



Telecom Decision CRTC 2021-210

PDF version

Ottawa, 23 June 2021

Public record: 8621-C12-01/08

CISC Emergency Services Working Group – Consensus report ESRE0092 related to handset-based location implementation

The Commission **approves**, with one modification, the recommendations set out in the CRTC Interconnection Steering Committee’s Emergency Services Working Group’s consensus report ESRE0092 related to handset-based location implementation.

Background

9-1-1 in Canada

1. 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 communications system.
2. Canadians currently have access to either basic 9-1-1 or enhanced 9-1-1 service through wireline, wireless, and Voice over Internet Protocol (VoIP) telephone services wherever a 9-1-1 call centre, also known as a public safety answering point (PSAP), has been established.¹ Canadians will soon have access to next-generation 9-1-1 (NG9-1-1) services as described in Telecom Regulatory Policy 2017-182 (the NG9-1-1 framework) and subsequent decisions.

Wireless location information

3. The location of an emergency is a critical part of the information needed by PSAPs and first responders when providing assistance to callers in emergency situations. Location information guides decisions as to which PSAP receives the initial 9-1-1 call and which resources should be dispatched, and helps to identify the quickest route to the incident.
4. The majority of 9-1-1 calls in Canada are made from wireless devices.

¹ Basic 9-1-1 service enables callers to connect to 9-1-1 operators, who dispatch the appropriate emergency responders. Enhanced 9-1-1 service includes basic 9-1-1 service but also automatically provides 9-1-1 operators with ancillary information, such as the telephone number and location of the caller.

5. Wireless carriers² were mandated to estimate the location of wireless 9-1-1 callers as a result of several Commission decisions. Location estimation was implemented in two phases, based on the evolution of location determination technology.
6. First, in Telecom Decision 2003-53, wireless carriers were required to implement wireless E9-1-1 Phase 1 service. In Phase 1 service, cellular tower location is used to route a wireless 9-1-1 call to the appropriate PSAP. The call is connected to the PSAP that serves the area of the cellular tower to which the caller's handset is connected. The 9-1-1 operator at the PSAP is provided with the caller's telephone number, the name of their wireless service provider (WSP),³ the location of the cellular tower, and the sector⁴ of the cellular coverage area where the tower is located.
7. Subsequently, in Telecom Regulatory Policy 2009-40, the Commission required the implementation of wireless E9-1-1 Phase 2 service, which improved wireless location accuracy considerably. In addition to Phase 1 information, Phase 2 includes the caller's estimated latitude and longitude coordinates, which are determined using several network-based technologies.⁵

Further improvements to wireless location accuracy

8. At present, location information for wireless calls is generally obtained from the wireless network. It can be impacted by environmental and geographical factors, by the situation of the caller, by handset characteristics, and by network coverage.
9. One of the key initiatives in the Commission's 9-1-1 action plan, set out in Telecom Regulatory Policy 2014-342, was to improve accuracy in locating 9-1-1 calls made from wireless devices.
10. In order to improve wireless location accuracy, the Commission established an annual process for monitoring performance, which involves the ongoing measurement and compilation of wireless carriers' success in accurately locating E9-1-1 calls made by their subscribers.⁶ The process enables the Commission and 9-1-1 stakeholders to observe progress made within the industry, and permits wireless carriers to compare their own results with other carriers and make adjustments to improve accuracy.
11. Over the last 12 years, the availability of Phase 2 location enhancements has considerably increased wireless location accuracy.

² Wireless carriers provide wireless services and own the network facilities required to do so.

³ WSPs include those that provide wireless services over network facilities they do not own.

⁴ A sector is the coverage area of a cellular antenna.

⁵ These include (i) assisted global positioning system, a handset-based positioning system which, with the help of a location server on the network, uses readings taken from satellites and cellular towers to determine a caller's location; (ii) advanced forward link trilateration, in which the handset measures signals from nearby cellular towers to triangulate an approximate location; and (iii) cell ID + round trip time, which also relies on cellular tower signals to triangulate an approximate location.

⁶ Telecom Decision 2015-255

12. Although the network calculations used in Phase 2 location generally yield accurate information, for a significant number of wireless emergency calls the location cannot be accurately determined by these methods because they are made from a location where these functions are not available, most commonly from indoors.

