

# 5.5



## **Systeme évolué de radiocommunication de l'agglomération de Montréal (SERAM) Project**



## Summary of the Preliminary Audit Study

### Purpose

Corroborate Service des technologies de l'information's (STI) diagnostic conclusions and ensure that the current remedial plan would be relevant and functional in remedying the SERAM project's management problems, stabilizing the network's reliability, and mitigating the risks associated with public safety issues.

### Results

*The background surrounding the conduct of this preliminary study and the results of our work resulted in no recommendations being made.*

*The details of these results and our conclusion are outlined in our preliminary audit study report, presented in the following pages.*

*Note that the business units have had the opportunity to formulate their comments, which appear after the preliminary audit study report conclusion.*

We are of the opinion that the measures taken or in the process of being taken by the STI to put the SERAM project back on course are relevant and functional, and they should reduce the number and impact of outages while promoting system stability.

As for the technical aspects, various measures have been taken by the STI with its suppliers to reduce the frequency and duration of network outages and their impact on public safety services. These measures include infrastructure upgrades, the development of an operational back-up solution and the temporary provision of cellular communications equipment during the development period of this solution.

Despite the STI's efforts to meet the public safety requirements that were expected at the outset of the SERAM project, the resulting network will not, in our opinion, meet some significant functional and performance requirements, at least on a short- or medium-term basis.

Real-time geolocation and signal penetration in public buildings and Montréal's underground precincts are still considered essential needs by the public safety services, yet they could not be met by the SERAM project and will need to be considered in other projects. In addition, a solution remains to be found to satisfy the particular needs of the Service de police de la Ville de Montréal's specialized investigation activities.



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## List of Acronyms

CSST	Commission de la santé et de la sécurité du travail	SIM	Service de sécurité incendie de Montréal
DAQ	Delivered Audio Quality	SLA	Service Level Agreement
RENIR	Réseau national intégré de radiocommunication	SPVM	Service de police de la Ville de Montréal
SERAM	Système évolué de radiocommunication de l'agglomération de Montréal	STI	Service des technologies de l'information
		UT	user terminals

## 5.5. Système évolué de radiocommunication de l'agglomération de Montréal (SERAM) Project

### 1. Background

The Système évolué de radiocommunication de l'agglomération de Montréal (SERAM) project results from the need to modernize the radiocommunication network of the Service de police de la Ville de Montréal (SPVM), which was acquired in 1989 and reached the end of its useful life in 2004.

A first call for tenders was launched in June 2008 with the purpose of permitting the SPVM to have access to a new radiocommunication network, both on the island of Montréal and in the Montréal Métro system, to meet current operational needs and to be developed into a modern and adaptable technological platform. The system being sought was to be divided into three parts:

- Rental of the surface network radio infrastructure
- Purchase or rental of user terminals (UTs)
- Addition of equipment to the Métro network needed for police operations

The planned duration of the contract was 10 years, and the SPVM expected to have migrated its police activities to the new network by October 2010, and its general investigations by October 2011.

The only compliant bidder to the tender proposed an overall price of \$179.1 million,<sup>1</sup> based, among other things, on a surface network infrastructure comprising at least 12 radio antenna sites and DAQ 4.0<sup>2</sup> (Delivered Audio Quality) quality equipment, to provide 97% coverage of the locations included in the area served.

However, having deemed this price too high, the authorities adopted a resolution in June 2009 not to proceed with the tender.

Subsequently, an ad hoc joint committee was mandated by the authorities in April 2010 to study this project and pay particular attention to governance, funding scenarios, monitoring mechanisms, accountability and the awarding process.

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<sup>1</sup> Unless otherwise indicated, all sums of money mentioned in this report include applicable taxes.

<sup>2</sup> Delivered Audio Quality. Although this criterion is not measured technically, it represents an accurate assessment of the user. For more details, see Appendix 5.1, which provides a description of the various DAQ levels.

In its report filed with the authorities in May 2011, the committee made a number of recommendations in this regard (see Appendix 5.2). The report also envisaged a broader scope for the project to encompass all public safety stakeholders on the island of Montréal, the departments and boroughs of the city and, secondarily, related municipalities. The report stipulated that the project should be carried out in three distinct phases:

- Phase 1: surface network composed of a network of antennas, transmitters and receivers distributed over the island of Montréal, and other equipment.
- Phase 2: UT consisting of mobile radios, portable radios, fixed stations and other accessories.
- Phase 3: an underground network of 110 transmission and reception points distributed throughout the Montréal Métro network.

The report also stated that the technical requirements of the network would call for good audio quality essential to operations, as well as portable and mobile coverage throughout the island of Montréal, and all recognized public safety standards and protocols. In addition, the committee recommended that the Service des technologies de l'information (STI) continue to undertake a detailed analysis of a scenario based on two interoperable networks, the first dedicated to public safety and the second for other users.

Concerning audio quality, the report stated that the issue of equipment performance being of DAQ 4.0 quality had been analyzed by an external firm specializing in radio frequency coverage. According to the results of this analysis, DAQ 3.4 quality equipment would be satisfactory to meet the SPVM's needs and would require only 12 antenna sites rather than 14, representing savings of about \$16 million. Note: the greater the number of antenna sites, the better the signal quality and degree of penetration.

In January 2012, the authorities approved a loan by-law of \$87 million to finance the SERAM project. In addition to the contracts for carrying out the above-mentioned phases of the project, this loan by-law was to be used to finance professional services, as well as incidental and unforeseen expenses.

Following the calls for tender issued in August 2011 and October 2012 to carry out Phases 1 and 2 of the SERAM project, the authorities awarded a contract to Cassidian Communications Corp. and to Motorola Solutions Canada Inc. in June 2012 and June 2013 respectively. Note: Cassidian Communications changed its name to Airbus DS Communications in 2014.

