard format and methodology for collecting and reporting the results of wireless carriers' E9-1-1 caller location accuracy performance.[17] The aim of the process was to enable wireless carriers, the CRTC, and other 9-1-1 stakeholders to analyze wireless carriers' location accuracy performance, make changes to the minimum and target thresholds as appropriate, and for wireless carriers to take remedial actions when necessary or when the minimum thresholds are not being met.

The CRTC also directed wireless carriers to provide, by 31 August 2015, the initial report of their wireless E9-1-1 caller location accuracy results for all PSAPs that provide wireless E9-1-1 service in the wireless carrier's serving area. The initial report was to include the aggregated results for each province the wireless carrier serves, and was to be based on data collected by the wireless carrier covering 1 May to 31 July 2015. Wireless carriers were also directed to submit follow-up reports to the CRTC in February 2016 based on data from 1 August 2015 to 31 January 2016, and thereafter to submit reports annually by the end of February.

[16] Wireless E9-1-1 Phase II Location Accuracy Requirements in Canada, Version 1.0, 16 January 2014 (ESRE0064)

[17] Wireless E9-1-1 Phase II Location Accuracy – Monitoring Process, Version 1.0, 12 March 2015 (ESRE0068)

Appendix 2: Aggregated 9-1-1 location accuracy performance results

The histograms and normal distribution charts below are based on the results reported by wireless carriers for each PSAP in their serving territory, for the three-month period of 1 May to 31 July 2015. To demonstrate wireless carriers' performance relative to each minimum and target threshold category, the charts and tables are based on the results for the percentage of wireless E9-1-1 calls[18] with location information that had an Uncertainty of less than 150 m or 1000 m, and by small/rural PSAPs or large metro PSAPs.

The charts and tables in sections a) to d) below show the distribution and frequency with which all wireless carriers reported various percentages of wireless E9-1-1 calls made per PSAP for each minimum and target thresholds category. For example, for section a), the charts and table shows the distribution and frequency with which all wireless carriers reported various percentages of wireless E9-1-1 calls with an Uncertainty of less than 150 m made in the serving areas of small/rural PSAPs. The X-axis represents the percentage of wireless E9-1-1 calls from a wireless carrier in a PSAP serving area, and the Y-axis represents the frequency (the number of times a particular percentage was reported) and the percentage frequency of all reported results for the particular minimum and target threshold category. This is shown as a percentage (left) and in the number of instances (right) of the histogram charts.

The charts and table in section e) show the distribution and frequency of the various Yield results reported by wireless carriers across all PSAPs. All wireless carriers reported a percentage Yield for each PSAP in their serving territory. For example, a wireless carrier reported that 99% of valid location requests from wireless E9-1-1 calls included wireless Phase II E9-1-1 location information in a particular small/rural PSAP serving area during the measurement period.

The table in section f) provides information on the maximum, minimum, mean, and standard deviation of the percentage of E9-1-1 calls reported by all wireless carriers for each minimum and target threshold category, and the reported Yield results. The maximum is the highest reported percentage of E9-1-1 calls by a wireless carrier across all PSAPs for that minimum and target threshold category, and the minimum is the lowest percentage of E9-1-1 calls reported.

