MEETING DATE: March 19, 2003

SUBJECT: Cellular Phones In The Subway

RECOMMENDATION

It is recommended that:

1. the Commission authorize staff to issue a Request for Expression of Interest (REOI) to determine the interest of cellular phone carriers in providing cellular coverage in the subway, and to estimate the potential revenue stream.

2. the Commission receive this report for information, noting that the existing subway antenna system is not suitable for carrying cellular traffic throughout the tunnels without equipment upgrades, and that implementation of cellular services will cause interference to the existing subway radio system.

3. this report be forwarded to the City's Telecommunications Steering Committee for their information.

FUNDING

Funding was not provided for in either the Operating or Capital Budgets to implement cellular phone coverage using either the existing radio communications system, or any newly installed systems.

BACKGROUND

At its meeting of March 20, 2002, the Commission adopted the report, TTC FIBRE OPTIC COMMUNICATIONS SYSTEM – USE BY OTHERS, in which staff was authorized to undertake a study to determine technical modifications necessary to allow cellular phone usage in the subway system. Further, on November 4, 2002, an update was given to the Commission in a memo from the Chief General Manager with a schedule for the completion of the study in early 2003. The study of the existing system has been completed and the results are presented herein.

The main purpose of the study was to answer the three following questions:

1. is our existing Subway Radio Communications (SRC) system capable of allowing use of cellular phones in the subway?

2. what improvements could be made to the existing SRC system to accommodate implementation of both analog and digital cellular phones in the subway?
3. what impact would these phones have on the existing radio communications?

The study identified a number of options with various differing technical and functional capabilities using both the existing system or installing a separate 'overlay' system. These options are listed in the chart below showing functional capabilities, limitations, risks and estimated costs.

It is important to note that in any of the studied scenarios, any additional radio traffic (i.e. cell phones) introduced into the existing SRC system could potentially affect radio communications in the 800 MHz band presently used by the Emergency Services (Police, Fire and Ambulance)**.** Technically, this is a result of two or more different transmitters combining to create interference at a third frequency, known as intermodulation. Also, adding cellular users will increase the noise level of all existing users. Maximum cellular usage would be expected during a train stoppage, which is when emergency communications would be the most critical and the probability of overloading and interference would be the highest. There is already interference occurring in certain areas of the subway on the existing emergency service channels. While technical staff are investigating, there is evidence to suggest that more interference will occur by adding channels to this complex radio network.

DISCUSSION

The existing Subway Radio Communications system (SRC) is technically capable of carrying analog or digital cellular phone signals within the 800-900 MHz band, but it cannot support the newer, more popular 1.9 GHz (digital) signals, as cellular technology at this frequency was not available at the time of its implementation. A new infrastructure would be necessary specifically for this new frequency band.

The capacity of the existing system is 45 channels in the 800-900MHz band with 13 presently occupied by emergency services. By keeping at least 10 channels for future changes and system expansions, the available capacity in the existing system is 22 channels. That would be enough to accommodate one cellular carrier with one control and 21 voice channels, or two carriers with 10 voice channels each. It will be determined via REOI whether service carriers would be interested in such a capacity (10 channels) at the 800 MHz band.

It should be noted that the existing SRC system is based on having a set of channels being available over a wide area of the subway system, supported by a central distribution point (Head End). The cellular systems are based on a different design philosophy, i.e. small, individual coverage areas (cells), and multiple sets of local

supporting equipment (cell sites). Further, the SRC system has extensive fault detection and reporting and response features, so that it can provide fault-tolerant service to TTC and Emergency Services. Reconfigurations that take place to provide fault switchover could render a cell-based system inoperative due to changes in the coverage areas that would occur. The fault switchover features of the SRC system are not only unnecessary, but also undesirable for the cellular carriers. The result is that the existing SRC infrastructure is not well suited to cell-based system implementations due to the differing needs of the TTC and emergency services versus cellular phone users.

The various scenarios presented below outline the cell coverage that is obtained, the equipment necessary, estimated costs and potential impacts on the existing TTC SRC system:

Scenario	**Coverage**	**Equipment**	**Estimated Cost ($)**	**Comments/Impact on TTC SRC System**
800 MHz only	Stations only	Existing cabling and equipment in the stations is reused where possible. Supplementary antennas and RF components are required for platform areas. Carrier equipment is needed in each station.	3 M	**There is a risk of interference with the existing SRC system.**
800 MHz only	Stations only	Mostly independent of existing SRC infrastructure. Separate antennas and cables are required at each underground station. Additional fibre optic cable between stations is required, to support "host-slave" design concept.	4 M	Price does not include installation of the **additional fibre optic cable** required to connect between "host" station and two adjacent "slave" stations. The risk of interference with the existing SRC is reduced.