For Phase 3 of the SERAM project, a solution other than the one originally considered was adopted, at a cost of \$0.4 million compared to the initial estimate of \$10.4 million. To this end, in June 2013, the authorities also approved a cooperation agreement between the Ville de Montréal and the Société de transport de Montréal for the use of



the expansion capacity of its Métro network, thus allowing interconnection with the SERAM network.

Table 1 below presents the main features of the original contracts awarded for each of the three phases of the SERAM project.

**Table 1 – Main Features of Contracts Awarded**

Phase	Purpose of contract	Original amount	Duration	Initial schedule
1	Acquisition, installation and maintenance of the surface network	\$42.5M	15 years	<ul style="list-style-type: none"> <li>• Installation of infrastructure equipment: August 2013</li> <li>• Provisional acceptance: November 2013</li> <li>• Final acceptance: November 2014</li> <li>• Maintenance: November 2028</li> </ul>
2	Acquisition, installation, and maintenance of UTs	\$31.5M	10 years	<ul style="list-style-type: none"> <li>• Start of acquisitions: Fall 2013</li> <li>• Start of deployment: March 2014</li> <li>• End of deployment: December 2015</li> <li>• Maintenance: April 2024</li> </ul>
3	Interconnection with Métro network	\$0.4M	10 years	<ul style="list-style-type: none"> <li>• Start date: March 2014</li> <li>• Network use: May 2023</li> </ul>
<b>Total</b>		<b>\$74.4M</b>		

The decision-making records in support of the calls for tenders and the awarding of these contracts show that all eight recommendations made by the ad hoc joint committee were considered. They also state that the business objective was to replace the current radio networks of the aforementioned entities with proven open-architecture technology that would meet public safety standards of all stakeholders, including interoperability.<sup>3</sup>

It was emphasized that, with regard to both the Service de sécurité incendie de Montréal (SIM) and the SPVM, the lack of current interoperability affects the quality of service delivery to citizens. Moreover, in the case of the SPVM, the increase in the number of outages of the current network observed over the years can seriously impact its gendarmerie operations and investigations. Also, the inability to encrypt communications may jeopardize the efficiency of police operations and police security.

<sup>3</sup> The Grand Dictionnaire Terminologique defines interoperability as "the capacity of heterogeneous computer systems to function jointly through the use of common languages and protocols, and to provide access to their resources in a reciprocal manner."

Lastly, the current network does not in any way meet the geolocation requirements of police officers using their portable radios.

However, the decision-making summary relating to the Phase 1 contract shows a price difference of 30.8% between the lowest bid and the second lowest bid, and 37.3% less between the lowest bid and the internal estimate. These differences are explained mainly by the fact that the lowest bid was based on an architecture consisting of seven radio antenna sites, while the second bid and the internal estimate were based on 12-site architecture.

Similarly, the Phase 2 contract decision-making summary makes reference to a price differential of 31.1% (lower) between the bidder and the internal estimate. This difference is attributable, among other things, to the large number of UTs requested in the bid list and to a drastic decline in their cost from 2012 to 2013.

The city gave its provisional acceptance to Phase 1 of the SERAM project in September 2014. Since then, the project has experienced a number of setbacks. Project management proved very deficient as evidenced by the results of an audit requested by the new STI manager within one month of his appointment in November 2014. Also, attempts to deploy SERAM with the two main clients, namely the SPVM and the SIM, highlighted a very worrying problem in the network's reliability. Moreover, outages in 2015 and 2016 made headlines in the media.

This situation necessitated the implementation of a remedial plan to rectify the management problems of the SERAM project and try to remedy the issue of the network's reliability.

In this regard, an accountability report was made jointly by the STI, SPVM and SIM to the executive committee on June 8, 2016, and to all elected representatives on June 16, 2016. The report underscored in particular the state of the SERAM deployment, as well as the efforts to stabilize the infrastructure and to meet urgent public safety needs, and also reviewed the financial framework of the project.

## 2. Purpose and Scope of the Preliminary Audit Study

The initial purpose of this preliminary study was to identify issues of importance to be addressed in our detailed audit, and to set out criteria that could form the basis of our conclusion.

Our approach was influenced by the strategic nature of the SERAM project for public safety services and by its considerable cost.

However, when we started our work, we saw that STI management had completed its own project evaluation, concluding that a major overhaul of the project was required, given the magnitude of the problems identified.

In this context, and given that some of the actions needed to correct the problems identified by this evaluation had already commenced, we determined that it was not appropriate at that time to begin a detailed audit of SERAM. Instead, we chose to corroborate STI's diagnostic conclusions and to ensure that the current remedial plan would be relevant and functional in remedying the project's management problems, stabilizing the network's reliability, and mitigating the risks associated with public safety issues.

We undertook to determine subsequently the appropriate time to undertake a detailed audit of this network, as well as to identify some important issues for further consideration.

Our preliminary study was conducted on an ad hoc basis from October 2015 to December 2016, and included an analysis of various documents related to the SERAM project, as well as interviews with the key stakeholders of the STI, SIM and SPVM. Therefore, this report does not reflect events occurring after that date.

### 3. Preliminary Audit Study Results

#### 3.1. Fundamental Issues in the Remedial Plan

As soon as our work began, we observed that the SERAM project had a number of problems that were symptomatic of poor project management:

- The switch-over by the SIM and SPVM to the new network initiated in late 2014 resulted in several major outages, to the point that these units had to revert to their original system, despite the fact that the network was already functional in other units;
- Equipment shortages;
- Deployments behind schedule;
- Dissatisfaction among client units, specifically those related to public safety in connection with the STI's failure to listen and the needs they had expressed;
- Many change requests had to be made, thus increasing the total financial commitment to the project;
- Difficulties in backing up the system,<sup>4</sup> as well as significant impacts on public safety operations that were observed when an outage occurred.

