The future of Botswana's numbering plan

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1 Introduction

The Botswana Telecoms Authority (BTA) commissioned an independent study of the future of Botswana's E.164 (telephony) numbering plan. This report is written on the basis of information gathered and discussions held during a week's visit by an external consultant to Botswana in July 1998. Discussions including BTA staff and the consultant took place with:

- Botswana Telecoms Corporation (BTC) (twice)
- Both cellular operators, Vista and Mascom
- Three users (with responsibility for large company telecoms), all based in Gaborone
- A C Braby (Botswana's directory producer)

All those who took part in these discussions are thanked for their valuable contributions. Comments on a draft report made by BTA, BTC and Mascom are also acknowledged, and have been reflected here wherever appropriate.

2 The current numbering plan

Botswana's population is around 1.6m, with a fixed line teledensity of about 5 per hundred population, amounting to some 80,000 lines. Over half of the lines are concentrated in the capital, Gaborone. Together with a small but fast growing number of mobile phones, the fixed lines are numbered by a closed near-uniform geographically structured 6-digit numbering plan. The following numbers have more than 6 digits:

- DDI lines in Gaborone, which have 7 digits, numbered in the ranges starting 36 and 355
- mobile phones, which have 2-digit codes (71 and 72) and 6-digit subscriber numbers, ie 8 digits in all
- the new 0800 freephone range, which with 6-digit subscriber numbers (SNs) amount to 10 digits in all

The current use of the first two digits of numbers is summarised in Figure 1. (The first digit dialled appears at the left hand side and the second digit dialled across the top of the figure).

Figure 1 Current use of Botswana's numbering plan

	0	1	2	3	4	5	6	7	8	9
0	International prefix								0800 – freephone	
1	S h o r t c o d e s									
	Operator services	BTC internal use		Phono-grams	Fault reports etc	BTC paging			time	Enquiries
2	Francistown	Francistown	Francistown					Letlhakane	Francistown	
3	Gaborone	Gaborone	Gaborone/ Mochudi/ Molepolole	Lobatse	Kanye	Gaborone	Gaborone (DDI, 7 digits)	Gaborone/ Mochudi	Jwaneng	Gaborone/ Molepolole
4		Mahalapye	Palapye	Serowe	Palapye	Palapye	Mahalapye			
5	Lobatse	Ghanzi/ Jwaneng	Gaborone	Gaborone	Jwaneng/ Ghanzi	Gaborone	Gaborone	Gaborone/ Mochudi	Gaborone	Ghanzi
6		Kasane		Kasane		Kasane	Maun	Maun		
7		Cellular (Mascom)	Cellular (Vista)							
8		Selebi-Phikwe			Selebi-Phikwe	Voicemail				
9										

2.1 Geographic structure

There is a clear geographic structuring on the first digit:

- the first digit 2 covers Francistown and region
- the first digit 3 covers Gaborone and region
- the first digit 4 covers Palapye and region
- the first digit 5 covers the large sparsely populated south-west part of the country
- the first digit 6 covers the large sparsely populated north of the country
- the first digit 8 covers Selebi-Phikwe and region.

The first digit 1 is reserved and partly used for short codes, and 7 similarly for mobile numbering. The first digit 9 is unused at present.

There was originally smaller-scale geographic structure in the second digit, and in some areas this still exists. For example, in the Palapye region the ranges 41, 42, 43, 44, 45, 46, 47 all apply to separate towns and their environs. However, this has broken down in the Francistown region, where for example Tonota and Masunga share the range 28, although they are 90 kilometres apart and on opposite sides of Francistown (whose numbers predominantly start 20 or 21). And because of number shortages (see below) it has been abandoned in the Gaborone region, where for example the range 32 is used partly in Gaborone itself and partly in several towns scattered widely over the region.

Our talks with users show that the meanings of the first digits are generally recognised, at least approximately. The second digits are only recognised within a small region - for example, a user based in Palapye might be aware of his own second digit and those of two or three neighbouring local areas.

2.2 Number shortages in Gaborone

Number resources are under pressure in the fast-growing Gaborone region. Number utilisation after the first digit 3 is near 50%, which is very high by international standards. Expedients already adopted in the face of this pressure include:

- the 7-digit ranges used for DDI
- the abandonment of recognisable small-scale geographic structure, as mentioned below
- the introduction of number blocks starting with 5 but not in use in their own region. These were first introduced in Mochudi (which now has open the blocks 377XXX, 329XXX and 578XXX), and several are now open in Gaborone.

While BTC has received no complaints about the use of mixed numbering ranges in Gaborone local area, our talks with users confirmed that this does lead to problems for them, such as the following:

- call monitoring equipment, often used to enable company staff to identify and pay for personal calls made from work, attributes trunk call charges to calls from Gaborone starting with 5, although some of them are actually charged at local rates
- selective call barring equipment, which may for example be used to allow certain personnel to make local calls only, bars legitimate local calls starting with 5

- PABX expansion may entail new numbers starting with 5 in addition to old numbers starting with 3. This looks odd, and may for example lead callers to think that the company has set up a new branch office
- it further confuses the already rather tenuous link in users' minds between numbers and call charges (discussed in more detail below).

The first two problems could have been reduced by better publicity for the new ranges, enabling users to reprogram their equipment correctly. However the case for a simpler, more consistent arrangement is clear.

All areas other than Gaborone still have ample capacity, however.

2.3 Numbering and charging

BTC's network is divided into 7 charging zones and 56 local charging areas (see Map 1). Calls are charged at three rates:

- local rate for calls within any one local charging area
- within-zone rate for calls outside the local area but in the same charging zone (or between zones but to an adjacent local charging area)
- between-zone rate for calls to a different zone.

There is a rough correspondence between charging zones and first digits of numbers:

- charging zone 1 matches first digit 3
- charging zone 2 matches first digit 4
- charging zone 3 matches first digits 2 and 8
- charging zone 4 and 5 together match first digit 6
- charging zones 6 and 7 together match first digit 5.

In the regions covered by first digits 5 and 6, second digit boundaries usually line up with charging zone boundaries (although 66 and 51 both cross zone boundaries). So it is usually possible to tell from the first digit whether a call will attract inter-zonal charges, and always possible from the first three digits.

It is not, however, generally possible for users to tell whether they are making local or within-zone calls. The telephone directory contains a map showing the charge zones and main towns, but it does not show local area boundaries or list all towns within any local area. Even at the time of billing, users still do not know which calls cost them how much, since they do not yet receive itemised call records.

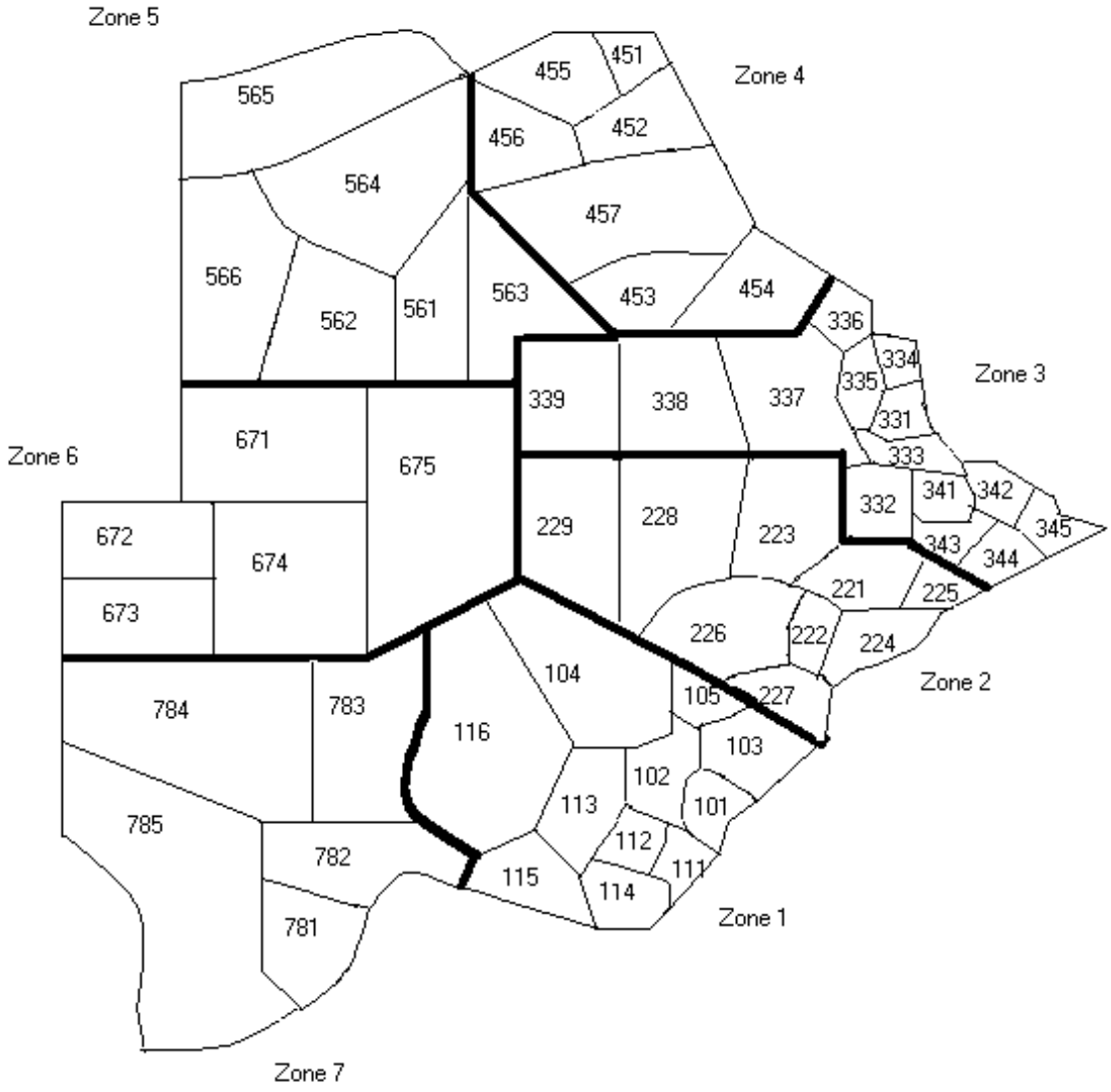
Nor is this information easily accessible from the number called. Again, in the Palapye region, the separate towns with distinct numbering ranges correspond well with local areas. Elsewhere, however, closely adjacent number ranges are used in separate local areas - for example, the 32 range is used in at least 4 different local areas.

