FORECAST FOR CONVENTIONAL LAND MOBILE SPECTRUM REQUIREMENTS

Mr. Parke Davis

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Introduction

The material presented in this forecast of land mobile spectrum requirements was developed from a report by Quasar Systems Ltd. entitled "Land Mobile Systems: A Forecast for Major Urban Centres". In addition, assumptions and loading criteria supported by various departmental and external studies including the FCC have been used.

The forecast of spectrum requirements for mobile are presented in terms of ranges of additional spectrum rather than specific values to parallel the forecasts of land mobile systems given the Quasar report. An intermediate range forecast is given for the year 1985 and a long range forecast for the year 2000.

The spectrum requirements for each forecast period result from loading the land mobile channels by varying numbers of land mobile systems. The number of systems per channel (i.e., loading ratio) which can, in practice, be employed is based on the number of mobiles in each of the systems and their collective operational message requirements (i.e., maximum permissible waiting time, average message length, etc.).

Loading criteria

A review of the present land mobile systems indicates that there are approximately 6.2 mobile licences for every land mobile base station in 1976.

Therefore, on a Canada wide average, there are 6.2 mobiles in the average Canadian land mobile system. There are however, indications that the average number of mobiles per system in the larger urban areas is higher than this figure and vice-versa.

The loading of channels by land mobile systems is treated in two ways. The first method uses the FCC land mobile loading criteria developed for assigning channels to new systems in the 900 MHz frequency band (806-890 MHz). These criteria relating to conventional dispatch type systems in terms of mobile loading are:

- police traffic — 50 mobiles per duplex pair
- business — 90 " " " "
- other — 70 " " " "
- motor carrier, buses — 150 " " " "

The criteria also specify that no more than 5 independent user systems may share a duplex pair nor when a duplex pair is shared, can more than a combined total of 50 mobiles operate on it.

From the Quasar study which was based upon numbers of land mobile and using the FCC loading criteria, no more than 5 systems could share the same duplex pair (or 2.5 systems per single channel). Under the assumptions that:

a) all new conventional land mobile systems will be operated in the duplex mode
b) new land mobile systems will have on average less than 10 mobiles each (i.e., to ensure no more than 50 mobiles operating on a duplex pair)

and using the FCC loading criteria, the following analysis has been prepared for Toronto:

In Toronto, approximately 40% of allocated land mobile frequencies are not useable due to:

- intermodulation products or other interference with existing licences stations
- prior co-ordinated U.S. use of a portion of the channels (for users in Buffalo, etc.)

- protection of off-air reception of channel 7 VHF-TV by Toronto viewers (land mobile assignments in the 170-174 MHz portion of the VHF mobile band interfere with reception)

Assuming that some new land mobile systems can be accommodated in existing land mobile allocations until the FCC loading level is reached, the following spectrum requirements are necessary

For Toronto.- 1985

Most probable number of systems forecast (from the Quasar study) 8,900 — (High estimate 11,400 / (Low estimate 7,000

Number of channels required to accommodate new systems $\frac{8,900}{2.5} = 3,560$ useable

Although at present only 60% of allocated land mobile channels are useable for reasons already discussed, this ratio should increase to approximately 70% since interference to the channel 7 TV assignment causes a fixed reduction in useable spectrum, not one which increases with the air increase in the land mobile allocation. Therefore, a figure of 70% useable will be used below.

Number of allocated channels required = $\frac{3,560}{.7} = 5,086$

Number of channels presently allocated in existing land mobile allocations = 3,000 channels (approximately)

Additional number of channels required 5,086 − 3,000 = 2,086

Assuming a standard 25 KHz required channel bandwidth, additional land mobile spectrum requirement to accommodate new systems:

= 2,086 X .025 MHz

= 52.1 MHz additional

The table gives the results of the analysis of spectrum requirements for 1985 for other major Canadian cities using the FCC loading criteria and also the existing loading level for the 150-170 MHz portion of the VHF band in Toronto.

As an alternative to the use of the FCC loading criteria of 2.5 systems per channel, the existing level of loading for the 150-170 MHz band in Toronto could be chosen. As may be seen in Appendix I, Attachment B additional system growth (i.e, base station growth) has not occured apparently due to its already high level of assignment. The band is in essence saturated at an average level of 3.25 systems per channel. (There are 1972 base stations in the 150-174 MHz band shown in Attachment B and 581 channels in the 150.8 to 170 MHz band and approximately 25 channels in the 170-174 band in Toronto). As most systems in this band are simplex, no correction for low proportion of duplex systems will be made.

CITY	NUMBER OF LAND MOBILE SYSTEMS 1976	1985	RATIO OF PRESENT USEABLE CHANNELS TO ALLOCATED CHANNELS	ADDITIONAL SPECTRUM REQUIREMENTS 2.5 systems/ channel 25 kHz	3.25 systems/ channel 25 kHz
TORONTO	2,812	8,950 13.7% per yr	70%	52 MHz 29	23 MHz
MONTREAL	2,726	7,800 12.4	75%	29	5
VANCOUVER	1,936	7,800 16.7	75%	29	5
EDMONTON	1,190	4,200 15	80%	0	0
HALIFAX	503	1,500 12.9	80%	0	0

The following points should be noted concerning the analysis:

1. The loading ratio of 3.25 systems per channel presently existing in Toronto in the 150-174 MHz band can be assumed to be the practical saturation level for loading as the growth of new base station assignments in this band in Toronto has dropped to zero due to the problems of accommodating new systems in the existing electromagnetic environment.
2. The distance from the border and from U.S. population centres has a significant impact in determining spectrum requirements.
3. The overall land mobile system loading existing in Toronto for all land mobile bands at present is approximately 1.5 systems per channel. To increase this loading to the maximum FCC rate of 2.5 may be very difficult or impossible due to the present electromagnetic environment in Toronto(i.e.,placement and power levels of existing stations, operational constraints, etc.)

Summary and Conclusions

1. Using the forecast of land mobile systems for 1985 presented in the Quasar study, and two different loading ratios, the additional spectrum requirements for Toronto lie between 23 and 52 MHz. Additional spectrum requirements for Vancouver and Montreal for 1985 lie between 5 and 29 MHz.
2. It is anticipated that neither Edmonton nor Halifax will require additional land mobile spectrum by 1985.
3. Due to likely changes in technology, uncertainty in and lack of data, no definitive forecast of land mobile spectrum requirements could be given beyond 1985 in the Quasar Report; however, using the same assumptions and techniques used above, the range of spectrum requirements for 2000 will lie within the following bounds.

Spectrum Requirements for 2000

CITY	MINIMUM	MAXIMUM
TORONTO	32 MHz	205 MHz
MONTREAL	9	142
VANCOUVER	16	164
EDMONTON	0	63
HALIFAX	0	0

In arriving at these bounds, the lowest and highest estimates for land mobile system growth was used from the Quasar Report. The minimum spectrum requirement shown about was calculated using this lowest forecast of system growth at an assumed maximum level of system loading (3.25 systems per channel. To determine the maximum spectrum requirement, the highest forecast of system growth shown in the Quasar Report was used using the FCC proposed loading level of 2.5 systems per channel. For each city, the percentage of useable land mobile channel to allocated channels shown earlier in this appendix was used.

An outline of the forecasts and conclusions of the Quasar Report are attached to this appendix.

In summary, this report and analysis relate only to the present day conventional land mobile systems. Any spectrum required for new types of systems (i.e., cellular radio telephone, new citizens band, etc.)., would be in addition to the above requirements.