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<sup>4</sup> Back-up includes the implementation of mitigation measures to ensure, on the one hand, network availability in the event of outages caused by a failure of its components and, on the other, continuity of service in the event of a disaster or major incident rendering the network's infrastructure unusable. The risk of unavailability can be mitigated by specifically building redundancy into the critical

Given the magnitude of the problems and issues, the new director of the STI began an audit of the SERAM project the month after his appointment. The STI team dedicated to this audit was then mandated to examine the quality of delivered physical products and the quality of the project management. The report of this internal audit, completed in February 2015, stated that:

- The public safety services were dissatisfied and believed they were not treated as clients;
- The communication process was ineffective;
- The project's issues were presented to the steering committee, but it was not clear that they were subject to an impact assessment;
- The reliability of the network had never been presented as an issue or discussed as a risk element;
- Despite the existence of some detailed plans for each phase of the project, there was no integrated planning to assess progress and measure project performance;
- The risk register was incomplete and not up to date, and there was no quantitative analysis or only partial analysis;
- Several new needs were identified after the contracts were awarded, requiring a number of change requests.

Beyond these issues raised by the STI, our own ongoing analysis led us to observe that:

- No budget had been set aside to back up SERAM other than investments in redundant equipment;
- A comprehensive major incident management structure was lacking;
- A document called "Plan de continuité" describing the technological recovery or switch-over mechanisms during a component failure had been produced in November 2011, but had not been updated since then;
- The service levels defined in the contracts with respect to availability and continuity did not meet public safety needs;
- The back-up solutions used previously by the SIM and SPVM could only be available for a limited period after their migration to SERAM.

Although the initial failures in the system may have been related to isolated issues, other failures challenged the robustness of its infrastructure, notably the January 2016 outage. Moreover, according to the STI, the contracted SERAM infrastructure was not sufficiently robust for an infrastructure used in public safety operations.

In order to properly confront the implications of this set of problems, the SERAM project aimed to satisfy the radiocommunication needs of the city's two main clients, the public safety services and other municipal services. In addition, this network needs

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components of the network. The risk of non-continuity is mitigated by the establishment of a remedial plan based on an analysis of the risk factors of a disaster or major incident and the impact of the resulting interruption of service.

cover the entire island of Montréal. Usually, city authorities use a separate network to serve each of these clienteles, because the needs are not the same.

A radiocommunication system used within the framework of public safety activities must be continuously available and cannot tolerate unavailability, even limited unavailability, since it is a vital support element for these operations. In such circumstances, a back-up system that is effective and transparent to the user in the event of a main network failure must be provided. In the case of other municipal services, smaller investments could be justified in this area.

Similarly, the territorial coverage required by the network is equally important for the public safety services because they serve the entire island of Montréal and must obtain an adequate audible signal, whatever their geographical location. In addition, these services sometimes have to maintain communication inside buildings or even go beyond the island of Montréal. Other municipal services, however, usually work within a more restricted area and the distance travelled by the signal between the sender of a message and its recipient is shorter.

As a result, a trade-off of needs had to be made: some remained unmet, while the cost of the project was driven up.

These observations illustrate several of the difficulties encountered by the SERAM project, the main causes of which were: major deficiencies in its management; and public safety infrastructure requirements that had apparently not been adequately reflected in the contracts.

Given these circumstances, it was clear that a project remedial plan was necessary. The challenge of this STI remedial plan was primarily to rectify the project management problems, otherwise it would have been difficult to make effective progress. In addition, the plan aimed to target and implement appropriate technical solutions to ensure greater reliability of network operations. Ultimately, the remedial plan sought to stabilize the network, which was essential for its improvement, and to the continuance of the project.

### 3.2. Remedial Plan Under Way

To better illustrate the actions to be taken in the remedial plan, we have divided them into two categories, namely those aimed at restructuring the management of the project itself and those aimed at improving the reliability of the solution.

### 3.2.1. Project Management

First, in view of the findings of the internal audit that he had requested, the STI manager put in place a new project unit, while also reorganizing the structure of his entire department.

Transparency in communications was improved. Relations between the STI and its public safety client units were improved and resumed in a collaborative environment. To this end, now, when there is a change to the network infrastructure that may have an impact on the operations of these units, they are informed beforehand. As a result, any major changes made to the infrastructure that affects them must first be approved. In addition, the financial framework for the project, which will be discussed further below, was updated.

The risk register was also monitored and updated. New risks were identified and the impacts on the approved financial framework, as well as on the project schedule, were assessed.

Additionally, regular accountability to the authorities resulted in the presentation of a status report on the project, including measures taken to stabilize the infrastructure and meet the urgent requirements of public safety.

In sum, several deficient elements of project management were addressed. However, contracts entered into produced issues that were not finalized or schedules that will affect future project operations. These include:

- An equipment installation contract with Motorola that will end in December 2017;
- An inter-municipal agreement to be concluded with each of the related municipalities;
- A service agreement to be entered into between the Service du matériel roulant et des ateliers of the city and each of the network's client units.

### 3.2.2. Reliability of the Solution

As noted earlier, a large number of major network outages occurred, which resulted in the STI having to review the agreement with its SERAM infrastructure provider. This enabled the STI to corroborate that certain needs had not been properly assessed at the outset, which meant having to determine and negotiate with the provider specific measures that needed to be put in place.