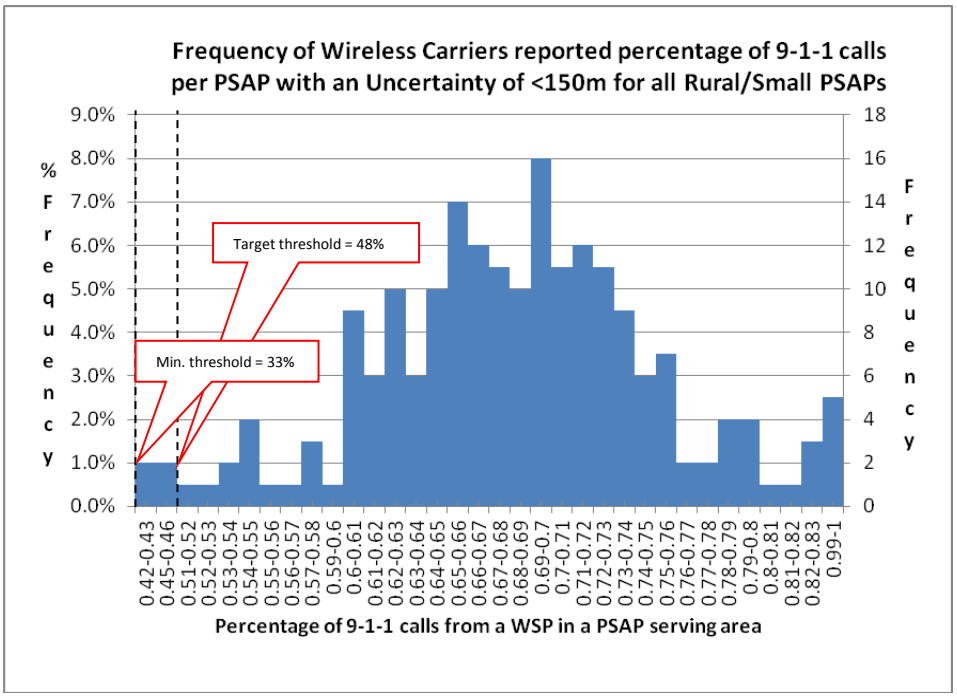
The mean is the average of all reported results for each minimum and target threshold category. The standard deviation indicates the variation or dispersion of the set of reported results in relation to the mean for each minimum and target threshold category. A standard deviation close to 0 indicates that the data points tend to be very close to the mean of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values. In a normal distribution, the mean is the same as the median.

[18] Referred to in this section, as the percentage of 9-1-1 calls, for simplicity to enable the understanding of the charts and tables. However, given that PSAPs can make a number of in-call location updates (rebid) requests per wireless E9-1-1 call, this represents the percentage number times wireless E9-1-1 call location information was provided by a wireless carrier to a PSAP, below the Uncertainty level in each threshold category.

a. Rural/small PSAPs for Uncertainty of <150 m (minimum threshold 33%, target threshold 48%)

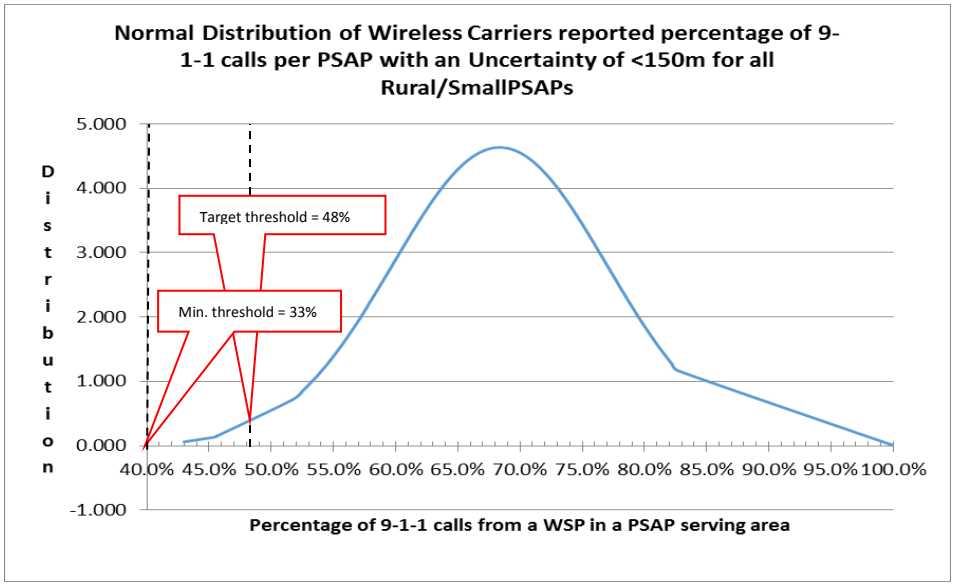
Frequency – the number of instances in which wireless carriers reported a particular percentage of 9-1-1 calls made in a PSAP serving territory for each minimum and target threshold category.

% Frequency – frequency as a percentage of the total number of instances reported for each minimum and target threshold.