Advanced mobile location

13. Advanced mobile location (AML) is a handset-based location protocol that was developed for smartphones. AML can be used to find caller location for 9-1-1 calls made from smartphones that use either an Android operating system (Android devices) or an iPhone operating system (iOS devices). In Canada, this accounts for the vast majority of smartphones.

14. The AML protocol uses handset-based location technology from either Google's Emergency Location Service (ELS), for Android devices, or Apple Hybridized Emergency Location (HELO), for iOS devices, to determine the location of a smartphone. Both services supplement network-determined location information and send enhanced location information directly from the handset to a designated endpoint, e.g., a PSAP.

15. For both ELS and HELO, the programs for capturing location information are built into the smartphone's operating system.⁷ They are not controlled by the WSP.

16. AML relies heavily on Wi-Fi location information, which is based on nearby Wi-Fi routers, most of which are short-range and located indoors.

17. Google and Apple continuously map cellular towers and identifiable Wi-Fi hot spots, among other locations. The resulting data is provided to Android- or iOS-based smartphones on an ongoing basis. The smartphone applies mathematical calculations that use this location data to determine the location of the smartphone, also on an ongoing basis.

18. AML protocol provides for two means of transporting location information to a PSAP or aggregator: Data SMS⁸ (which is a best effort service) and HTTPS POST (HTTPS)⁹ (which requires the user to have an active data plan on their device), and defines the message structure for each.

⁷ These include parameters such as when and where the first location should be sent, how many additional location determinations should be sent, and how far apart they can be sent without depleting the user's battery.

⁸ Data SMS is a text messaging solution that enables users of mobile telephones to exchange short text messages over a wireless data network. It is a best-efforts service that provides bandwidth on a first-come, first-served basis.

⁹ HTTPS is a secure communication using the Hypertext Transfer Protocol over a computer network, and is used to send data to a receiving server to create/update a resource.

19. If a 9-1-1 call is made from a smartphone that uses AML, and location services are turned off, AML will detect that an emergency call is being made, automatically turn those services back on, and send the location information to wherever the handset/smartphone is programmed to send it. For emergency calls, there is usually a pre-determined data aggregator that collects the information and forwards it to the appropriate PSAP when requested to do so.

Report

20. On 15 October 2020, the Emergency Service Working Group (ESWG)¹⁰ of the CRTC Interconnection Steering Committee (CISC) submitted the following consensus report (the report) for Commission approval:

- *Handset-based Location Implementation in Canada*, 10 September 2020 (ESRE0092)

21. The report can be found in the “Reports” section of the ESWG page, which is available in the CISC section of the Commission’s website at www.crtc.gc.ca.

22. The report is issued as directed by the Commission in Telecom Decision 2019-120.¹¹ It identifies recent advancements in the availability of wireless handset-based location technology and how these can be used to improve accuracy in locating such calls.

23. The report is based on the views of 9-1-1 stakeholders, including WSPs, NG9-1-1 network providers, PSAPs, representatives from Google and Apple, and wireless mobile telecommunications subject matter experts. It relies on numerous submissions from industry subject matter experts and on reports and recommendations concerning handset-based technology published by the European Emergency Number Association and the National Emergency Number Association.

24. The report reflects the approach the ESWG took in completing its analysis and in developing recommendations based on the conclusions it reached. The report includes

- a) findings with respect to the differences between ELS and HELO location services in how location data is compiled and transmitted by the smartphone to different endpoints;
- b) an assessment of the advantages and disadvantages of each service;
- c) a description of two proof-of-concept trials undertaken by TELUS Communications Inc. (TCI) and Bell Canada (Bell) for ELS and HELO, respectively;

¹⁰ The ESWG is a working group under the CISC that deals with technical and operational issues related to 9-1-1 service in Canada.