Since within-zone long-distance charges are at least 9 times local charges (whereas between-zone charges are only 3 times within-zone charges) it seems important for users to be able to find out easily when their call is not local.

Our talks with users confirmed that users are not generally aware of this information. When itemised billing arrives (planned for 1999), BTC is likely to start to get complaints that users are being charged at trunk rates for calls that they have always assumed were local.

Users are however well aware of the evening and weekend cheap rate (when local calls attract a 33% discount and long-distance and international calls a 20% discount), and indeed tailor their personal calling patterns to take advantage of these discounts. These price differences are of course much smaller than the distance-dependent ones, which suggests that if the local area boundaries were better known then calling within the local area might be stimulated.

Map 1 Existing charging zones and areas



Charging zone boundary
Charging area boundary
123 Charging area identity code (as used in Figure 9)
NB These codes have no connection with telephone numbers.

3 Options for the future plan

3.1 Requirements for the future plan

A numbering plan is part of a country's essential telecoms infrastructure. Its role is to permit and support telecoms growth and development. It cannot however drive them - that will be done by the market, within the policy and regulatory framework decided by government and implemented by the regulator.

As will be seen in this report, there are close links between the numbering plan and both regulatory and commercial issues. In particular:

- The plan must accommodate evolving competition. Liberalisation in Botswana is still at an early stage, so it is not yet possible to say exactly what this will mean. On the basis of emerging good practice in other countries, however, we can make recommendations which we expect to cover most eventualities. A companion report on number portability deals separately with this important related issue.

- In Botswana as elsewhere, both the network and customers must use the number to determine the correct charging for a call. The new numbering plan must take account of likely broad changes in call charging (in particular, that charges will probably become less distance-dependent). The actual changes to be expected or encouraged are of course outside the scope of this study.

The main requirements of the future plan may be summarised as follows.

Capacity. The primary requirement of the numbering plan is to provide numbering capacity of the right kind and amount to meet Botswana's telecoms needs over the planning period. A planning period of 20 to 30 years is typical though increasingly ambitious. (Changes to any given number should not be necessary more than once in a decade. Unfortunately, in today's highly uncertain telecoms environment it may be unrealistic to plan with any confidence even 20 years ahead).

User-friendliness. Numbers are the major interface between users and the network. It is in both users' and operators' interests that this interface should be simple, understandable and easy to operate.

Competition- and technology-neutrality. As already mentioned, the numbering plan is a national resource which must be equally accessible to all legitimate participants in Botswana's telecoms industry. It should not unduly favour any particular participant or technology. When competition is introduced, the plan will need to take account of the numbering needs of new entrants. These are outlined at 3.4 below. In particular, new access network providers are likely to need block allocations of numbers within each charge area.

Practicable migration. It must be practicable to move to the new plan from the existing one at reasonable cost, both for the industry and for users. In practice this mainly means giving users adequate notice of the changes, and wherever possible providing for parallel running of old and new numbers before the change and changed number announcements afterwards.

Ease of operation. The running costs of the new plan should be as low as possible, both for the networks which must interpret and act on the numbers received, and for the regulator who will be responsible for managing number allocations to network operators.

3.2 Closed and open numbering plans

As mentioned above, Botswana currently has a closed numbering plan. That is, the whole country is accessible through one single dialling procedure. The alternative, an open plan, uses two dialling procedures, local and trunk, with a trunk prefix (usually 0) and a set of trunk area codes, to enable the network to tell when a call must be routed out of one area into another. Figure 2 below aims to clarify these differences, giving examples from a hypothetical 8-digit plan.

Figure 2 Closed and open numbering plans

	Closed numbering plan	Open numbering plan
Dialling trunk calls	Full national number (no trunk prefix) eg 2345 6789	Trunk prefix + full national number (code + subscriber number) eg 023 456 789
Dialling local calls	Full national number (no trunk prefix) eg 2345 6789	Subscriber number only eg 456 789
Number of digits in national number	Usually uniform eg 2345 6789 and 3456 7890	Often varies eg 023 456 789 and 0345 6789
Tariff indication	In first few digits of number eg 23 and 34	In use of trunk prefix, and in code digits eg 023, 0345
Geographic portability	User of 3456 7890 moves next door to user of 2345 6789	User of (0345) 6789 moves next door to user of (023) 456 789

Open plans are the traditional pattern, especially for countries with large networks and correspondingly long numbers. But increasingly, smaller countries (eg Norway, Denmark, Hong Kong - all with 8 digits) and even some larger ones (eg France - 10 digits, Switzerland - 9 digits) are moving towards closed plans. The advantages of a closed plan over an open one are:

- It is very simple for users, who have no need to grasp two-part dialling nor to know whether they are calling inside or outside their own area. This is a special advantage in a country like Botswana where many users are new to the telephone or use it only occasionally.
- A closed plan lends itself to uniform number length. This has advantages both for users (who know when they have a complete number) and for equipment (which does not need special programming to recognise different number lengths in different ranges).
- A closed plan allows numbers to be used more efficiently. Because any number of blocks of a given size (say, 100,000 numbers) can be allocated to an area, a closer fit can be achieved between number demand and supply than in an open plan (where capacity expansion is normally by a factor of 10). It should therefore have a considerably longer life before another major change is needed than an open plan of the same theoretical capacity.
- Because the full national number is always dialled, closed plans are more compatible with number portability between locations and between services. (With an open plan, doubt could arise on how to dial a number which had been ported from one code area to another).

All these are general points but they do apply to Botswana.

Against this, the major disadvantage of a closed plan over an open one is that it usually means that users must on average reproduce and dial more digits per call. This would be especially burdensome in countries like Germany with short local numbers, much local calling and long national numbers. In Botswana, however, it is unlikely that more than 7 or at most 8 digits will ever be needed. Fortunately, 7 digits are within most people's memory capacity, so this number length should not cause user problems. (The detailed proposal in Section 4 below would mean that the first one or two digits of the number would have a familiar geographic meaning, so that actually only 5 or 6 digits would need remembering).

An argument in favour of open plans is that dialling the trunk prefix sends a powerful signal to the caller that this is likely to be a much more expensive call. This information could certainly be of value at present, but in future this value will probably be reduced because of lower distance differentials and itemised billing. Tariff information in the number is important, but this can equally be presented in the first digit or two of a closed number plan.

A further disadvantage of moving from an open to a closed plan is the required change in users' dialling habits. However, since Botswana already has a closed plan, remaining with a closed plan means less change to users' habits than would a change to an open plan.

Taking all these points together strongly suggests that Botswana should retain, and expand as necessary, its existing closed numbering plan, with proper care that trunk tariffs are clear to callers.

3.3 Gross numbering capacity and national number length

In this section, we look at capacity requirements for geographic numbering. Currently, as already mentioned, Botswana has 6-digit numbers on 6 initial digits (2, 3, 4, 5, 6, 8), or a gross capacity of 600,000 numbers dedicated to geographic numbering. At around 15% utilisation, this may appear ample for the current demand to number under 100,000 lines. However, considering that:

- over half the existing lines are concentrated on the initial digit 3 (covering Gaborone and environs), where number utilisation is therefore over 50%;
- further rapid growth must be expected, both in Gaborone and elsewhere;

it is clear that the future plan will need to provide more geographic capacity.