Instances below Min Threshold = 0

Instances below Target Threshold = 4 or 2 %

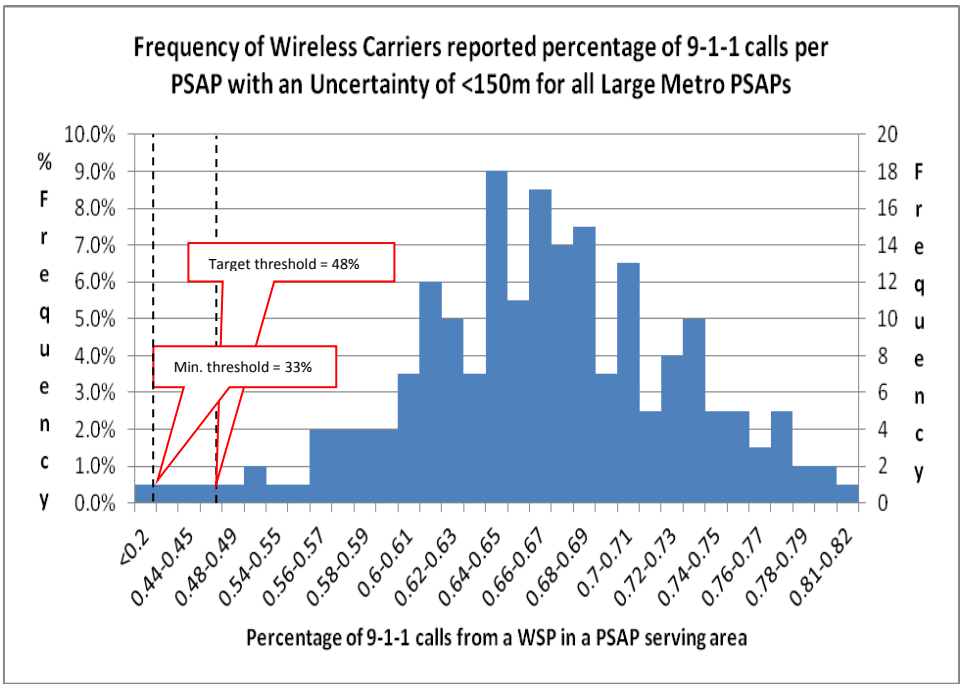


Mean = 68.4%
Standard Deviation = 8.6%

Frequency of wireless carriers' reported percentage of 9-1-1 calls per PSAP with an uncertainty of <150 m for all rural/small PSAPs

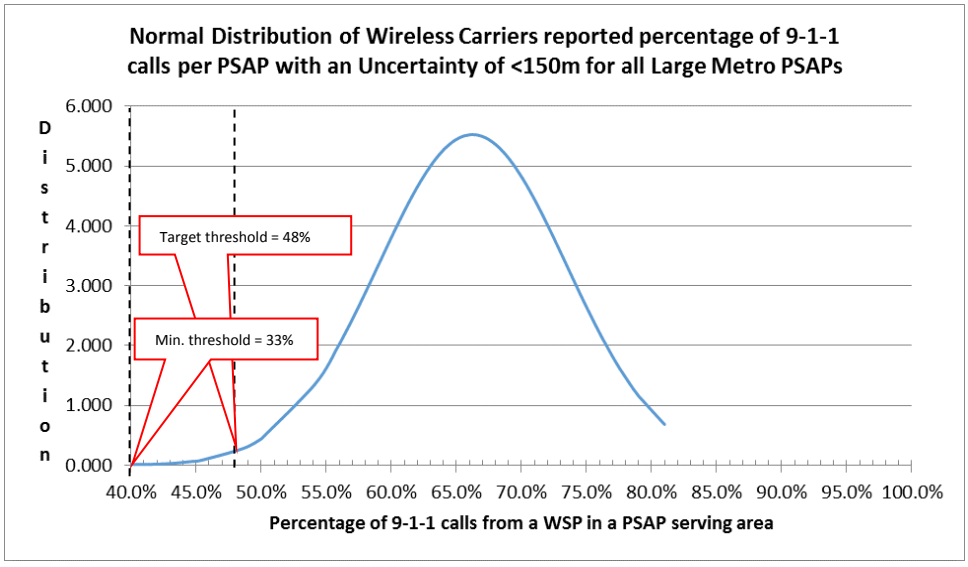
	Frequency	
Percentage of 9-1-1 calls from a wireless carriers in a PSAP serving area	**Number of instances**	**Percentage of total**
0.42-0.43	2	1.00%
0.45-0.46	2	1.00%
0.51-0.52	1	0.50%
0.52-0.53	1	0.50%
0.53-0.54	2	1.00%
0.54-0.55	4	2.00%
0.55-0.56	1	0.50%
0.56-0.57	1	0.50%
0.57-0.58	3	1.50%
0.59-0.60	1	0.50%
0.60-0.61	9	4.50%
0.61-0.62	6	3.00%
0.62-0.63	10	5.00%
0.63-0.64	6	3.00%
0.64-0.65	10	5.00%
0.65-0.66	14	7.00%
0.66-0.67	12	6.00%
0.67-0.68	11	5.50%
0.68-0.69	10	5.00%
0.69-0.70	16	8.00%
0.70-0.71	11	5.50%
0.71-0.72	12	6.00%
0.72-0.73	11	5.50%
0.73-0.74	9	4.50%
0.74-0.75	6	3.00%
0.75-0.76	7	3.50%
0.76-0.77	2	1.00%
0.77-0.78	2	1.00%
0.78-0.79	4	2.00%
0.79-0.80	4	2.00%
0.80-0.81	1	0.50%
0.81-0.82	1	0.50%
0.82-0.83	3	1.50%
0.99-1.00	5	2.50%
Grand total	**200**	**100.00%**