¹¹ See Telecom Decision 2019-120, paragraph 13

- d) a set of recommendations;
 - e) identification of matters for further consideration required to implement handset-based location technology in Canada by 1 March 2022;
 - f) identification of a potential new opportunity to use handset-based location technology to enhance B9-1-1 service; and
 - g) potential ELS timers configurations (shown in Appendix 1 of this decision)
25. The report indicates that the proof-of-concept testing of ELS and HELO conducted by TCI and Bell shows that both services provide significant improvements in determining accurate locations in environments where GPS¹² is not available, e.g., indoors, because they both use available Wi-Fi data and the associated locations of Wi-Fi routers. TCI concluded, albeit on the basis of a small dataset, that ELS provided a threefold increase in the number of wireless calls that are located accurately to within 50 metres when compared to network-based calculations for similar scenarios.
26. The ESWG stated that, because of the large and growing number of existing W-Fi access points, the addition of Wi-Fi device-based location information has the potential to substantially increase the possibility of accurately locating wireless calls.
27. The ESWG noted the fact that some areas, such as Newfoundland and Labrador, the Yukon, and the Northwest Territories, currently have only B-1-1 service, which does not provide location information, and will not be ready for NG9-1-1 service for several years. However, the framework for implementing handset-based location information recommended in the report offers an opportunity to improve B9-1-1 service within the context of NG9-1-1 implementation throughout most of the country, because the availability of aggregation points for handset-based location data could present an opportunity to make that data available for calls placed to PSAPs that use B9-1-1 service, even before they are fully NG9-1-1 compliant.
28. The ESWG made several proposals based on its conclusions, and requested that the Commission
- a) approve the recommendations listed in section 7 of the report, and direct WSPs to implement handset-based location in Canada by 1 March 2022; and
 - b) request the ESWG to complete the work associated with the matters for further consideration listed in section 8 of the report, starting on or before 1 October 2021.

¹² Global positioning systems

Commission's analysis and determinations

29. The Commission is of the view that there was appropriate stakeholder representation in developing the report and recommendations, and that the report is within the defined scope of the Wireless Phase 2 Location Accuracy Requirements in Canada Task ([ESTF0069](#)).
30. The Commission considers the ESWG's recommendations to be reasonable and consistent with the broader strategic objectives set out in the NG9-1-1 framework, namely, (i) to increase the safety of Canadians by giving them the best access to emergency services through world-class telecommunications networks; (ii) to provide high-quality information, services, and support to PSAPs, which will ultimately enable emergency responders to effectively assist Canadians, and (iii) to use standards-based solutions that allow for flexibility and to strive for national consistency in their application.¹³
31. The Commission notes that, because approximately 80% of 9-1-1 calls are made on wireless devices, improvements to the accuracy of the location information that such devices provide will improve the accuracy of the information that emergency dispatchers and first responders receive.
32. The Commission notes the comprehensiveness of the report, which includes assessment of several options related to different technical and operational aspects of implementing handset-based location technology; shared knowledge with respect to implementation of AML in Europe and the U.S.A.; results of proof-of-concept testing done by TCI and Bell; and expert contributions from representatives of Google and Apple.
33. The Commission agrees with the ESWG's initial choice of HTTPS as the transport mode because it has several advantages over Data SMS, as identified in the report. However, the Commission also agrees with the proposal to further assess the impacts of implementing Data SMS, which is widely available across Canada. This aligns with Google's recommendation to use both modes.
34. The Commission finds that, subject to its future determinations, the proposed aggregation model whereby Bell, TCI and Saskatchewan Telecommunications act as national aggregators would provide a good foundation for interconnections that could facilitate the future inclusion of additional handset-determined data about the call, the caller, and the location, including the vertical co-ordinate. It would also provide superior reliability and redundancy compared to other models.
35. The Commission notes the recommendation that it request the ESWG to assess the requirements for implementing a new process in which the ELS and HELO location information would be validated against Phase 1 and Phase 2 location information. Under this process, only the most accurate location, whether Phase 1, Phase 2 or

¹³ Telecom Regulatory Policy CRTC 2017-182, paragraph 24

handset-based, would be sent to the PSAP. This would ensure that PSAPs have the most accurate location information in the shortest possible time and would not need to determine it themselves.