Three main options may be considered, and we discuss these in turn below:

- remain with 6 digits, but use the capacity that they provide more flexibly, and if necessary dedicate more of it to geographic numbering
- expand to 7 digits
- expand to 8 digits or beyond.

3.3.1 Six digits

The first option is effectively the one that is being pursued at present, with numbers being imported into Gaborone that are proper to another part of the country. For the time being this may well be the only option. As discussed above, problems do arise when number ranges are mixed. However, even if these could be resolved, this would still be a limited-life solution.

Non-geographic services are likely to need significant numbering space, so the blocks designated for them cannot easily be made available for geographic numbering. At a high efficiency of (say) 50%, we obtain a supply of 300,000 geographic numbers. At one number per line this would limit Botswana's teledensity to under 20%, which is not an acceptable long-term scenario.

There is certainly an argument that any expansion to 7 or more digits should be postponed for as long as possible. This is usually put forward in the hope that thereby the cost of the change will be reduced. Sometimes this is a sensible and valid point. However it is important to remember that:

- delay may increase change costs, if only because the network is growing fast, and the later the change is left, the more customers will be affected;
- an inadequate numbering plan has its own very serious costs in terms of hampering growth.

The conclusion must be that it is important to get the timing of the change right, so as to permit proper planning and avoid unnecessary costs, but there is little case for avoidable delay.

3.3.2 Seven digits

Later in this report we put forward a detailed proposal for a change to a uniform 7-digit plan. Figure 3 below shows at the top level the capacity that this plan would make available, together with relevant demand estimates for 20 to 30 years ahead.

The demand estimates are unavoidably approximate. They have been arrived at as follows:

- Urban and rural population estimates in the year 2021 for each numbering area were derived from the "medium variant" projections provided by the Central Statistical Office[1]. As numbering areas and census districts are only distantly related, an approximate mapping was devised for the purpose, with adjustments (see the Annex).
- The following teledensities were applied to these populations to obtain line numbers:
  - Gaborone: 40%
  - other urban populations: 24%
  - rural populations: 16%

(The overall average teledensity is taken as 25%).

These figures in turn are based on the following estimates:

- the per capita income of US$8,500 (in 1996 real terms) officially envisaged for the year 2016[2]
- ITU statistics[3] showing 25% as a rather high expected teledensity for this per capita income level

[1] 1991 Population and Housing Census. Population Projections, 1991-2021. CSO, April 1997. Figures taken from Appendix A1.1: Medium variant projections for districts and all 1991 urban settlements (page 52). (The high variant is about 12% higher and the low variant about 9% lower).

[2] Long term vision for Botswana: Towards Prosperity for All. Presidential Task Group for a Long-Term Vision for Botswana, September 1997. Per-capita income, page 7.

- estimated variations of 2 to 1 between teledensities in the capital city and the rest of the country, and of 2 to 1 between urban areas and rural areas. These are based on trends shown in ITU statistics[4].

Figure 3 Projected number supply and demand estimates in a 7-digit plan

New first digit	Gross number supply k	Projected population k	Envisaged teledensity %	Envisaged lines k	Current lines k	Annual growth rate needed	Assumed number utilisation	Net number supply	Avail nos per line
2	1000	659	21	138	19	8 %	40 %	400	2.9
3	1000	656	40	262	41	8 %	50%	500	1.9
4	1000	382	18	70	14	10 %	40%	400	5.7
5	1000	658	20	130	12	11 %	30%	300	2.3
6	1000	307	18	55	5	11 %	40%	400	7.3
All	5000	2649	25	653	91	9 %	40%	2000	3.1

Figure 3 shows that the proposed 7-digit plan provides, on generous growth projections, a minimum of 1.9 numbers per fixed line. The annual growth rates required consistently for the next 23 years to achieve these line levels are also shown. These all equal or exceed the 8% real growth rate envisaged for the economy as a whole by the Presidential Task Group[5] - that is, they are extremely ambitious.

The figure shows that the prospect of running out of geographic numbers with a 7-digit plan is at worst a long way off. Even with continuing consistent growth , it may never happen at all. In the very long term (beyond the plan period), new technologies may mean that E.164 numbering is superseded by a new more user-friendly numbering and addressing system.

It also suggests that, should a problem indeed arise, the most likely region to run out of numbers would again be the Gaborone region. Should this become a real prospect, the following alternatives are available, and could be considered depending on circumstances at the time:

- if the geographic identity of Gaborone must still be preserved, supplement its number supply with unused non-geographic numbers (for example, part or all of the first digit 9 could be held in reserve for this)
- if regional location portability is acceptable, merge the regions served by the first digits 3 and 5, with location portability throughout the combined region. This would permit a

[3] World Telecommunication Development Report (WTDR) 1998: Universal Access. World Telecommunication Indicators. See especially Indicators Table 1: Basic Indicators; main text Figures 1.5 and 1.6.

[4] WDTR 1998 Indicators Tables 7 and 8; World Telecommunications Visual Data Book 1996, Figure 2.11.1.

[5] Long term vision for Botswana: Towards Prosperity for All. Presidential Task Group for a Long-Term Vision for Botswana, September 1997. Per-capita income, page 7.

more efficient use of the combined number supply, as well as allowing both ranges to be used in Gaborone

- if national number portability is acceptable, merge all geographic regions, making any unused geographic number available for Gaborone (and again improving numbering efficiency)
- expand Gaborone numbers to 8 digits (one second digit would have been reserved for this purpose)
- expand the entire national numbering scheme to 8 digits.

The first three options entail no number changes. It is hard to predict the rate of tariff rebalancing and the speed of arrival of location portability, but on current showing (and if the proposals in our companion report on number portability are adopted) they are likely to be available well before any number shortages make themselves felt. In short, the geographic numbering capacity provided by a 7-digit scheme may well be all that is ever needed in Botswana.

3.3.3 Eight digits

Although, as shown above, the capacity offered by 7 digits seems generous for the foreseeable future, there is an argument for moving straight to 8 digits. This might be framed as follows:

- growth in number demand may be even greater than is assumed above;
- number changes are unwelcome and, when they happen, should last for a very long time;
- even 8 digit numbers are not unmanageably long for Botswana's public or network;
- this could permit a simpler migration plan to be devised (as it is easier to find spare two-digit combinations in the current plan than spare single digits).

These are all good points. But against them, one must consider:

- growth in number demand may be less than has been assumed above, and leave everybody dialling a redundant additional digit for the indefinite future;
- changes once in twenty or thirty years are acceptable;
- it is already hard to plan accurately for two decades ahead. If we try now to provide additional capacity in the right places further ahead than that, we risk getting it wrong and ending up with more change, not less.

The decision between these two viewpoints is ultimately more emotional than rational. A compromise solution could be to go for 8 digits in the current 3 region (Gaborone and environs) and 7 digits (or even 6 digits) elsewhere in the country. However this would reduce the benefits from uniform number length and eventual national number portability.

3.4 Numbering for competition

All the development options discussed in this report are for numbering plans which are integrated among competitors - that is, the primary significance in numbers (eg 3=Gaborone, 7=mobile) is shared by all operators. This contrasts with an alternative approach, which has been adopted in a few places (mainly with a long-term tradition of more than one operator), where the primary significance in numbers is the network. The reasons for integrated plans are:

- Work in many countries shows they are preferred by users (who are not very interested in operator identity).

- They are also preferred by new fixed network competitors, who do not want to "look different" from the incumbent.

- They are compatible with operator portable numbering.

- They produce a much more efficient use of numbering space than codes (leading digits) for each network.

The main argument in favour of the alternative approach is that if the plan is already structured that way then the trouble of changing is not justified. This clearly does not apply in Botswana.

Apart from an integrated plan, allowing all access network providers number blocks in each area where they offer service, the major requirement that new entrants have of the numbering plan is that it should be impartially administered. Numbering administration is discussed in more detail in section 5 below. Other requirements are:

- **Carrier selection codes**. Providers of indirectly accessed long-distance or international services (that is, those offering services accessed via local loops provided by a different operator) need codes that customers can dial before any call to select their service. These are usually short codes in the 1XX range. There seems to be ample space available in Botswana. The ranges 16 and 17 could be reserved for this purpose and used initially at 4 digits (16XX, 17XX) unless and until a need for an extra digit has been established. (Running out of these codes has proved a common problem in liberalising countries, and it would be wise to keep an easy expansion route, eg by not issuing the ranges 160X, 170X).