b. Large metro PSAPs for Uncertainty of <150 m (minimum threshold 33%, target threshold 48%)



Instances below Min Threshold = 1 or 0.5%

Instances below Target Threshold = 4 or 2 %

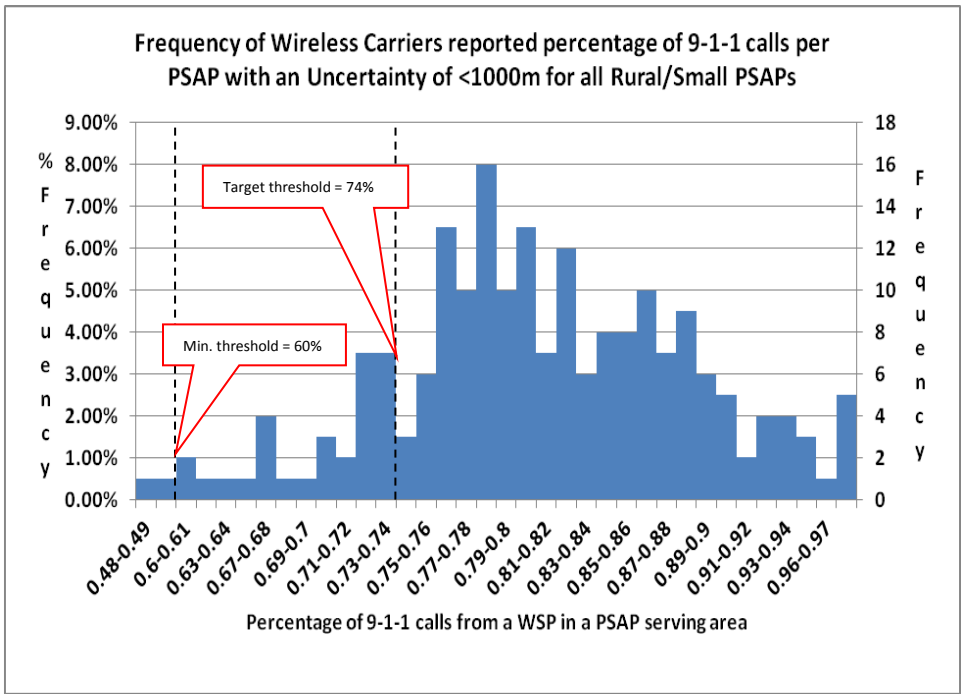


Mean = 66.2%
Standard Deviation =7.2%

Frequency of wireless carriers' reported percentage of 9-1-1 calls per PSAP with an uncertainty of <150 m for all large metro PSAPs