36. The Commission also notes that the process recommended by the ESWG for sending the most accurate location information to PSAPs would use the existing Phase 2 process, and would not result in additional costs to PSAPs or require training for its implementation.
37. The Commission notes that item 1 i) in section 8 of the report includes, among the matters identified for further consideration, an action plan to determine the impacts of the proposed arrangements to transmit handset-based location information on the existing platforms provided by telecommunications service providers (TSPs) and on the pending NG9-1-1 tariffs. However, the assessment of impacts on pending NG9-1-1 tariffs is beyond the scope of the ESWG and should not be included in its assessment or in its subsequent report. Consequently, the Commission will modify the ESWG's recommendation regarding this item by removing the reference to pending NG9-1-1 tariffs.
38. The recommendations included in the report will impact over 90% of the wireless handsets in Canada and benefit consumers in a similar proportion, which aligns with the Commission policy of improving the 9-1-1 caller location information provided to PSAPs.¹⁴
39. The Commission notes that the recommended option for the timing of sending the handset-determined location information to the aggregator (sampling mode) aligns with NG9-1-1 location request timing approved by the Commission in Telecom Decision 2020-373, found in the appendix to that decision.
40. Regarding the recommendation that the provision of wireless handset-based location information to PSAPs in B9-1-1 service areas should be further investigated, the Commission notes that the provision of such information to first responders in those areas could enable them to respond more quickly and effectively to those in need.
41. The Commission requests that the ESWG continue to monitor and report on technical and standards developments in the wireless industry that could lead to further improvement in the accuracy of location information, including those that impact non-Android- and non-iOS-based handsets, or new devices that may appear on the market.
42. In light of the above, the Commission **approves** the recommendations found in sections 7 and 8 of the report, with one modification. The recommendation set out at paragraph 48, item i), below, has been modified in accordance with the Commission's analysis found at paragraph 37 of this decision.

¹⁴ Telecom Regulatory Policy 2014-342, paragraph 18

43. In accordance with this, and in order to implement handset-based location in Canada by **1 March 2022**, the Commission **directs** facilities-based WSPs to take the steps listed below.

44. By **1 October 2021**, WSPs are to

- 1) enter into an agreement with Google to enable the Canadian ELS configurations as follows:
 - a) set the emergency number as 9-1-1;
 - b) set the minimum handset battery percentage threshold at 10 percent (i.e., ELS will not be calculated or delivered below 10 percent);
 - c) push ELS location data simultaneously to the designated NG9-1-1 network providers;
 - d) deliver ELS location using HTTPS to the applicable aggregation point(s) based on the WSP identifier (i.e., the mobile country code or the mobile network code);
 - e) test and confirm ELS timers as follows:
 - i. deliver the initial handset first fix location as soon as available;
 - ii. set the sampling mode timer at 4 seconds (confirm the optimal value for the best Wi-Fi result during testing, e.g., 4, 5, 6, 7, etc.);
 - iii. set the tracking mode timer at every 60 seconds for the duration of the call; and
 - f) set the ELS location confidence level at 90 percent; and
- 2) enter into an agreement with Apple to formally enable the Canadian HELO configuration as follows:
 - a) Apple configures the handset to calculate handset-based location; and
 - b) Apple calculates the most accurate location and makes it available in response to the WSP network initiated location request (NILR) query.

45. By **1 March 2022**, WSPs are to

- 1) activate the Canadian ELS software load to complete their implementation of ELS, subject to completion of the tasks listed in paragraph 46 of this decision; and

- 2) activate the Canadian HELO software load to complete their implementation of HELO, subject to the completion of the tasks in paragraph 47 of this decision.

46. When the Canadian ELS software load is complete and in-service, WSPs are to

- 1) enable the following functionalities for all wireless 9-1-1 calls from compatible Android devices:
 - a) undertake a validation process to ensure the ELS result and/or the calculated control plane location are within the Phase 1 serving area;
 - b) compare Phase 2 location with handset-based location if available and validated to determine the most accurate location result and send it to the PSAP using the existing Phase 2 configuration;
 - c) maintain the current in-call location update (ICLU) process (i.e., no Phase 2 configuration changes are required); however, that process may now include ELS location data as part of the most accurate location calculation from the WSP; and
- 2) configure their networks to deliver 9-1-1 calls from ELS-enabled handsets that do not have a data plan in order to deliver the location data to the applicable aggregation point(s).