Scenario	Coverage	Equipment	Estimated Cost ($)	Comments/Impact on TTC SRC System
800 MHz only	Stations and tunnels	Existing SRC radiating cable, amplifiers and in–station antennas are reused to distribute the signal. Supplementary antennas and RF components are required for platform areas. Carrier equipment is needed in each "Zone Interface" station (12) and "Open-Cut" portal (16)	1 M	The existing fixed cell size **configuration of SRC system may be problematic for cellular carriers,** due to the fault switchover design. The risk of interference with the existing SRC system is high.
800 MHz &1.9 GHz	Stations only	Existing cabling and equipment in the stations is reused where possible. New antennas and RF components are required for 1.9 GHz. Carrier equipment is needed in each station.	3.5 M	**There is a risk of interference with the existing SRC system**.
800 MHz &1.9 GHz	Stations only	Mostly independent of existing SRC infrastructure. Separate antennas and cables are required at each underground station. Additional fibre optic cable between stations is required, to support "host-slave" design concept.	4 M	Price does not include installation of the **additional fibre optic cable** required to connect between "host" station and two adjacent "slave" stations. The risk of interference with the existing SRC is reduced.
Scenario	**Coverage**	**Equipment**	**Estimated Cost ($)**	**Comments/Impact on TTC SRC System**

800 MHz &1.9 GHz	Stations and limited tunnels	Most of the existing cabling is reused. New antennas and RF components are required at the stations for 1.9 GHz. Carrier equipment is needed in each station. 1.9 GHz is provided only short distance into the tunnels using the existing radiating cable.	3 M	The existing SRC fixed cell size configuration may **be problematic for the cellular carriers**, due to the issue of fault switchover**.** The risk of interference with the existing SRC system is high due to system overload.
800 MHz &1.9 GHz	Stations and tunnels	Existing radiating cable is reused, but new 1.9 GHz equipment is installed in parallel with the existing system. Carrier equipment is needed in each station.	8.5 M	The SRC fault switchover does not affect cellular carriers. **The risk of interference with the existing SRC system is high** due to system overload, and existing **power supplies may require upgrading** (additional cost)

It should be noted that the estimated costs shown above are order of magnitude estimates provided by the designers of the existing system and TTC staff. The cellular carriers would likely produce different estimates based on their technical knowledge of the cell phone industry and the desired level of functionality and coverage. Also, the costs shown are only for modifications to the existing SRC system or installation of new radiating equipment and do not include the costs of the radio transmitters and receivers that the carriers would be required to install, nor do they include costs of any installation of additional fibre optic cable.

It is recommended that the cellular phone carriers be given the opportunity via an REOI to inform the Commission of their interest in cellular phone implementation in TTC. As part of this process, the carrier would estimate the potential revenue stream in comparison to their own implementation costs. Also, they would be required to state how they would minimize interference to the emergency services using the existing radio system. To alleviate concerns regarding the impact of introducing cellular phones to the existing system, a prototype installation at one subway station is recommended prior to full system implementation.

TTC staff investigated the status of cellular phone usage at three transit properties. Our preliminary review revealed the following:

• Montreal does not have cell phones in the tunnels. They only have coverage at a few surface stations. The infrastructure for that was installed by Bell. They have two separate radio systems, 175 MHz used for operations people, maintenance and trains, and 450 MHz radio system used by Emergency Services and Metro Security.

• New York Transit does not have cell phones in the subway either. They have a radio system similar to ours; one radiating cable for VHF, UHF, and 800 MHz. They are looking into getting a third party who would build a new (physically separate) infrastructure in the tunnels for cell phone use. They still have a lot of unresolved issues regarding future maintenance (especially in tunnels), access to the system (security), money, etc.

• Washington Transit has cell phones in the system. They have three separate radio systems (three separate radiating cables at 12" apart). One system is a 30 year old VHF radio used by Transit Police, operations and maintenance people, and trains. The second one is 800 MHz Public Safety radio used by Fire and Ambulance, and the third one is a 800 MHz radio used by only one cell provider "Verizons" (former Bell Atlantic). Approximate cost for this separate system was in the order of $30M.

JUSTIFICATION

It is important that cellular carriers be given the opportunity to express their interest in cellular phone coverage in TTC to determine the cost-effectiveness of such services.

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March 3, 2003

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