- **Operator number portability**. As is discussed in detail in our companion paper on number portability, provision should be made now for the likely introduction of number portability in the future. This implies in particular that the numbering scheme should allow for portability prefixes. These prefixes identify either the network to which the number has been ported or the exchange or concentrator now serving the number within that network. A range of short codes is appropriate[6].

[6] No standard practices have yet been established on which range to choose. As these codes are never dialled, non-diallable hexadecimal digits (A-F) may be used.

3.5 User-friendly numbering

Traditional number plans were dictated by equipment requirements and greatly influenced by network economics. With step-by-step switching, an extra digit meant an extra switching stage, and that cost money. With common control exchanges and especially with digital switches, there is a new freedom in number plan design. It is now widely accepted that the biggest factor influencing number plans should be user convenience. This is not for altruistic reasons - it is because anything encouraging users to make calls is good policy for operators. A good numbering plan can make it easier for callers to be connected correctly first time.

Users' requirements and preferences for a numbering plan have not been thoroughly researched in Botswana. However research in other countries has revealed the following general preferences, which we would expect to be valid also in Botswana.

- Users like the simplest possible dialling procedures, compatible with number that are not too long. The simplest is a closed plan where all digits are always dialled for every call.
- Users prefer all numbers of the same type (eg fixed network numbers) to be the same length. This way the most obvious errors in copying or reproducing numbers can be avoided.
- Users like to know from the number how any call will be charged (eg at local or long-distance rates), and they are also interested in the location of the called party and in the service called (eg cellular). They are much less interested knowing the called party's network operator.
- Users who travel favour a degree of international harmonisation in commonly used codes like those for emergency services or fault repair.

Whatever is decided about the number change, it is clear that BTC needs to improve the way it informs its customers about both existing and new number ranges and the charges associated with calls to different locations. The planned move to itemised billing will probably make this point to BTC without the need for BTA to do so. There is an example below of how such information could be presented in an additional page in the directory.

We recommend that BTA satisfy itself in future that BTC is informing its customers properly on these matters. At the same time the directory could be made easier to use by including an index of the places for which alphabetic listings are provided, or just making these match the places listed for charging purposes (as in the example below).

Example of charging information for directory

Calls between places in the same local charge area are charged at local rates. Calls between places in different local charge areas in the same zone are charged at 'within zone' rates.

Charging zone 1

Local charge area	**Other places in this area**
Gaborone	Mogoditshane, Tlokweng, Gabane, Ramotswa
Molepolole	Thamaga
Mochudi	Lentsweletau
Letlhakeng	
Sojwe	
Lobatse	Otse
Kanye	Moshupa
Pitsane	
Bray	
Jwaneng	

3.6 International aspects

It is clearly desirable for numbering plans to be designed with increasing international travel and calling in mind. In practice this means considering harmonised short codes (and possibly new service codes) with other countries with whom Botswana has a strong community of interest. Figure 4 below summarises some relevant information from countries in the region and elsewhere.

Figure 4 Short codes and mobile numbering in various countries

	Open or closed	Emerg-ency	Fault repair	Operator	Mobile	Other information
Botswana	Closed	99X	14X	100	7X	
South Africa	Open	999	10212	102X	08X	New services on 08X
Namibia	Open	1199	11XX	119X	?	All area codes start 06
Zimbabwe	Open	99X	95X	96X	011X	Trunk prefix changing from 1 to 0
Zambia	Open	999	10X	10X	?	
Swaziland	Closed	999	97	9X	?	Expanding from 5 to 7 digits
United Kingdom	Open	999/112	151	100	07X	Random non-geog codes being rationalised on 07, 08, 09
ETO[7] guidelines	-	112	1XX	1XX	(0)6, (0)7[8]	(0)8 and (0)9 recommended for other non-geog services, 11X for harmonised short codes
North America	Open	911	Various	0	various	Likely to move to a closed plan

This figure shows that:

- There is little pattern internationally in the codes for the selected services.
- Botswana is already in line with such pattern as may be seen (ie the use of 1XX for short codes, 999 for emergencies and a late initial digit for mobile).
- There may be difficulty in achieving any further harmonisation among Botswana's communication partners.

However two recommendations come to mind:

- The range 11X could be reserved for internationally harmonised use in the light of possible developments in Europe and elsewhere. In particular, the code 112 (which has been adopted as the common emergency code throughout Europe and for GSM) should not be used for any other purpose.
- Botswana should raise the issue of co-ordinated numbering development in the region at any suitable regional gatherings.

A further possibility worth considering which might ease international communications is use of the first digit 0 as an option for short international dialling in the region. This is similar to the option already offered in Swaziland for calling to South Africa. For example the sequence 01 might be accepted (instead of 0027) for dialling South Africa, and 02 for calls to Zimbabwe (instead of 00263). Naturally, the full international dialling sequence would also remain valid.

[7] ETO: European Telecommunications Office (recommends numbering practices for Europe)
[8] 6, 7 in closed plans; 06, 07 in open plans

4 A proposal for a closed uniform 7-digit numbering plan

4.1 Geographic numbering

4.1.1 Principles and alternatives

Below we describe in some detail one approach to a closed uniform 7-digit numbering plan. It will doubtless be possible to improve on this, but in doing so it is important to bear in mind the guiding principles underlying the design. These follow and as far as possible should be retained in any variation on it:

- To create a sustainable new numbering structure which will convey useful geographic and charge information to users.
- To do so with the simplest possible migration from the status quo, which in practice means:
  - Retain familiar early digits in numbers.
  - To permit parallel running of old and new numbers before changeover day, and rapid trapping of misdialled calls after that day (with routing to a changed number announcement), create new numbering ranges only in empty numbering space. This sometimes means clearing destination space as a preliminary step.

  There is a clear conflict between these two aims, since it is harder to find empty numbering space in a well-used familiar block. Our design has given precedence to retaining familiar digits, but reasonable alternatives could take the other course (eg interchanging the roles of 5 and 3, or using 6 as the first digit in Gaborone).
- To be consistent with likely fixed network tariff developments. While it is not essential, it is highly desirable that before too long, calls within a local numbering area should attract a local call charge. Usually, price rebalancing in a competitive market means that local call charges need to rise, and this is often made more palatable to customers by giving them larger areas over which local call charges apply.
- To line up with the distribution of population and likely future demand for numbers in Botswana. This means leaving some ranges clear in each number region for eventual relief purposes. For example, when the 24 range designated for Francistown exhausts, it can be overlaid by (say) 25.
- To line up with the structure of BTC's network (and regional management?).
- To simplify the task of allocating numbers to new competitors (they will need fewer number blocks).

Our particular approach is based on new local charging areas which are enlarged from the current ones (the current total of 56 areas being reduced to 15). Reasonable alternatives to this approach include:

- Designing a revised numbering scheme which recognisably preserves the existing local charging areas. This is possible but would obviously mean a more complex series of changes than the one proposed here. It would not be sensible to do this if plans are already in hand to move to a simpler charging structure.
- Moving straight to a much less structured scheme, eg one which identifies only the existing charging zones. This would be easier to implement, but it is questionable whether it would preserve enough information in numbers either for customers or for BTC management purposes.

4.1.2 Proposal for a 15-area numbering plan

Below is presented one approach to revising the numbering scheme, which has been developed in moderate detail to permit an informed decision to be taken whether or not to pursue this route. If it is pursued, many details of timing and implementation remain to be settled.

The proposal is based on fulfilling the requirements which were outlined in Section 3 above, according to the principles laid out earlier in this section. The essence of the approach is:

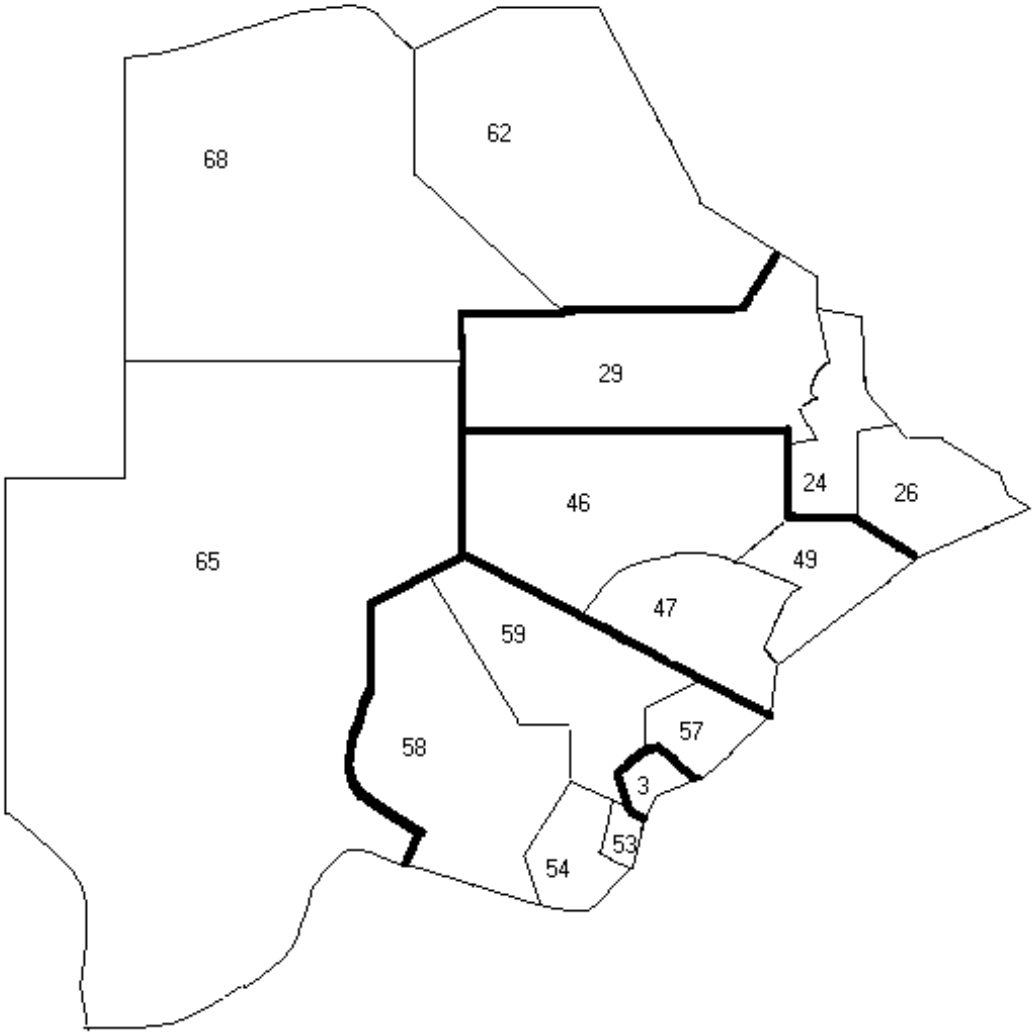
- Move towards uniform 7-digit geographic numbering on the first digits 2, 3, 4, 5, 6 (options remain on the speed and order of implementation).
- Free the first digit 8 for non-geographic services (see below).
- Improve the balance between number demand and supply by:
    - splitting the current 3 region – dedicating 3 to the current Gaborone local area, and changing the rest to start with 5
    - combining the current 5 and 6 regions (absorb 5 into 6)
    - combining the current 2 and 8 regions (absorb 8 into 2)
- Reduce the number of local call areas and ensure that the new areas are clearly identified by the first two digits of their number (this could be done in many ways - one has been presented below as an example, which can doubtless be improved upon). This is in keeping with expected trends in tariffs, but can only be implemented if and when BTC wishes to expand local charge areas along these lines.
- Reserve unused ranges in all regions for expansion of number supply in that region, if needed.
- Reserve ranges in all regions and local areas to allow for:
    - new local access networks sharing digits with local significance;
    - eventual possible expansion to longer numbers.

Long-term, if charging becomes nearly the same across a zone, the significance of the second digit might be lost, enabling all numbers starting with a particular digit to be used anywhere in a zone. With non-distance-dependent charging across the whole country, eventually even the first digit may lose geographic significance, and just come to mean "fixed network". Fully flexible use of numbers like this allows great efficiency and a long-lived scheme[9].

Figure 9 shows the detail of the 15 proposed new "local numbering areas" which are formed by selectively combining the existing 56 local charging areas. Map 2 illustrates the new areas.

[9] Similar flexibility may be achieved even with differentiated tariffs so long as alternative ways are provided for users to find out the correct tariffs. This could for example be done through voice announcements or a visual display during call setup. The relevant technology is however still embryonic.

Map 2 Proposed new numbering regions and areas



The actual new proposed codes are only examples based on the principles set out above, as are the possible migration paths suggested. Doubtless BTC, with its full local knowledge, will be able to suggest improvements.

A process like this would need to be carried out in stages. The following gives an example of how it might be done, taking account of BTA's expressed preference for reaching a uniform 7-digit scheme as quickly as possible.

Stage 1: Preliminaries

Although relatively complex to explain, these steps involve rather few customers (Figures 5 and 6[10] suggest probably under 3,000 for each step). The publicity for these changes is therefore best dealt with by local advertising in the affected areas, writing to customers individually and by intercepting misdialled calls with changed number announcements.

- Clear 5X numbers from Zones 6 and 7 (prefix them by 6).
- Extend Gaborone numbers starting 39 to 7 digits by adding 3 after 39[11], eg 391 234 becomes 393 1234.

Stage 2: Main Gaborone expansion

- Expand Gaborone charge area 6-digit numbers starting with 3 to 7 digits by inserting 9 after 3, eg 300 123 becomes 390 0123. This is the single major step involving change for many customers and requiring international publicity.
- Prefix 3 to Gaborone charge area numbers starting with 5, thereby giving them 7 digits and rationalising them into the new structure.

Now Gaborone numbers all have 7 digits, in the ranges:

355 XXXX	existing DDI range
36X XXXX	existing DDI range
35X XXXX	migrated numbers formerly starting with 5
39X XXXX	migrated numbers formerly starting with 3

Stage 3: Changes in greater Gaborone region

- Check and if necessary complete any required clearance of 5X ranges to be reused[12].

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[10]Key to Figures 5 and 6: Gabs: Gaborone Main Switching Unit (MSU)
Loba: Lobatse MSU
Jwan: Jwaneng MSU
Gantsi: Gantsi MSU
DDI: reserved for direct dialling in (7 digits) in Gaborone
Each MSU covers several local charging areas, eg numbers marked Gabs may be in use in Mochudi local charging area (and so incur a trunk call charge when called from Gaborone).
The number given after the name is the number of 100-number blocks open in that 1,000-number block (no information available for DDI blocks).

[11] The choice of 39 and 393 is made on the basis of the information currently available to this study (summarised in Figure 5, showing use at the MSU level). This suggests that 39 is the most lightly loaded 3X range and that 393 is clear. The point of this preliminary move is to free 39X where X is not 3 for expanding the rest of Gaborone. 393 is not needed because numbers starting 33 are in Lobatse and will change to 533.

- Implement changes to 5X in the rest of the current 3 region. The value of X will vary by new charge area as shown in Figure 9.
- Extend to 7 digits existing 5X numbers elsewhere in the current 3 region (see Figure 6)[13].

Stage 4: rest of country

- Implement changes in current 2, 4 and 8 regions.
- Implement changes in current 6 region.

Figure 5 Use of 100 number blocks after first digit 3

First & second digits	Third digit									
	0	1	2	3	4	5	6	7	8	9
30	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10
31		Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10			Gabs 10	Gabs 10
32	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10
33	Loba 10	Loba 2	Loba 10				Loba 1	Loba 3	Loba 1	Gabs 1
34	Loba 10		Loba 10	Gabs 7	Gabs 2			Gabs 6	Loba 1	Gabs 5
35	Gabs 1	Gabs 10	Gabs 10	Gabs 10	Gabs 1	Gabs 1	Gabs 10	Gabs 10	Gabs 2	Gabs 10
36	DDI	DDI	DDI	DDI	DDI	DDI	DDI	DDI	DDI	DDI
37		Gabs 10	Gabs 10	Gabs 10	Gabs 10	Gabs 10		Gabs 10	Gabs 2	Gabs 1
38	Jwan 10	Jwan 10	Jwan 7	Jwan 1	Jwan 1		Loba 5	Loba 2		Jwan 10
39	Gabs 9	Gabs 10	Gabs 3		Gabs 1	Gabs 8	Gabs 1		Gabs 5	Gabs 6

[12] Information available to this study suggests that no further clearance should be necessary at this stage. However as the situation is constantly changing, this point should be checked. In particular, if the range 577 XXX is not yet in use in Mochudi, it should be kept clear to avoid future clashes.

[13] No specific migration path can be suggested by this study. However, the amount of empty space in Figure 6 should mean that it is relatively easy to chose suitable migration paths without causing confusion, and again it is likely that rather few numbers will be affected.

Figure 6 Use of 100 number blocks after first digit 5

First & second digits	Third digit									
	0	1	2	3	4	5	6	7	8	9
50	Loba 5			Loba 7	Loba 5		Loba 10	Loba 5		Loba 5
51	Jwan 4							Jwan 2	Gantsi 1	
52		Gabs 10								
53			Gabs 10	Gabs 10						
54	Jwan 9	Jwan 5	Jwan 3	Jwan 2	Jwan 2	Jwan 4				
55				Gabs 1						
56		Gabs 10		Gabs 10				Gabs 10		
57							Gabs 10	Gabs 10	Gabs 10	
58	Gabs 10	Gabs 10	Gabs 10		Gabs 10			Gabs 10		
59			Gantsi 2	Gantsi 1	Gantsi 1		Gantsi 9		Gantsi 1	

4.2 Practical considerations

4.2.1 Timing

Because the number supply in Gaborone is already exhausted, Stages 1 and 2 (or whatever equivalents assure the future number supply for Gaborone) should be carried out without delay. Stages 3 and 4 (or equivalents) could in principle be delayed, but in accordance with BTA's preference for a uniform 7-digit scheme as soon as possible, their timing should be fixed for as soon as practicable after Stage 2[14].