47. When the Canadian HELO software load is complete and in-service, WSPs are to

- 1) enable the following functionalities for all wireless 9-1-1 calls from compatible Apple handsets:
 - a) undertake a validation process to ensure the HELO result is within the Phase 1 serving area or the calculated control plane location;
 - b) send the handset-based location result to the PSAP using the existing Phase 2 configuration;
 - c) maintain the current ICLU process (i.e., no Phase 2 configuration changes are required); however, that process may now include HELO location data as part of the most accurate location calculation from the WSP; and
- 2) configure their networks to deliver 9-1-1 calls from HELO-enabled handsets that do not have a data plan.

Matters for Further Consideration

48. With respect to the ESWG's recommendations regarding matters for further consideration, the Commission requests the ESWG to

- 1) undertake an assessment, starting on or before **1 October 2021** and reporting the results to the Commission not later than **1 March 2022**, of action items identified in the report as necessary for the implementation of handset-based location technology in Canada, in which the ESWG will
 - a) work with WSPs to confirm how HTTPS will be allowed from handsets without a data plan;
 - b) work with WSPs to determine if Data SMS is required in addition to HTTPS for the delivery of ELS location results;
 - c) work with WSPs to determine if the ELS configuration, validation process, and the best location result calculation (i.e., algorithm) perform as expected, subject to an agreed-upon test plan;
 - d) work with WSPs to determine if the HELO configuration, validation process, and location result calculation at the handset perform as expected, subject to an agreed-upon test plan;
 - e) work with Google to confirm a single aggregation implementation for Canada that sends the ELS location data simultaneously to each of the designated NG9-1-1 network providers;
 - f) confirm the process and interconnection required to push the ELS location results delivered from Google to the applicable WSP;
 - g) determine if additional processing is required to handle multi-operator core network arrangements between two WSPs;
 - h) confirm how licencing with Google, encryption and decryption, and the privacy of ELS location data will be addressed in the arrangement described in item e); and
 - i) determine the implications for TSPS (i.e., the enhancements to existing platforms required) of the arrangement described in item e); and
- 2) complete the following steps in order to implement the new wireless location query tool proposed for B9-1-1 PSAPs in Canada:
 - a) work with Apple to facilitate the delivery of HELO location data to NG9-1-1 network provider aggregation points;
 - b) confirm the interconnection requirements between a B9-1-1 PSAP and the serving NG9-1-1 network provider;
 - c) develop the query tool to be used as detailed in section 5.3 of the report; and

- d) conduct a proof-of-concept trial starting on or before **1 October 2021**, to be completed by **15 December 2021**, to confirm that the proposed query tool can be implemented; and
- 3) continue to monitor and report, as applicable, regarding the questions that follow.
- a) When will we be able to implement the z-axis (vertical) coordinate in Canada? Google and Apple are actively working on the vertical coordinate, and testing is already possible with Google. The ESWG will propose future trial work, to take place within one to two years, to help determine the parameters required to use z-axis in Canada. As well, PSAPs will need to work with their vendors to determine what CAD¹⁵ and mapping changes, if any, would be required to support delivery and display of z-axis data. The ESWG will continue to monitor developments around the world and file a future report when the necessary technology is ready for deployment in Canada.
 - b) Can we support parameters beyond a circle radius of uncertainty? The current WSP location technology already supports native shapes such as circles, polygons, arc bands, and elliptical shapes, which are converted to a circle for uniform display at PSAPs today. We need to determine when PSAPs will have the ability to display, i.e., map, different shapes (perhaps within three to five years).
 - c) Does the WSP configuration change when we move from E9-1-1 to NG9-1-1 service? Currently no changes are expected. However, changes will be required within three to five years when we move to the geo-routing of 9-1-1 calls using the location provided by the device processing the call. This issue will be flagged for follow-up as part of the new ESWG geo-routing task scheduled to begin in 2021.

Other matters

49. The Commission reiterates its request that the ESWG continue to monitor and report on technical and standards developments in the wireless industry that could lead to improved location accuracy, including those that impact both currently available non-Android- and non-iOS-based devices and new devices that may appear on the market.