First, the frequency and duration of these outages had to be reduced in order to minimize the overall impact on the network. Thus, it was agreed with the provider to reprogram the public safety's UTs in order to limit the impacts of the signal interruptions. A moratorium on work related to deployment and infrastructure was also declared. It was also agreed with the network provider to make changes to SERAM's

infrastructure only at fixed times established in advance with the agreement of the two public safety services.

Second, given that public safety operations were disrupted due to the lack of an adequate back-up system, technical solutions had to be found to provide back-up as quickly and smoothly as possible whenever network outages occurred. These measures were also aimed at providing the radiocommunication network with the long-term stability necessary to develop the SERAM project.

Before specifying the measures agreed to with the successful bidder regarding these solutions, certain concepts need to be explained.

IT robustness, also known as IT resiliency, is defined as the ability of an IT solution to function as well as possible in the event of an incident. This capability is generally provided for in the initial design of the network, as it refers to how the network reacts to the occurrence of various incident scenarios related to relatively serious failures of its various components.

Redundancy is one of the elements making up the robustness of a system. This is defined as the duplication of certain components in a network that are critical to its operation. The redundancy ensures that, when one of these devices fails, the other installed component takes over, thus ensuring service continuity in a transparent manner.

As mentioned earlier, the measures taken to provide back-up to the SERAM network suffered from several shortcomings. This situation effectively rendered the network very vulnerable and, most important, was likely to have a direct impact on public safety operations if the network were to become unavailable.

The old radiocommunication network of the SPVM served as a back-up during the early stages of the switch-over to SERAM. However, having to use two different types of equipment, one of which was outdated, did not make this solution very functional.

As for back-up for the SIM, this service relied for a certain time after the deployment of SERAM on its old back-up system, called RENIR.<sup>5</sup> However, prior to the SERAM implementation, the RENIR network manager had said that the city's installations would require modifications if this were to be used. But when SERAM was implemented, it was decided not to make these investments and eventually to abandon the RENIR. Currently, these installations are being dismantled.

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<sup>5</sup> RENIR: Réseau national intégré de radiocommunication. Provided by the Centre de services partagés du Québec, this service is for the benefit of public safety, security and public service organizations working in Québec.

In light of this problem, and as per the agreement concluded with the provider, the latter agreed to carry out the following at its own expense:

- Upgrade the existing infrastructure;
- Develop an operational back-up solution;
- Set up a temporary back-up solution and, for this purpose among others, provide cellular communication devices in the event of a network failure during the period from the development of the back-up solution to the stabilization of the network. These devices were delivered in the summer of 2016.

We note, therefore, that efforts were made to stabilize the infrastructure by adding and replacing equipment, thus increasing the network's power and robustness. Cellular devices with radiocommunication functionalities were also provided to the SIM and the SPVM in order to compensate for SERAM's downtime. It should be noted, however, that this solution had certain limitations, in particular due to the number of devices available and to certain programming that resulted in the devices being dedicated only to certain geographical areas.

In addition, the STI agreed to conduct a periodic audit of the infrastructure up to the date of final acceptance of SERAM, in order to identify all the problems and ensure that the necessary adjustments are made.

All of these measures should, in our view, help reduce the number and impact of outages and promote a certain stability of the network, as illustrated by Figure A of the Appendix 5.3 that shows the outages drawn up by the SPVM for 2016.

However, some issues and risks related to public safety and associated matters still remain. Let now clarify their key elements.

### 3.2.3. Issues and Risks Related to Public Safety and Associated Matters

#### Operations Back-Up Solutions

We previously discussed the provider's commitment to develop an automated operations back-up solution. This solution would allow users to recover network functionalities within five minutes of an outage, in a transparent way. During 2016, three solutions were proposed by the provider, but these proved to be unsatisfactory.

As of the writing of this report, the conditions for the implementation of an operations back-up solution had not yet been finalized. A proposal was under development and needed to be discussed with its main users—the SIM and SPVM—in early 2017. We understand that they would have to give their approval to this solution in consideration of the risks inherent to their operations.



According to the STI, the back-up solution should be the provider's responsibility and should be deployed by the end of the first quarter of 2017.

In addition, the contract provides for penalties for service breaches (SLA)<sup>6</sup> set out in the contract. However, the current parameters are considered by STI managers to be too low since they only take into account a general unavailability of the network, regardless of the frequency or duration of outages. According to the information obtained, these parameters should be revised as part of the new SLA, following deployment of the automated back-up solution. Accordingly, following an agreement with the provider, the penalties will be revised upwards as of July 1, 2017, if the new parameters for the duration and frequency of outages are exceeded.

### Signal Penetration into Buildings and Coverage

A distinctive feature of public service networks, such as those of the SPVM and SIM, is that the radiocommunication must sometimes extend beyond a simple exterior geographic space. During an intervention, it is not uncommon for communications to continue inside a building, or at least to be accessible in the entrance hall. The signal must therefore be able to pass through certain walls.

The old systems used by the city's public safety were not specifically provided with internal coverage. However, for the SPVM, the technology and frequency used meant that sometimes internal communication was possible. Analogue gives a degraded signal, while a lower frequency gives more power to the signal.

According to the information obtained, it was not foreseen by the ad hoc joint committee at the time of the project study that the new network would cover inside premises.

It should be noted that the issue of internal coverage includes public buildings and Montréal's underground precincts. In 2017, STI intends to carry out a study of opportunities within the framework of the SERAM project to solve this problem. Among other things, agreements with these buildings' owners are being considered in order to use their internal networks. If other avenues have to be considered and these result in additional costs, the problem will be resolved by a different project than SERAM.

Internal coverage is also an issue during emergency interventions in other buildings located on the territory of the Montréal agglomeration, especially for the SIM. Mobile and transportable repeaters<sup>7</sup> will be acquired as part of the SERAM project, to ensure better coverage during these interventions.