An implementation plan is required which minimises change costs for both the industry and customers. Customers' costs will be minimised by:

- Timing the change as early as practicable – the longer it is left, the more customers will be affected in this fast-growing network.

- Adequate notice of the change, to enable business customers to reprogram their equipment, reprint stationery, etc as part of their normal routines rather than as a special measure. In Botswana around 6 months' notice seems appropriate.

Similarly, industry costs will be minimised by careful planning and avoidance of unnecessary delay. Directory production in January is an important practical factor, but not so great that it should be allowed to drive the entire change process or lead to rushed decision-making.

[14] The determining factor may be availability of some limited resource, such as BTC skilled staff, or misdialled call announcement apparatus.

4.2.2 Parallel running and changed number announcements

A period of parallel running of old and new numbers before the official changeover is often appreciated, especially by business customers who have relatively complex equipment like PBXs to reprogram. The length of parallel running needed depends on the frequency of routine maintenance visits – for example if PBXs are visited quarterly, then a quarter's parallel running will be appropriate. We suggest that in Botswana, major business customers should be consulted about how much parallel running is required in what areas. It may well be that a quarter is adequate in Gaborone, and no parallel running at all may be needed in country districts with little or no business equipment to be reprogrammed.

Regardless of the length of parallel running before the official changeover, changed number announcements should be provided on all old numbers after the changeover, until misdialling has dropped to an insignificant level. With good publicity this may be only a few months. (Higher levels of misdialling must be envisaged within the first days and weeks after a change, with only occasional callers misdialling thereafter).

4.2.3 Other practical considerations

The checklist in the box below, reproduced from the website provided by the UK National Code and Number Change Steering Group, is designed to help business customers to prepare for the UK numbering change. Not all these items will apply for any one customer, and in the simpler environment of Botswana relatively few business customers should need to be concerned about many items. Residential customers mainly need to be aware of the changes and to inform their correspondents of them, although they too may need to reprogram memory phones or fax machines, amend personal records and reprint stationery.

Once the planned changes have been decided, the main responsibility of the regulator is to be satisfied that the industry's implementation plans adequately protect customers' interests, and that these plans are indeed carried out. The customer protection measures required have already been mentioned: first and foremost, well-timed and properly targeted publicity and reference material about the change (including directories listing the new numbers); supplemented by parallel running and changed number announcements in the network. Fortunately, it is in the network operators' interests to minimise false traffic and keep their customers as content as possible, so full co-operation may be expected.

Business customer number change checklist (from UK NCNC)

List all materials that carry your contact numbers. Consult your suppliers about phasing in the changes.

Stationery
Advertising
Promotional Material
Signage & Livery
Website
Helpline and emergency numbers on packaging/machinery
Other

Automatic systems may have numbers programmed into them. Speak to your equipment supplier if you do not have the expertise in-house to modify your systems.

Switchboard/PBX/Least Cost Routing
Call forwarding/barring
Call loggers
Alarms/security
Teleconferencing
ISDN (including CLI and international)
Modem (e-mail/internet/laptops)
Telephones/mobiles/pagers/fax machines
Private payphones
Other

Telephone numbers stored in records and databases will need updating. Some records may be paper-based, others electronic. Speak to your IT contacts to implement the changes.

Address/phone books (computers/laptops/mobiles)
Databases: staff, customers, suppliers
Other

The operators, of course, have to implement all the network changes required as well as carrying out the publicity programme. International publicity should be placed in the ITU Operational Bulletin, and may supplemented by press announcements in a few countries originating significant amounts of traffic to Botswana.

4.2.4 Bearing the costs of change

The fact that the regulator is now involved in numbering decisions may invite the suggestion that he should contribute to the cost of the change. Attractive though this possibility may appear to some at first sight, it is unfortunately misguided. The need for occasional numbering changes is inherent in network operation, and the network costs clearly have to be borne by network operators, whether in a monopoly or a competitive environment. Similarly, customers will have to bear their own change costs, and it is reasonable for them to ask for these to be kept to a minimum.

In a competitive environment, it is normal for each operator to bear its own costs for network changes and for direct communication with its own customers. Costs for general publicity (eg posters, or press or radio advertisements) may be shared among the operators[15], although in Botswana the advantages of sharing costs may be rather limited, and should be weighed against the disadvantages of the more cumbersome management of the campaign which this would naturally entail. The regulator may be able to help in kind by issuing press notices which will generate some free publicity.

4.3 Short-term expedients for Gaborone

Until Gaborone numbers are extended, new lines must continue to be numbered. Some alternative approaches to this are given below, with some pros and cons. Combinations of these approaches are also possible[16].

1. Continue with use of 5XX XXX numbers. This has the merit of extending an existing practice, and of potentially lasting for some time (especially if 5 is cleared completely for this purpose), but all customers getting these numbers will have to change them. Also, full public information on what is going on will be essential. Up to about 80,000 numbers could be supplied this way.
2. Use 3XX XXXX numbers from the unused blocks in Gaborone ranges. Customers getting these numbers will not have to change them. However, using many blocks in this way makes the change more complicated for people calling in to them (they have to recognise which blocks do not follow the general change rule). Figure 5 suggests that, without encroaching on the ranges reserved for expansion, this might supply up to around 50,000 numbers.
3. Import unused 3XX blocks from the environs, eg Lobatse, and use at either 6 or 7-digit length. Pros and cons similar to the previous two possibilities, but with the additional potential problem of depleting the number supply for Lobatse below safe limits. Figure 5 suggests that at 7 digits this option might supply around 40,000 numbers.
4. Use 9XX XXX numbers. Pros and cons similar to the first possibility, but without the familiarity that 5XX XXX numbers are acquiring, and with no planned long life in the region. However, a good supply is available (nearly 100,000 numbers) without risking confusion with other uses.

The choice among these options will depend on how fast the main change can take place and on current growth requirements. If Option 2 is adequate by itself, then this may on balance be the best approach.

4.4 Non-geographic and mobile numbering

At this stage, non-geographic services in Botswana are still very limited and numbering them is relatively simple. The main relevant recommendations of this study are to clear and

[15] Cost sharing among operators would need to be on an agreed equitable basis, such as revenues, lines, or numbers used. Recently in the UK the industry agreed to share numbering publicity costs on the basis of number blocks held by each operator. This resulted in the return to the regulator of some 500 number blocks which were found to be no longer needed.

[16] The assumption here is that the eventual intention is indeed to follow an approach like the one described above. Obviously, if a different eventual solution is adopted, then different interim arrrangements might be better.

reserve numbering space for possible future non-geographic services. Figure 7 below provides an overview of the recommended use for Botswana's numbering space. The proposed non-geographic ranges (7X, 8X, and X0) are in keeping with trends in other countries.

Figure 7 Overview of proposed use of Botswana's numbering space

First digit	Second digit								
	0	1	2	3	4	5	6	7	8	9
0	Int'l[17]	Short international dialling in region?								
1	Short codes									
2	NG[18]	Geographic numbering (Francistown region)								
3	NG	Geographic numbering (Gaborone)								
4	NG	Geographic numbering (Palapye region)								
5	NG	Geographic numbering (South-east region)								
6	NG	Geographic numbering (North and west regions)								
7	Personal and mobile numbering									
8	Non-geographic numbering (freephone etc)									
9	PRS[19]	Reserved								Em[20]

Below we discuss some specific ranges in more detail.

4.4.1 Short codes

The use of 1XX for short codes is well-established internationally, although as seen in Figure 4 above the details of how this range is implemented vary considerably. Current publicly accessible short codes in Botswana include the emergency codes 997 (ambulance), 998 (fire) and 999 (police) as well as the 1XX codes shown in Figure 8.

[17] Int'l: international access code
[18] NG: non-geographic numbering
[19] PRS: premium rate services (non-geographic)
[20] Em: emergency code(s) (999, 998, 997)

Figure 8 Use of 1XX for short codes in Botswana

First 2 digits	Third digit									
	0	1	2	3	4	5	6	7	8	9
10	National operator	Int'l operator	Radio call						National operator	Int'l operator
11		BTC int[21]								
12										
13		Phono-grams					BTC int			
14	Cable damage	Faults – phone	Faults - telex	Faults - PABX	Excava-tion	BTC int			Faults - data	
15	Paging (BTC manual)	Paging (BTC auto)								
16										
17										
18	Auto alarm	Time	Time							
19		Exch info - phone	DQ[22] (nat)	DQ (int'l)	Exch info – telex	Enqu – install-ation			Enqu - accounts	

Our recommendations in relation to short codes are:

- Retain the 99X range of emergency codes, to be implemented by all operators. These codes are probably well known, and because they may be used in life-or-death situations should not be withdrawn unless/until any alternative has superseded them.