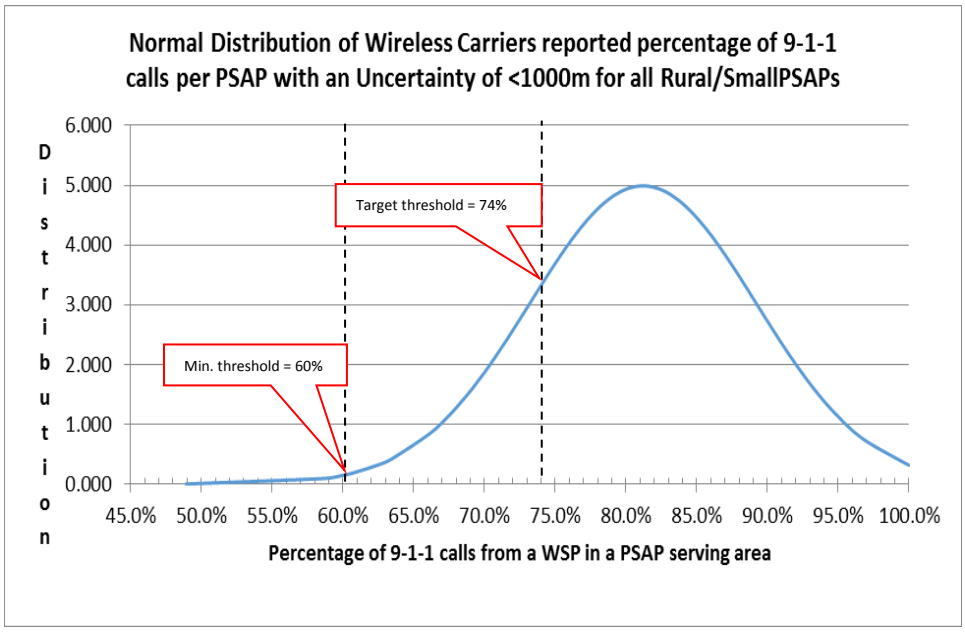
	Frequency	
Percentage of 9-1-1 calls from a wireless carrier in a PSAP serving area	**Number of instances**	**Percentage of total**
<0.2	1	0.5%
0.41-0.42	1	0.5%
0.44-0.45	1	0.5%
0.45-0.46	1	0.5%
0.48-0.49	1	0.5%
0.50-0.51	2	1.0%
0.54-0.55	1	0.5%
0.55-0.56	1	0.5%
0.56-0.57	4	2.0%
0.57-0.58	4	2.0%
0.58-0.59	4	2.0%
0.59-0.6	4	2.0%
0.60-0.61	7	3.5%
0.61-0.62	12	5.9%
0.62-0.63	10	5.0%
0.63-0.64	7	3.5%
0.64-0.65	18	8.9%
0.65-0.66	11	5.4%
0.66-0.67	17	8.4%
0.67-0.68	14	6.9%
0.68-0.69	15	7.4%
0.69-0.70	7	3.5%
0.70-0.71	13	6.4%
0.71-0.72	5	2.5%
0.72-0.73	8	4.0%
0.73-0.74	10	5.0%
0.74-0.75	5	2.5%
0.75-0.76	5	2.5%
0.76-0.77	3	1.5%
0.77-0.78	5	2.5%
0.78-0.79	2	1.0%
0.79-0.80	2	1.0%
0.81-0.82	1	0.5%
Grand total	**202**	**100.0%**

c. Rural/small PSAPs for <1000 m (minimum threshold 60%, target threshold 74%)