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<sup>6</sup> Service Level Agreement

<sup>7</sup> A repeater is an electronic device that compensates for the transmission losses of a medium by amplifying the signal between transmitter and receiver.

Similarly, some central departments, such as the Service de l'eau and the Espace pour la vie, do not yet use SERAM because internal coverage is essential for them. These units work mostly in tunnels or inside the city's buildings. In order to solve this problem, the STI notified us that it would perform an RFI<sup>8</sup> and thus evaluate possible solutions with companies so that SERAM could be deployed in these departments. According to the information obtained, the implementation of this particular SERAM component is planned within the updated financial framework of the project.

### Geolocation

GPS geolocation is a method of positioning an object on a plan or map using its geographic coordinates.

For the SPVM, this need arises from an enquiry undertaken by the Commission de la santé et de la sécurité du travail (CSST), now the CNESST<sup>9</sup> following the death of a police officer in 2002. The enquiry revealed that real-time location (GPS) technology would have enabled several units to assist the police officer during his intervention. The CSST recommended over 10 years ago that geolocation technology be integrated into the SPVM communications network.

A partial solution was implemented in 2011, but it was not integrated into the SPVM's computerized distribution network. A project was subsequently created to rectify the situation. However, the project was suspended in 2014 in anticipation of the SERAM project.

According to the information provided to us by the STI, SERAM cannot conduct geolocation in real time. Indeed, the network is only able to carry out an emergency geolocation, upon request only. On this matter, the contract specifies that the geolocation data could be updated in three different ways:

- Polling
- Automatically at a pre-programmed rate (e.g., every 10 minutes)
- Triggered systematically during an emergency call

According to the information obtained, the SPVM, in collaboration with STI, will study the technical solutions currently available to enable real-time geolocation. Discussions were scheduled to take place in January 2017. Again, the timetable for implementation and the budget allocated to it will be part of a different project than SERAM.

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<sup>8</sup> RFI: Request for information.

<sup>9</sup> Commission des normes, de l'équité, de la santé et de la sécurité du travail.

## Prioritizing Voice Over Data

The UTs regularly need programming changes and software updates to ensure proper operation. This is why licences were acquired for the “Over the Air Programming (OTAP)” for each UT device.

With this feature, software changes and certain updates to each device can be performed remotely rather than manually. As a result, these changes and updates can be made in a short time with minimal resources, while keeping the devices in service.

However, since these devices are almost always in service and are used for voice communication, there must be a mechanism for prioritizing voice over data. Otherwise, it may cut off the conversation, corrupt the software update or render the UTs unavailable for an inappropriate period of time. This prioritization ensures that voice conversations always take precedence over data transmission.

At the moment, this prioritization is not functional as the configurations have yet to be finalized. In addition, another software version has to be installed within the infrastructure. This installation has not been carried out so far due to the network's instability.

Currently, changes and updates must be made manually, with impacts on resources, on deadlines for making the changes and on the availability of the devices involved.

According to the STI, this issue should be resolved within SERAM's capital budget and be deployed toward the months of March or April 2017.

## Deployment of the Network in Some Service de police de la Ville de Montréal Units

The SPVM has three main operational divisions: gendarmerie, investigations and surveillance. Currently, only the gendarmerie division uses SERAM. The other two do not yet have SERAM, as technical solutions still need to be found to meet their particular needs. For now, these units use the old system, which is being used less than before.

According to STI, this issue should be resolved within SERAM's revised capital budget. However, the planned deployment date has not currently been halted due to the priority given to stabilizing the network.

## Inventory Management of User Terminals

Phase 2 of the project resulted in the acquisition of nine separate lots of UTs as well as support and maintenance for these devices for a period of 10 years. A tool to manage the inventories of these UTs had to be set up at the start of the project.

During the first deployments, the devices were delivered directly to the units. Thereafter, there was some movement in the devices, mainly for repair and maintenance purposes.

Without adequate tools, it was difficult to monitor UTs in operation and manage replacement radios.

Also, most of these devices were physically similar, but special programs could be installed, mainly for those used by the SPVM. Since these devices were not clearly identified with their original unit, UTs from other units were sent to the SPVM as replacements. However, these devices could not be used by patrol officers, thus may create a temporary shortage.

For now, the inventory management tool is still not in place. The SIM and SPVM perform their inventory tracking manually, with all the hazards that this entails.

According to information obtained from the STI, inventories of UTs were taken for all the administrative units that received them. However, this inventory is available in an Excel format and is not in a database, permitting efficient management of the problems associated with a real-time inventory.

According to STI, this issue should be resolved within SERAM's revised capital budget, but a schedule has not yet been set.

### 3.2.4. Financial Framework of the Project

As mentioned in Table 1 under the heading "Background" of this report, the total of the original authorized amounts for SERAM is \$74.4 million. The portions attributable to capital and operating expenditures over the term of the contracts represent \$36.7 million and \$37.7 million, respectively.

Since then, various change requests and additions to the project required additional commitments of \$10.8 million for capital expenditures and \$4.5 million for operating expenses.

To these already approved commitments were added new financial requirements, mainly attributable to the implementation of the remedial plan. These requirements represent capital expenditures estimated at \$39.5 million and concern the addition of

additional infrastructure and equipment (\$28 million), implementation efforts (\$8 million) and a contingency<sup>10</sup> (\$3.5 million).