- Continue to reserve the 1XX range for short codes, managing it carefully and fairly across all operators. Encourage all access network operators to use the same codes for commonly called functions like directory enquiries and fault reporting. Where necessary, expand codes from 3 digits to 4 or 5 digits.

- Reserve the 11X range for the time being in case internationally harmonised uses of this range emerge. 112 is the internationally agreed emergency code and 118XX is being developed in Europe for directory enquiry serices.

- Reserve the empty ranges 16X and 17X (and 15X as and when paging migrates to the mobile numbering range) for carrier access/selection codes when there is long-distance/international competition.

- Reserve a 1XXXX range for portability codes. (As these are used internally in networks they can be longer than average and the specific choice of code is immaterial. The non-diallable hexadecimal digits A-F may also be considered for this purpose.)

[21] BTC int: internal use by BTC (not publicly available)
[22] DQ: directory enquiries

4.4.2 Mobile and personal numbering

Mobile numbering has already started in Botswana on the first digit 7. This is in keeping with practice in many other countries, and we recommend reserving this range for mobile and personal numbering.

Mobile numbers are currently of 8 digits total length. This was decided upon to ensure adequate capacity for the very long term. Meanwhile, if the rest of the numbering plan is developed at 7 digits, it could be argued that for consistency and fairness mobile numbers should also be of 7 digits. Our recommendation is that, once the form of the plan as a whole has been decided, the length for mobile numbers should be reviewed, giving the mobile operators the opportunity to move to the predominant national number length.

Customers on mobile networks currently have to dial 01 before the full national number to access BTC customers. This arrangement seems to have arisen as a result of interim arrangements. It is no longer necessary and appears inconvenient and inequitable. We recommend that it be dropped, and that mobile customers access the fixed network by dialling just the full national number, exactly as they would from a fixed phone.

Standard emergency codes are essential, and it is highly desirable that all operators should standardise on a single set of short codes for common functions such as directory enquiries and fault reporting. This is already important given that most mobile users will also use a fixed phone, amd will become even more so with number portability. If non-standard codes have been introduced, they may continue in parallel with new standard codes.

As mentioned above, we expect that eventually automatic paging will migrate to this range. Initially the 75 range may be most suitable, as it retains 5 from the existing 15X numbering. Any expansion needed could be into 76 etc.

4.4.3 Freephone

In advance of full Intelligent Network (IN) implementation, a basic freephone service is currently available on 0800 XXX XXX.

We recommend clearing the first digit 8 from its current rather sparse use (for geographic numbering in the Selebi-Phikwe region) and reserving it for non-geographic services. This would make using 800 XXXX for freephone services (or, if demand warrants, 80 XXXXX) an attractive option, uniform with other services in this range.

The current 0800 numbers look identical to South African freephone numbers. Apparently some confusion has already arisen as to whether these numbers can be called from within South Africa, and similarly whether South African freephone numbers can be called from within Botswana. This situation could be turned to advantage for both countries by an agreement to develop this range (or at least part of it) in an integrated way, so that any relevant 0800 XXX XXX number will not be issued for different purposes in the two countries. Then, where the customer concerned wishes, access can be made available to callers in both countries, providing an extended market.

4.4.4 Other uses of the 8 range

Voicemail is already being offered on the 85 range, and this is entirely in keeping with these proposals. Other future applications will doubtless emerge; some that are already known of are:

- Services tariffed in special ways (eg at local or national rate);
- Corporate numbering (where a large company with many branches has its own code, eg 8765XXX; suitable network support can enable internal extension numbers to be used as the XXX).

The main recommendation for the time being is to look after this range carefully and manage it fairly among all market participants.

4.4.5 Use of the 9 range

We have not suggested any specific use of the 9 range, because what is best depends on the decisions taken about the geographic part of the scheme. If a 7-digit closed scheme is adopted along the lines discussed above, then the first digit 9 should be reserved long-term for possible overall expansion of the numbering scheme. This does not preclude:

- Continuing use of the current emergency codes
- Use of the widely recognised 900, if desired, for premium rate services
- Temporary purposes such as expedient relief in Gaborone (see section 4.2).

4.4.6 Use of the X0 series

We have suggested reserving the X0 series, X=2 to 9, for non-geographic services. Again we have done this without making specific suggestions as to their uses (other than in the 7, 8 and 9 ranges). The reason is that this range can easily be reserved, and is another candidate for non-geographic use in many countries. If Botswana also reserves it, then it will be well placed to follow any trends that may arise in this area.

Figure 9 Possible number restructuring around new local areas

Area name	Proposed code	Current areas	Main current blocks	Popn k	Lines k	MSUs	Possible migration path
Gaborone	3	101	30-2,35-37,39,52,57,58	260	41	2	Clear 39, then 3X (6 digits) to 39X; later, 5X to 35X
Lobatse	53	111	33	40	3	1	Replace first digit by 53
Kanye	54	112,114	34	107	2	0	Replace first digit by 54
Mochudi	57	103	32, 37, 57	93	1	0	Replace first digit by 57
Jwaneng	58	113,115,116	38, 54	50	3	1	Replace first digit by 58
Molepolole	59	102,104,105	32, 39	73	3	0	Replace first digit by 59
Francistown	24	331-4	20,21,22,28	143	15	1	Insert 4 after initial 2 in all relevant areas
Selebi-Phikwe	26	341-5	81,84	93	6	1	Replace initial 8 by 26
Letlhakane	29	335-9	27	100	4	2	Insert 9 after initial 2 in all relevant areas
Mahalapye	47	222,226,227	41,46	58	2	0	Insert 7 after initial 4 in all relevant areas
Palapye	49	221,224,225	42,44,45	99	2	1	Insert 9 after initial 4 in all relevant areas
Serowe	46	223,228,229	43	64	4	0	Insert 6 after initial 4 in all relevant areas
Kasane	62	451-7	61,63,65	34	1	1	Insert 2 after initial 6 in all relevant areas
Maun	68	561-6	66,67	102	3	2	Insert 8 after initial 6 in all relevant areas
Ghanzi	65	671-5,781-5	51,54,59	50	1	1	Prefix all numbers by 6
Botswana				**1370**	**91**	**13**	

5 Numbering administration

BTA's terms of reference for this assignment included advice on how it should implement its new responsibilities for administering the numbering scheme. In the immediate future, while BTC remains the only fixed network operator, this should not prove an onerous task. Nor need preparing for it be a major priority at present, when the details of the future numbering scheme must still be decided and the change itself smoothly managed. The following notes aim to outline what will be required.

5.1 Number block allocation

BTA will need to allocate blocks of numbers to network operators and/or service providers who require them. In preparation for this job the following three steps are suggested.

1 Check the adequacy of the relevant legal instruments (Act, licences, etc) to permit BTA to:

- allocate numbers and/or number blocks on application from network operators and service providers, subject to reasonable conditions of use, levying fees which may be designed to balance demand and supply for numbers as well as to cover administrative costs
- if it is not satisfied of the merits of an application, to decline to allocate numbers as requested; and on reasonable notice, to recover numbers or number blocks that are not needed or whose conditions of use have been breached. (It may be useful to list grounds for such decisions, eg anticompetitive effects, and to specify how any disputes are to be resolved - if there is an existing channel for appeal against the regulator's decisions then this may be adequate).
- obtain full information at regular intervals (say, annually) from those allocated number blocks, on how their allocations are being used

If any gaps are revealed, set in motion the necessary actions to fill them (eg supplementary legislation, statutory instruments, new licence conditions). Typical problems that have arisen in other countries are:

- the legal framework may only permit allocation of numbers to licensed network operators, when public policy requires that unlicensed service providers should also be eligible
- any fees charged may be restricted to recovery of administrative costs, which are probably inadequate to the wider task of fostering sensible use of numbering resources

2 In parallel with the above, set up a national numbering database. This can easily be held on an ordinary personal computer, with sensible back-up practices. In due course BTA may wish to consider permitting on-line access to these records. Initial steps will include:

- Obtaining full records from existing operators (primarily BTC) of their current and planned use of number blocks. This should include not just the fact that a block is in use, but the particular purpose for which it is being used.
- Formally allocating to existing operators those number blocks for which they can show a real need, and formally withdrawing blocks that are not currently needed, returning them to the national pool of available numbers.