Instances below Min Threshold = 2 or 1%

Instances below Target Threshold = 32 or 30%

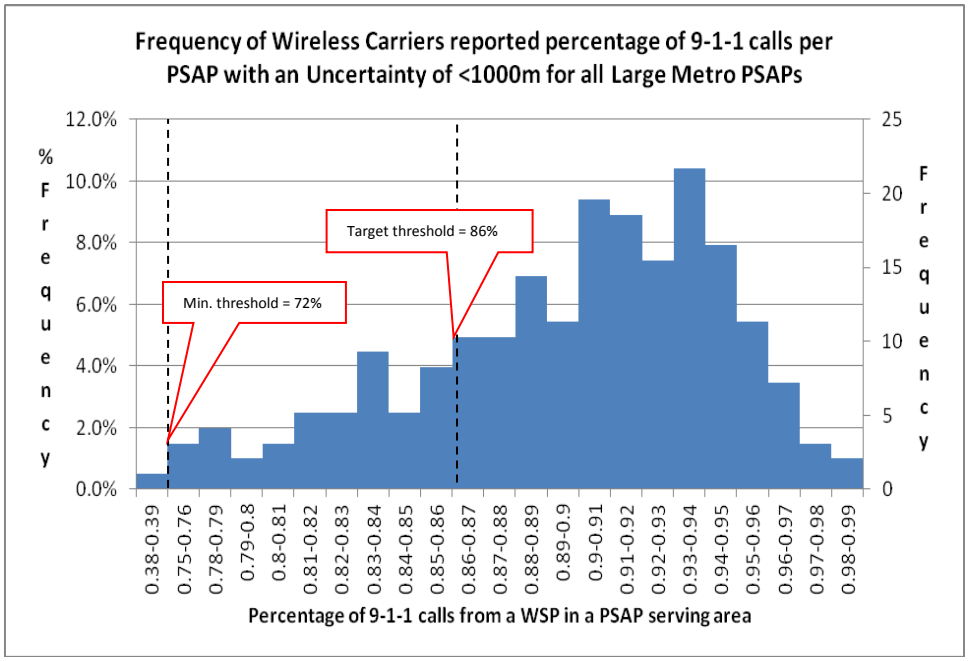


Mean =81.2%
Standard Deviation =8.0%

Frequency of wireless carriers' reported percentage of 9-1-1 calls per PSAP with an Uncertainty of <1000 m for all rural/small PSAPs

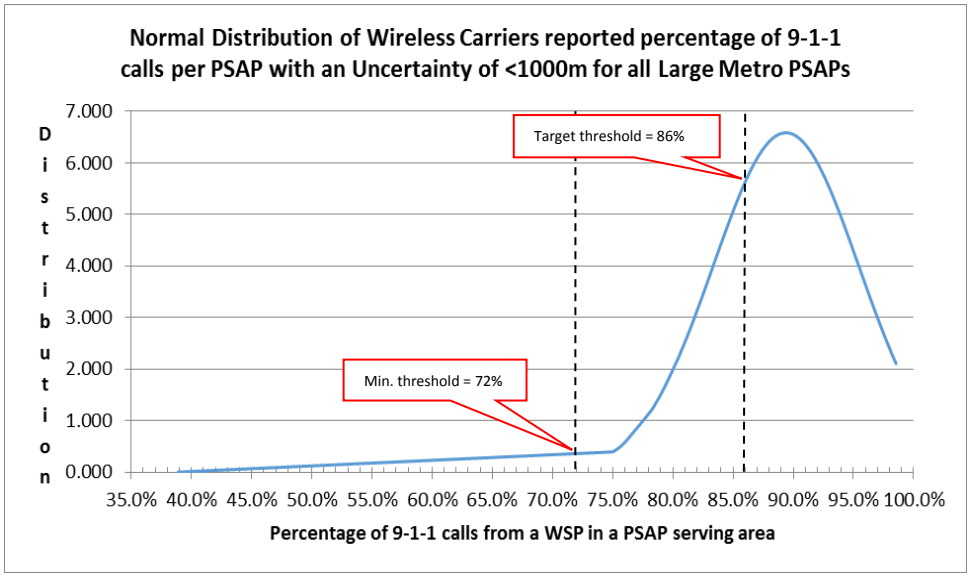
	Frequency	
Percentage of 9-1-1 calls from a wireless carrier in a PSAP serving area	**Number of instances**	**Percentage of total**
0.48-0.49	1	0.50%
0.58-0.59	1	0.50%
0.60-0.61	2	1.00%
0.62-0.63	1	0.50%
0.63-0.64	1	0.50%
0.66-0.67	1	0.50%
0.67-0.68	4	2.00%
0.68-0.69	1	0.50%
0.69-0.70	1	0.50%
0.70-0.71	3	1.50%
0.71-0.72	2	1.00%
0.72-0.73	7	3.50%
0.73-0.74	7	3.50%
0.74-0.75	3	1.50%
0.75-0.76	6	3.00%
0.76-0.77	13	6.50%
0.77-0.78	10	5.00%
0.78-0.79	16	8.00%
0.79-0.80	10	5.00%
0.80-0.81	13	6.50%
0.81-0.82	7	3.50%
0.82-0.83	12	6.00%
0.83-0.84	6	3.00%
0.84-0.85	8	4.00%
0.85-0.86	8	4.00%
0.86-0.87	10	5.00%
0.87-0.88	7	3.50%
0.88-0.89	9	4.50%
0.89-0.90	6	3.00%
0.90-0.91	5	2.50%
0.91-0.92	2	1.00%
0.92-0.93	4	2.00%
0.93-0.94	4	2.00%
0.94-0.95	3	1.50%
0.96-0.97	1	0.50%
0.99-1.00	5	2.50%
Grand total	**200**	**100.00%**