In sum, the updated financial framework of the SERAM project is as follows:

**Table 2 – Updated Financial Framework of the SERAM Project<sup>11</sup>**

Item	Expenditures		Total
	Investments	Operation	
Amount of original contract amounts (see Table 1)	\$36.7M	\$37.7M	\$74.4M
Change requests and additions to project	\$10.8M	\$4.5M	\$15.3M
Future commitments related to remedial plan	\$36.0M	–	\$36.0M
Contingency	\$3.5M	–	\$3.5M
<b>Total</b>	<b>\$87.0M</b>	<b>\$42.2M</b>	<b>\$129.2M</b>

Despite the upward revisions to the SERAM financial framework, we note that the updated capital expenditure budget of \$87 million coincides with the amount of the loan by-law adopted by the authorities in January 2012 to finance this project.

This situation is explained by the fact that the amount of the loan by-law was established on the basis of internal estimates of contract costs, which proved to be considerably higher than the bid prices of the successful bidders as previously explained in the “Background” section of this report. As a result, the discrepancies between these bid prices and these internal estimates provided some margin for manoeuvre that would permit funding the "change requests and additions to the project," "future commitments related to the remedial plan" and "contingency."

However, this projection of the updated financial framework remains to be confirmed in view of the issues still to be resolved and any risks that may arise. It should be noted that some commitments will need to be added eventually to this financial framework in order to align the planned duration of the UT maintenance services, for which the contract ends in April 2024, with that of the infrastructure contract, ending in November 2028. Furthermore, it appears that a significant number of UTs will have reached the end of their useful lives by the end of the expected duration of these services, and will need to be replaced.

<sup>10</sup> The original contractual commitments of the project did not provide for any contingency.

<sup>11</sup> This financial framework is based on unaudited data obtained from STI in July 2016.

It should also be emphasized that this financial framework does not include certain significant indirect costs associated with, among other things, maintenance of temporary back-up solutions, resulting from delays in migration and in the provision of human resources by user services to support SERAM deployments and manage the impacts of network outages.

In addition, as outlined above, some unresolved issues, including real-time geolocation, will not be included in the SERAM project, but will fall under separate budget envelopes.

### 3.3. Continuing the Audit

As a result of our work, we considered it appropriate to postpone our detailed audit of this project for the following reasons, among others:

- The network was in stabilization mode and several recovery measures were in the development and implementation mode, which did not make it possible to currently audit its effectiveness;
- We did not want to interfere in the operations when all parties were involved in finding solutions to the various problems identified.

We were, however, in a position to assess that the remedial plan was relevant and functional, as were the public safety services—its main clients.

In this context, we postponed our detailed audit to a time when the network would be stabilized and the improvement phase would be well under way. In the meantime, we will be providing regular oversight with the Direction bureau de projet within the STI.

Some of the detailed audit topics that could be the subject of an eventual mission on our part include:

- Awarding of contracts
- Compliance, monitoring and reporting of the project's financial framework
- Managing contracts with suppliers and other entities
- Back-up and continuity of operations procedures covered by the system
- Managing and controlling UT inventories

## 4. Conclusion

The Système évolué de radiocommunication de l'agglomération de Montréal (SERAM) should ultimately meet the needs of several categories of users throughout the island of Montréal, including those of the public safety services.

Before the new Service des technologies de l'information (STI) team initiated a turnaround in the management of the SERAM project, major deficiencies had been

noted in the project management. These included an incomplete analysis of needs, a glaring lack of rigour in risk management, marked dissatisfaction from the public safety services and an inefficient communication process.

Concurrently with the start of this remedial process, the new network that had just been deployed among the public safety services was experiencing major failures, while major outages kept recurring. Furthermore, the observed recovery times underscored serious deficiencies in SERAM's back-up systems. The STI's findings indicated that SERAM's infrastructure did not have the robustness required for a public safety infrastructure.

These deficiencies in the SERAM project management, combined with the repeated network outages and downtime, meant that the initial efforts to finalize the project had to be rapidly redirected toward the launch of a remedial plan.

This resulted in significant delays in the initial timeline for project implementation, upward pressure on costs, and some needs that were neglected or put on hold.

The implementation of SERAM was initially scheduled for completion in December 2015. However, we understand that the implementation will not be complete until late 2017, subject to the remaining technical issues and challenges being resolved.

In terms of project costs, change requests resulting from poorly crafted quotes or needs that were not well defined at the beginning, coupled with remedial actions taken or in the process of being taken, resulted in an increase of \$46.8 million for capital expenditures and \$4.5 million for operations. Thus, the updated financial framework of the project is now \$129.2 million.

It should be noted that this revised financial framework does not take into account certain issues that must be addressed in meeting certain needs deemed essential by the public safety services, or the costs inherent to aligning the maintenance service term for user terminals (UT), and their eventual replacement, with that of the infrastructure contract. These needs include real-time geolocation and possibly signal penetration into public buildings and Montréal's underground precincts, which will be considered in projects other than SERAM.

On the other hand, despite the potential issues and pitfalls that remain to be addressed, we are of the opinion that the measures taken or in the process of being taken by the STI to put the SERAM project back on course are relevant and functional, and they should reduce the number and impact of outages while promoting system stability.

With regard to the management of the project itself, the STI has taken measures to:

- listen more carefully to its clients and enable participation in decision-making that affects them;
- update and monitor the risk register;
- strengthen its relations with its suppliers;
- acquire new technical expertise;
- develop and negotiate palliative measures and a new SLA;
- provide regular accountability to the authorities.

As for the technical aspects, various measures have been taken by the STI with its suppliers to reduce the frequency and duration of network outages and their impact on public safety services. These measures include infrastructure upgrades, the development of an operational back-up solution and the temporary provision of cellular communications equipment during the development period of this solution.

Despite the STI's efforts to meet the public safety requirements that were expected at the outset of the SERAM project, the resulting network will not, in our opinion, meet some significant functional and performance requirements, at least on a short- or medium-term basis.