- Making the database available for public reference, showing each number block as *allocated* to a certain party for a certain purpose, *reserved* for certain purposes, or *available*. (Initially it will probably be adequate to permit reference only for personal visitors to BTA's offices by appointment, or to anyone content to receive a printout by post).

3 Set up a procedure for applying for number blocks. This need not be complex, but it should include a list of the information needed from applicants and a target time for dealing with any application. Applicants must satisfy the regulator that they have a bona fide need for the number blocks requested, and should forecast future requirements (for, say, the next 5 years) to permit capacity planning.

When these three sets of actions have been completed, BTA can announce that it is officially open for receiving number block applications. Meanwhile, existing informal procedures will doubtless suffice. It may well be most sensible to delay the official procedures until the new numbering scheme is in place. The important immediate actions for BTA are:

- to ensure a disciplined use by all operators of existing numbering resources
- to reclaim clear unused space, especially from BTC, in order to control what is available for migration purposes
- to meet demand by issuing the smallest practicable number blocks (at present, this probably means 100 fixed numbers or 10,000 mobile numbers)

Longer term, it must be sure to reserve early digits in all ranges for possible expansion, as mentioned elsewhere in this report.

5.2 Conditions of use

As mentioned above, number blocks will be allocated subject to conditions. Some sample conditions follow.

1 The period of allocation - this may be indefinite, or for a fixed period (at least 5 years would be normal). There is little point in number allocations outlasting a licence to which they are tied. The regulator must retain the power to require changes to the numbering plan within the period of allocation, which might entail changes to the allocated numbers. However there must be limits to this power - it must only be exercised on grounds of demonstrable necessity and only with reasonable notice.

2 The purpose of the allocated numbers, in conformity with the numbering plan. For geographic numbers this would naturally stipulate that they will be used for fixed lines (or fixed wireless service) within the area covered by the relevant early digits. For non-geographic services it would specify the planned service.

3 The requirements of good husbandry. This will include using numbers systematically and achieving reasonable utilisation in any block before moving on to new blocks. The target of 40% utilisation in the fixed network is offered for guidance, though different services will have different requirements. Mobile numbers should achieve at least 60% efficiency, while fixed non-geographic numbers may have a lower utilisation because of demand for "golden" (attractive) numbers .

4 Number sterilisation and re-use. It is not sensible to have a standard set of requirements, as each operator will have its own practices reflecting its perception of need. A condition could require that these practices should be clearly stated and approved by the regulator. The practices should balance the goals of:

- protecting users from receiving calls intended for a previous user of the number
- making good use of ceased numbers

The sterilisation period may well depend on the call volume attracted by the previous use, the intended new use and on the publicity given to the change. For example it would be wrong to assign to a private individual a number previously used by a busy government department, before (say) a year had gone by. However a change in the other direction could be acceptable after a month.

5 Reporting and forecasting. Each allocatee should be obliged to provide an annual return on the utilisation of its number holdings, including updated forecasts for each service and any sub-allocations (see below).

6 User information. Any allocatee offering services to the public must ensure that callers can find out the cost of calls to their numbers.

7 Sub-allocations. Any allocatee sub-allocating number blocks (typically to service providers) remains responsible for ensuring that the sub-allocatees comply with these conditions.

8 Directories. The allocatee must provide information on the end-users of his numbers, sufficient to permit the compilation of national or specialised directories. This information must be in accordance with user preferences (eg any user should have the opportunity to not have his number published) and may be charged for, on a justifiable cost basis.

9 Number portability. The allocatee must conform with any requirements for number portability (these will be notified separately - see the companion paper on this subject).

5.3 Individual number allocation

The traditional method of allocating numbers in all countries has been in blocks, as discussed so far in this section. However there is now increasing pressure for the allocation to end-users of individual numbers, and this approach is beginning to be introduced in some countries for certain number ranges - notably those where memorable numbers have special value, like freephone. In the UK, Oftel has recently issued a consultative document[23] on this issue, with the intention of moving towards individual allocation after the year 2000.

Individual allocation must be approached with caution because it can greatly multiply the load on the numbering administrator. Its big advantage is for end-users, who can obtain a particular desired number from one known source, rather than having to go "shopping" around several service providers. So long as competition in Botswana remains limited, there is little point in moving to individual allocation.

However the technology and procedures for individual allocation go hand-in-hand with those for number portability, and as and when number portability is to be implemented for any number range in Botswana, BTA may want to consider its position on individual number allocation. The companion paper on number portability contains more detail on this issue.

[23] Developing Number Administration: consultative document, Oftel, July 1998. (Available on Oftel's website at http://www.oftel.gov.uk)

5.4 Charging for numbers

At present charging for numbers is a somewhat controversial topic, at least if proposed charges go beyond covering administrative costs. In North America, there are strong objections in principle to charging for numbers, on the grounds that making a charge may create a presumption of ownership by the person who has paid the charge. This conflicts with the basic notion that the numbers are a national resource, to be managed in the public interest, and cannot be privately owned.

Most regulators in Europe, however, make a modest charge for allocating number blocks. The most thoroughly thought out position is found in Australia, where "rights of use" of numbers have been defined and are not seen as in conflict with the numbers as a whole remaining a national resource. Oftel is currently proposing[24] to introduce charges of up to 10 pence per number per year. This level is based on rough calculations of the "cost" of a number (based on the cost of the 1995 National Code Change and the number of numbers it created), but at the same time is subject to adjustment to ensure it achieves the primary aims of disciplining the use of numbers without cramping growth.

Our recommendation to BTA is to discuss with the operators what level of charging for number blocks would achieve these aims, and then to give notice that these charges will be applied, at least from the start of the formal block allocation procedure, discussed above.

6 Summary of main recommendations

Our main immediate recommendations to BTA are:

- Using this report as a guide, consult with the industry and users and decide as soon as possible on which route to pursue for Botswana's numbering plan, and to agree with the industry a timescale for implementing change.
- In consultation with BTC and users, to decide on expedients to provide a continuing supply of numbers to Gaborone until the main change can be implemented.
- Ensure that BTC informs its customers fully about call charges to any number, both at present and as they change.
- Take control of currently unused parts of the numbering plan, including short codes.

Less urgent recommendations include:

- Once the overall shape of the future plan has been decided, consult with the mobile operators on possible changes to bring mobile numbering into line with the rest of the plan.
- Supervise the implementation of the numbering change to make sure that it keeps to plan, and that users' interests are properly protected.
- Take steps as outlined in Section 5 to introduce a numbering administration system.

[24] See footnote 7

Annex: Mapping of population from census districts to numbering areas

Figure A1 Non-urban census districts and numbering areas

Non-urban census district	Assumed numbering area(s)	Non-urban census district	Assumed numbering area(s)
Barolong	54	Kgatleng	57
Central Kgalagadi	65	Kweneng East	57, 59
Central Bobonong	48	Kweneng West	57
Central Boteti	29	Lobatse	53
Central Mahalapye	47, 49	Ngamiland Delta	68
Central Tutume	62, 24, 29	Ngamiland North	68
Chobe	62	Ngamiland South	68
Francistown	24	Ngwaketse	54, 58
Gaborone	3	North East	24
Ghanzi	65	Orapa	29
Jwaneng	58	Selibe-Phikwe	26
Kgalagadi North	65	Serowe-Palapye	46, 49
Kgalagadi South	65, 58	South East	53
Kgatleng	57	Sowa Town	29

Figure A2 Urban census districts and numbering areas

Town (= urban census district)	Numbering area
Gaborone	3
Francistown	24
Lobatse	53
Selebi-Phikwe	26
Orapa	29
Jwaneng	58
Sowa	29

Figure A3 Urban villages and numbering areas

Urban village	Non-urban census district	Numbering area
Kanye	Ngwaketse	54
Moshupa	Ngwaketse	54
Ramotswa	South East	3
Tlokweng	South East	3
Molepolole	Kweneng	59
Mogodishane	Kweneng	3
Thamaga	Kweneng	59
Gabane	Kweneng	3
Mochudi	Kgatleng	57
Serowe	Serowe-Palapye	46
Palapye	Serowe-Palapye	49
Mahalapye	Central Mahalapye	47
Bobonong	Central Bobonong	26
Letlhakane	Central Boteti	29
Tonota	Central Tutume	24
Tutume	Central Tutume	29
Maun	Ngamiland South	68
Kasane	Chobe	62
Ghanzi	Ghanzi	65

The method used for allocating population to numbering areas was:

- population of towns and urban villages: allocated as urban population to the relevant area, as shown in Figures A2 and A3 above;
- urban village population subtracted from population shown for non-urban census districts, to leave rural population;
- rural population for each non-urban census district divided equally among the one, two or three assumed numbering areas shown against it in figure A1 above.

This method should lead to relatively accurate figures for urban population, which of course accounts for most numbering demand. The rural populations by numbering area can only be very rough, but this should not lead to significant errors in the numbering demand projections.