d. Large metro PSAPs for <1000 m (minimum threshold 72%, target threshold 86%)



Instances below Min Threshold = 1 or 0.5%

Instances below Target Threshold = 44 or 36%

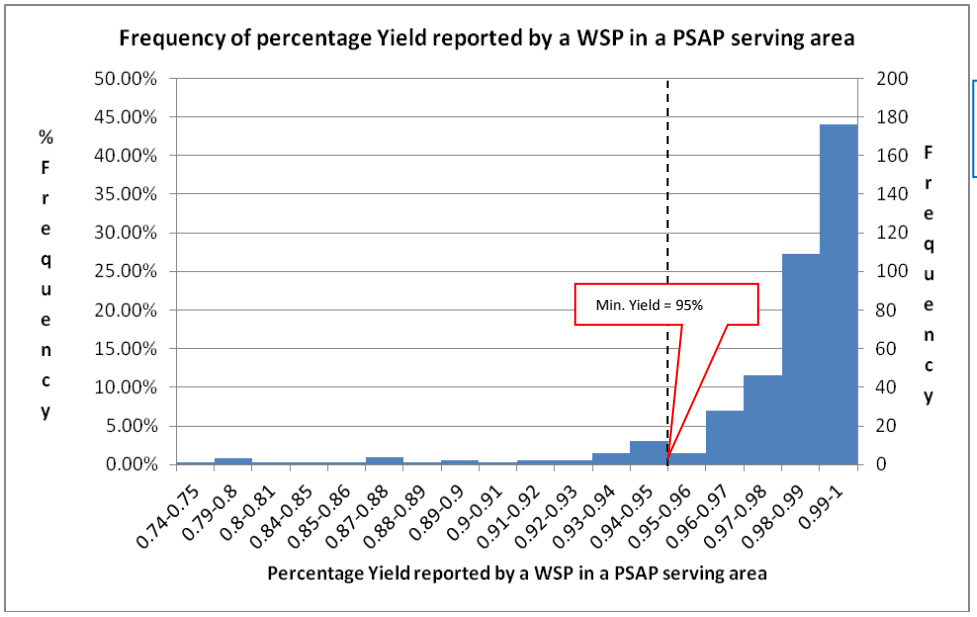


Mean =89.4%
Standard Deviation =6.1%

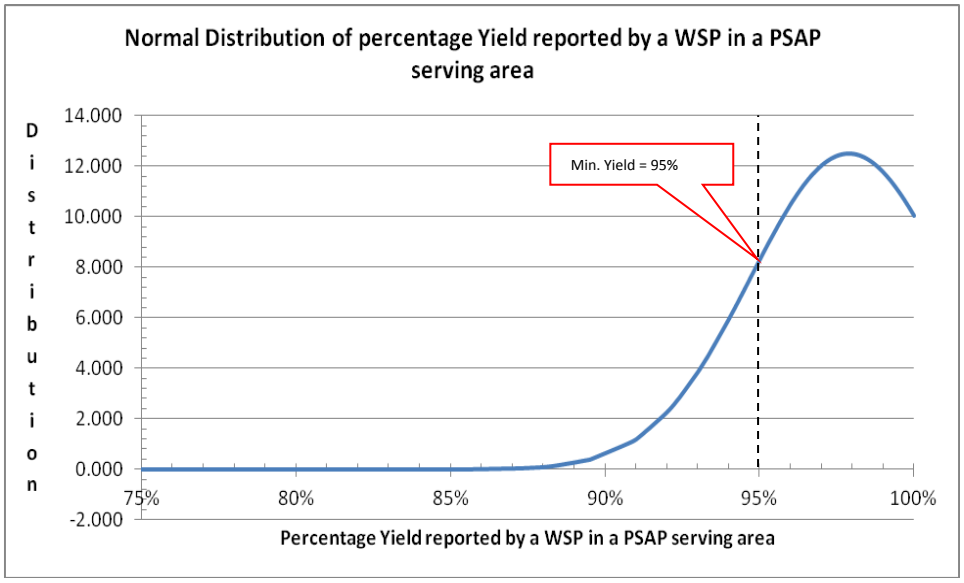
Frequency of wireless carriers' reported percentage of 9-1-1 calls per PSAP with an Uncertainty of <1000 m for all large metro PSAPs