Real-time geolocation and signal penetration in public buildings and Montréal's underground precincts are still considered essential needs by the public safety services, yet they could not be met by the SERAM project and will need to be considered in other projects. In addition, a solution remains to be found to satisfy the particular needs of the Service de police de la Ville de Montréal's (SPVM) specialized investigation activities, for which the expected deployment date has not yet been determined.

#### BUSINESS UNITS' RESPONSES

***Service de police de la Ville de Montréal***

*[TRANSLATION] It is with great interest that the SPVM reviewed this report consisting of the preliminary audit study on the SERAM project. We note the quality of the report that, while not containing any recommendations, clearly identifies the various issues brought to light in the SERAM project management and roll-out. **The aspects of planning the needs versus the offered product must be stressed.***

*Since the arrival of **new management at the helm of the STI**, it's safe to say that the situation has turned around by 180°. This sense of responsibility and rigour in the new business approach is inspiring us for the future of the radiocommunication system. Of course, many*



questions remain in the minds of users, but there's a **definite recognition of the efforts that have been made.**

*Amongst the issues raised in this report, we would like to focus on a few that we feel are truly crucial. The table in Appendix 5.3 illustrates the number and duration of SERAM breakdowns viewed as major in 2016. At the bottom of the table, it is also stated that there were seven display breakdowns between January 1 and October 30, 2016. For the vast majority of these breakdowns, the SPVM's Centre de communications opérationnelles (CCO) did not have a temporary solution for communicating with policemen on patrol, a system that **was only installed at the end of August.***

*It must be noted that during incidents or breakdowns, a large part of the SPVM personnel was mobilised and frequent adjustments were needed with regard to how we communicated with officers on patrol.*

*As indicated in the report, it was not anticipated that the SERAM would have internal coverage. But the report states, with good reason, that the old radio system allowed for some communications, sometimes limited, within buildings. Indeed, communication by radio is impossible in certain areas. The STI will have to prioritize the opportunity study mentioned in the report. We believe that this study will take several months to come up with viable solutions, and that the SPVM will have to adapt its communication methods during interventions within a building, in order to ensure the safety of police officers.*

*The "Over the Air Programming (OTAP)" function, that should make it possible to reprogram the UT devices in a short period of time with minimal resources, cannot be activated since the prioritization of voice over data is not currently functional. This meant that the last reprogramming of the UT devices had to be performed manually, that it took nearly 3 months, that it involved more than 10 people and that the SPVM personnel had to set up significant logistics in order to complete this reprogramming.*

*We again confirm that the STI has taken measures to ensure that we're better heard and that the SPVM can participate in the decision-making that relates to it. We agree that, despite the STI's efforts, the SERAM will not meet certain significant functionality and performance needs, such as real-time geolocation, whether in the short or medium terms. This observation means that the SPVM must devote resources to completing this important matter as quickly as possible, given that it traces back to an investigation report from nearly 15 years ago.*

*In parallel with the gendarmerie file, the component relating to specialised investigations must also be included, though it has so far not determined the appropriate system and functionalities required by the specialised units.*

*In conclusion, the next few weeks will see the STI launch a consultation on the future needs not initially addressed in the SERAM project. The number one challenge for this second phase will be to come up with recommendations and a quick implementation that will add to the SERAM functionalities. The SPVM will cooperate fully in this project, now and in the future.*

#### **Service de sécurité incendie de Montréal**

*[TRANSLATION] The report's overall drafting covers all aspects of the project. You've identified and brought to light the issues, shortcomings and pitfalls that have been experienced, on the levels of both the SIM and our partners. The conclusion accurately reflects the discussions with the project managers and clearly sets out the project's observations, while highlighting the hazards that lie in wait for us as well as the challenges that are still pending.*

*Just like the SPVM, the SIM must be able to rely on a radiocommunication system with a flawless infrastructure. In time, the SERAM should provide a functional and high-performance tool. Despite all of the efforts that have been made, these functionality and performance needs remain unstable over the short and medium terms. We hope that your report will serve as a springboard towards a much more reliable and robust system, one that offers the redundancy required of such a radiocommunication system.*

#### **Service des technologies de l'information**

*[TRANSLATION] After taking over the corrective measures for the SERAM project, we noted that several elements were missing from the project's scope and that certain elements of the technical solution resulted in a regression relative to public safety radiocommunication solutions. This assessment was performed in collaboration with the SERAM clients, notably the SPVM and the SIM.*

*Let us recall that in 2011, the city adopted a loan by-law for \$87 million, so as to provide the initial investment budget envelope. The project had no financial framework at the time of its inception. This loan by-law was approved by the Ministère des Affaires municipales et de l'Occupation du territoire. We also note that the initial investment budget of \$87 million has not changed.*

*A project review was carried out in 2016. This exercise served to improve SERAM's scope, to undertake system improvements, to*

*implement corrective measures with the supplier, and to adjust the service levels to the Airbus contract. It's important to mention that the improvement of the city's infrastructure and equipment will take place within an initial investment budget envelope of \$87 million.*

*Meanwhile, costs for the system's corrective improvements are entirely borne by Airbus, and are not at the city's expense. This includes specific corrective measures made by Airbus as a result of incidents that have occurred since December 2014. These measures were applied in 2015 and 2016 and others are still to be applied in 2017, in keeping with the system's upgrade, with Airbus still being responsible for these costs. We point out that the city's approach is to have suppliers pay the additional costs resulting from performance challenges.*

*As stated in the report, many risks have been identified and still exist within the project. Technical solutions in order to address major challenges are still being analysed by the architects, with the fulfilment costs and schedule still to be confirmed after the technical solutions have been identified.*

*Also, the city is working closely with the supplier Airbus in order for the system to be compliant with the expected quality standards, though significant challenges are still to be resolved.*

## 5. Appendices

### 5.1. Perceived Audio Quality According to Delivered Audio Quality Criteria

**Table A – Description of DAQ Criteria**

DAQ	Subjective description
1	Speech heard, but unusable
2	Speech understandable with considerable effort
3	Speech understandable with slight effort, occasional repetition
3.4	Speech understandable with few repetitions, slight noise and distortion
4	Speech understandable, occasional noise
4.5	Speech easily understandable, infrequent noise
5	Speech easily understandable, no discernible noise

Source: Expert report by Pierre Lebel et associés inc., October 2010.