¹⁵ Computer-aided design

Policy Directions

50. In accordance with subparagraph 1(b)(i) of the 2006 Policy Direction,¹⁶ the Commission considers that approval of the report and the recommendations will advance the policy objectives set out in paragraphs 7(g) and (h) of the Telecommunications Act.¹⁷ The report's recommendations, as modified by the Commission, represent a competitively neutral and symmetrical approach to implementing NG9-1-1 service, and specifically handset-based location determination, which affects all facilities-based WSPs.
51. The 2019 Policy Direction,¹⁸ which complements the 2006 Policy Direction, states that the Commission must consider and specify how its determinations can promote competition, affordability, consumer interests, or innovation, as applicable. The report addresses technical matters related to improving the ability to accurately locate those who call for emergency services on wireless devices, as is the case with the majority of emergency calls. The Commission considers that by directing WSPs to implement the various measures outlined in the report's recommendations and by requesting the ESGW to complete and report on the work associated with the matters for further consideration, all in support of the implementation of wireless handset-based location technology, the Commission will be better ensuring the proper functioning of 9-1-1 networks and thereby promote consumer interests. In approving the recommendations in the report, the Commission is promoting innovation, because it is exercising leadership in a coordinated nationwide transition to NG9-1-1 networks and services, to the benefit, first and foremost, of all Canadians. As technology and consumer expectations evolve, it is imperative that 9-1-1 networks maintain the path towards NG9-1-1, and that innovations in this field remain responsive to the public safety needs of Canadians.

Secretary General

Related documents

- *CISC Emergency Services Working Group – Consensus report ESRE0086 regarding dispatchable location from originating networks*, Telecom Decision CRTC 2020-373, 12 November 2020
- *CISC Emergency Services Working Group – Consensus report recommending updates to the wireless 9-1-1 caller location accuracy thresholds originally*

¹⁶ *Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives*, SOR/2006-355, 14 December 2006

¹⁷ The cited policy objectives are: 7(g) to stimulate research and development in Canada in the field of telecommunications and to encourage innovation in the provision of telecommunications services; and 7(h) to respond to the economic and social requirements of users of telecommunications services.

¹⁸ *Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives to Promote Competition, Affordability, Consumer Interests and Innovation*, SOR/2019-227, 17 June 2019

approved in Telecom Decision 2017-119, Telecom Decision CRTC 2019-120, 26 April 2019

- *Next-generation 9-1-1 - Modernizing 9-1-1 networks to meet the public safety needs of Canadians, Telecom Regulatory Policy CRTC 2017-182, 1 June 2017*
- *CISC Emergency Services Working Group – Consensus report on monitoring the wireless 9-1-1 caller location accuracy performance of wireless carriers, Telecom Decision CRTC 2015-255, 15 June 2015*
- *9-1-1 action plan, Telecom Regulatory Policy CRTC 2014-342, 25 June 2014, as amended by Telecom Regulatory Policy CRTC 2014-342-1, 30*
- *Implementation of wireless Phase II E9-1-1 service, Telecom Regulatory Policy CRTC 2009-40, 2 February 2009*
- *Conditions of service for wireless competitive local exchange carriers and for emergency services offered by wireless service providers, Telecom Decision CRTC 2003-53, 12 August 2003*

Appendix 1 to Telecom Decision CRTC 2021-210

Potential Emergency Location Service (ELS) timers configuration

Here is a potential Canadian configuration for ELS.

- a. The initial ELS result is calculated and delivered at 3-5 seconds to the designated advanced mobile location (AML) aggregation point(s) using HTTPS and (for future consideration) Data SMS.
- b. The subsequent ELS results are calculated and delivered at each 60 second interval, while the call is in progress, to the designated AML aggregation point(s) using HTTPS and (for future consideration) Data SMS.
- c. Per the existing Phase 2 requirements, the WSP will initiate a regular Phase 2 location query (either network-calculated or calculated by GPS and GNSS).
- d. If an ELS location is not available, the existing Phase 2 location response will be used.
- e. If both are available, the WSP will then do a validity check and deliver the best location to the PSAP using the existing Phase 2 delivery mechanism.
- f. The WSP will perform validity check calculations on results, including (but not limited to) ensuring the ELS result is within GPS or network radius of uncertainty, and then calculating the best location (i.e., either ELS or Phase 2) to forward to the PSAP.
- g. When a PSAP initiates an in call location update, steps c to f will be repeated, with a result returned within 30 seconds.

The following figure illustrates an example of a configuration option for timers:

Potential ELS Timers Configuration