	Frequency	
Percentage of 9-1-1 calls from a wireless carrier in a PSAP serving area	**Number of instances**	**Percentage of total**
0.38-0.39	1	0.5%
0.75-0.76	3	1.5%
0.78-0.79	4	2.0%
0.79-0.80	2	1.0%
0.80-0.81	3	1.5%
0.81-0.82	5	2.5%
0.82-0.83	5	2.5%
0.83-0.84	9	4.5%
0.84-0.85	5	2.5%
0.85-0.86	8	4.0%
0.86-0.87	10	5.0%
0.87-0.88	10	5.0%
0.88-0.89	14	6.9%
0.89-0.90	11	5.4%
0.90-0.91	19	9.4%
0.91-0.92	18	8.9%
0.92-0.93	15	7.4%
0.93-0.94	21	10.4%
0.94-0.95	16	7.9%
0.95-0.96	11	5.4%
0.96-0.97	7	3.5%
0.97-0.98	3	1.5%
0.98-0.99	2	1.0%
Grand total	**202**	**100.0%**

e. Yield of the successful provision of location information (minimum 95%)



Instances below Min Yield = 37 or 9.3%



Mean =98%
Standard Deviation =3%

Frequency of percentage Yield reported by a wireless carrier in a PSAP serving area

	Frequency	
Percentage Yield reported by a wireless carrier in a PSAP serving area	**Number of instances**	**Percentage of total**
0.74-0.75	1	0.25%
0.79-0.80	3	0.75%
0.80-0.81	1	0.25%
0.84-0.85	1	0.25%
0.85-0.86	1	0.25%
0.87-0.88	4	1.00%
0.88-0.89	1	0.25%
0.89-0.90	2	0.50%
0.90-0.91	1	0.25%
0.91-0.92	2	0.50%
0.92-0.93	2	0.50%
0.93-0.94	6	1.49%
0.94-0.95	12	2.99%
0.95-0.96	6	1.49%
0.96-0.97	28	6.97%
0.97-0.98	46	11.44%
0.98-0.99	109	27.11%
0.99-1.00	176	43.78%
Grand total	**402**	**100.00%**

f. Table of the maximum, minimum, mean, and standard deviation of the wireless carriers' aggregated results

Maximum, minimum, mean, and standard deviation of the wireless carriers' aggregated results					
	Uncertainty <150 m for rural/small PSAPs	**Uncertainty <150 m for large metro PSAPs**	**Uncertainty <1000 m for rural/small PSAPs**	**Uncertainty <1000 m for large metro PSAPs**	**Yield**
Maximum	100.0%	81.0%	100.0%	99.0%	100.0%
Minimum	43.0%	19.0%	49.0%	39.0%	75.0%
Mean	68.4%	66.2%	81.2%	89.4%	98.0%
Standard deviation	8.6%	7.2%	8.0%	6.1%	3.0%

Maximum – the highest reported percentage of 9-1-1 calls by a wireless carrier across all PSAPs for that minimum and target threshold category.

Minimum – the lowest percentage of 9-1-1 calls reported by a wireless carrier across all PSAPs for that minimum and target threshold category.

Mean – the average of all reported results by all wireless carriers for all PSAPs for a particular minimum and target threshold category.

Standard deviation – the variation or dispersion of the set of reported results in relation to the mean for each minimum and target threshold category. A standard deviation close to 0 indicates that the data points tend to be very close to the mean of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

Appendix 3: Aggregated wireless carriers' results on a national, provincial, and per-PSAP basis

Note: For security and confidentiality reasons PSAPs have requested that the Table in this Appendix be redacted from the version of the document that is posted on the CISC Emergency Service website.