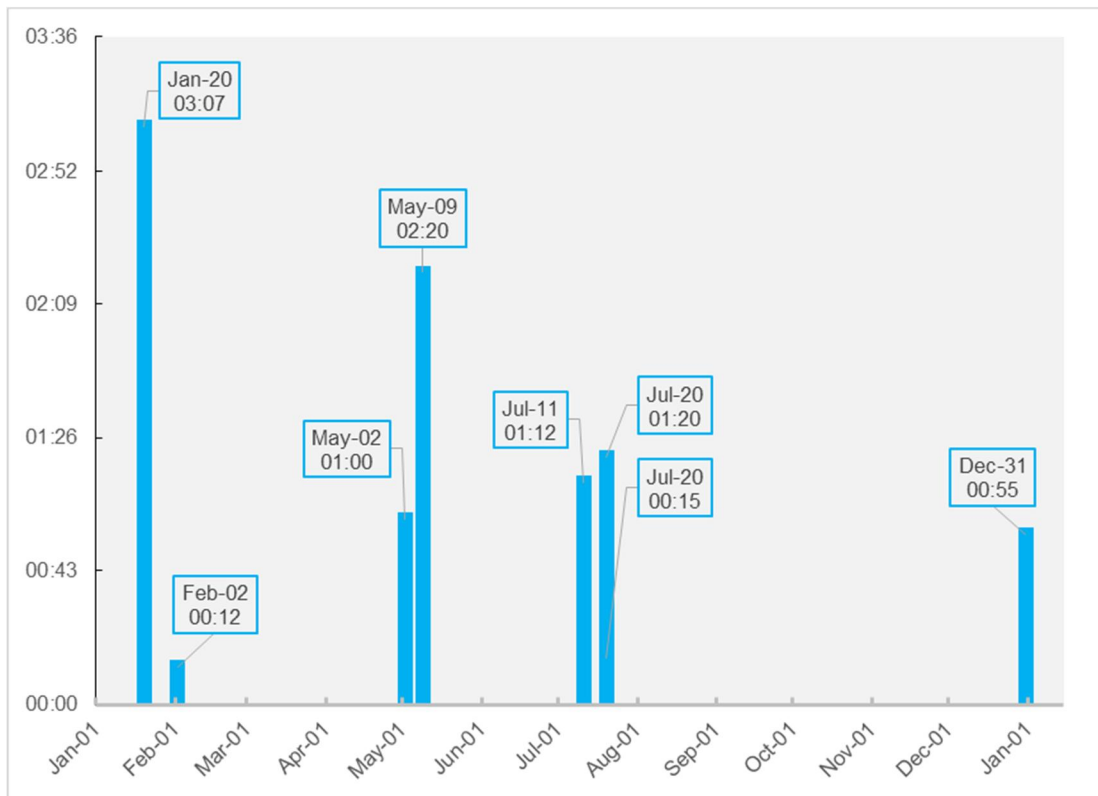
Note that, according to the Public Safety Wireless Advisory Committee, the audio quality level of messages exchanged on radio waves for a public safety service must be equal to or higher than the DAQ 3.4 standard, and provide 97% coverage of the service delivery area.

## 5.2. List of Recommendations Made by the Ad Hoc Joint Committee in April 2011

- R-1 *That the Montréal agglomeration continue to develop the common voice radiocommunication project for all public safety stakeholders and entrust its management to the Service des technologies de l'information.*
- R-2 *That the Service des technologies de l'information continue to undertake a detailed analysis of a scenario based on two interoperable networks, the first dedicated to public safety and the second for other users.*
- R-3 *That the Service des technologies de l'information continue with the comparative analysis and documentation of equipment lease and acquisition options, as well as scenarios for optimizing existing antenna towers, and identify the option that offers the greatest benefits to the Montréal agglomeration.*
- R-4 *That the Service des technologies de l'information, in collaboration with the Service des finances, continue with and finalize the financial analysis of the project, taking care to include all indirect costs of the project, including the costs for upgrading the technology and their impact on the payroll when conducting risk analyses, based on the revised scenarios.*
- R-5 *That the Service des technologies de l'information continue to develop the partnerships envisaged internally and externally in order to formalize the commitment of the various partners to the radiocommunication network modernization project and to identify avenues that could result in savings through shared resources.*
- R-6 *That the Service des technologies de l'information continue the project study and obtain the necessary validations from the decision-making authorities concerned according to the planned execution schedule and the governance framework of the municipal asset management projects and programs.*
- R-7 *That the Service des technologies de l'information, for information purposes, present the optimal solution chosen by the ad hoc committee for the radiocommunication network project before issuing the call for tenders.*
- R-8 *That the project be submitted to the contracts review committee before the contract is awarded by the city council and the urban agglomeration council.*

### 5.3. Duration of Major Outages of the Service de police de la Ville de Montréal in 2016

**Figure A – Duration of Major Outages of the Service de police de la Ville de Montréal in 2016**



Source: Data provided by the SPVM December 5, 2016 and subsequently updated.

In addition to these outages in 2016, there were seven display failures up to October 30, ranging from four minutes to a few hours.