Antelope Consulting

Telecoms numbering

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Outline: part 1

1. Numbering overall
   - Numbering organisations
   - Number structure
   - Numbering documents
2. Numbering planning
3. Numbering in relation to services
4. Numbering inventory management
5. Numbering user protection
6. Numbering user support
7. Numbering variants

Numbering workshop purposes

- **The workshop purposes include:**
  - **Reviewing (mostly phone) numbering and the associated procedures.**
  - **Introducing past, present and future considerations in numbering.**
  - **Providing chances to talk to others dealing with numbering.**
- **Its content reflects our experience with numbering plans in many countries, which is partly summarised in *World Numbering Developments* (http://www.itu.int/ITU-D/treg/related-links/links-docs/numbering.html); some examples of papers are at http://www.antelope.org.uk.**

Please feel free to ask questions or suggest changes at any time.

Some relevant roles of international organisations

- **International Telecommunication Union (ITU):**
  - Developing telecommunications standards ('Recommendations'), such as E.164 and E.212.
  - Helping telecommunications development through technical assistance.
  - Allocating phone number country codes, such as '20' and '252'.
  - Allocating various other numbers (including ones after global country codes).
  - Distributing national numbering plan updates in its *Operational Bulletin*.
  - Publishing national numbering plans on its web site.
- **Internet Corporation for Assigned Names and Numbers (ICANN):**
  - Delegating the operation of top-level domain names, such as 'eg' and 'so'.
  - Allocating IP addresses (before further allocation by regional registries).
- **Internet Engineering Task Force (IETF):**
  - Drafting internet standards ('Requests For Comment'), such as RFC3261 ("Session Initiation Protocol") and RFC8225 ("Secure Telephone Identity Revisited").

In this presentation we look at numbers in the scope of the ITU, not domain names or IP addresses.

International and national responsibilities in numbering

- **ITU: Allocating phone number country codes (and various other numbers).**
- **International operators: Providing connections for calls between countries.**

- **National regulators:**
  - **Designing numbering to meet national needs, short term and long term.**
  - **Maintaining authoritative records of allocated numbers.**
  - **Allocating numbers to operators (and sometimes users).**
  - **Supervising how numbers are used.**
- **National operators:**
  - **Ensuring international and national connectivity.**
  - **Providing connections for calls within countries.**
  - **Keeping full records of assigned numbers.**
  - **Assigning numbers to users.**

Regulators and operators have rights to use country codes but do not own them.

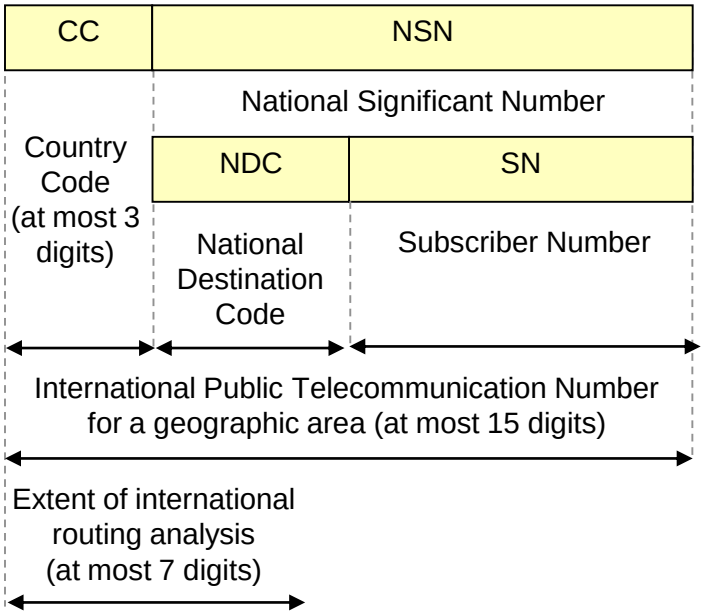
Some kinds of numbering

- Identifiers for telephony standards, such as:
  - E.164 phone numbers.
  - Q.708 Signalling Point Codes (SPCs).
  - E.212 International Mobile Subscription Identities (IMSIs).
  - X.121 Data Network Identification Codes (DNICs).
  - F.69 Telex Network Identification Codes (TNICs).
- Identifiers with national uses, such as:
  - Number portability codes.
  - Operator identification codes.
- Identifiers for internet standards, such as:
  - Domain names.
  - Internet Protocol (IP) addresses.
- (ENUM is really just a mapping from E.164 phone numbers to domain names.)

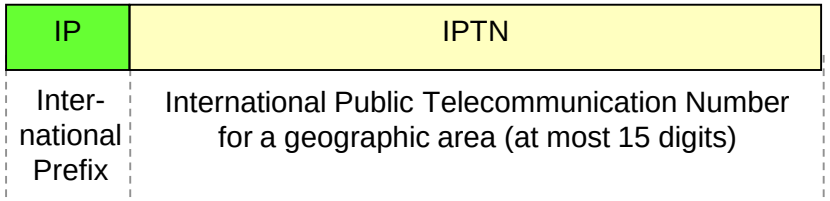
In this presentation we focus on E.164 phone numbers, because they are seen by users and could be scarce.

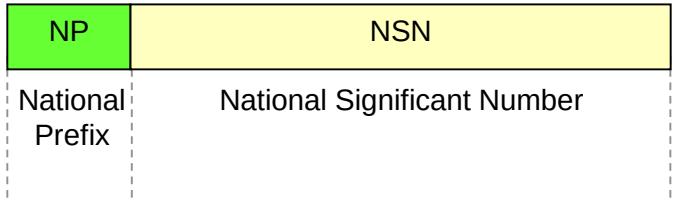
Essentials from E.164

- **Numbers:**
  - **Country Code (CC).**
  - **National Significant Number (NSN) (or N(S)N, in E.101 and related standards).**
  - **National Destination Code (NDC) (or trunk code, area code, service code, …).**
  - **Subscriber Number (SN).**

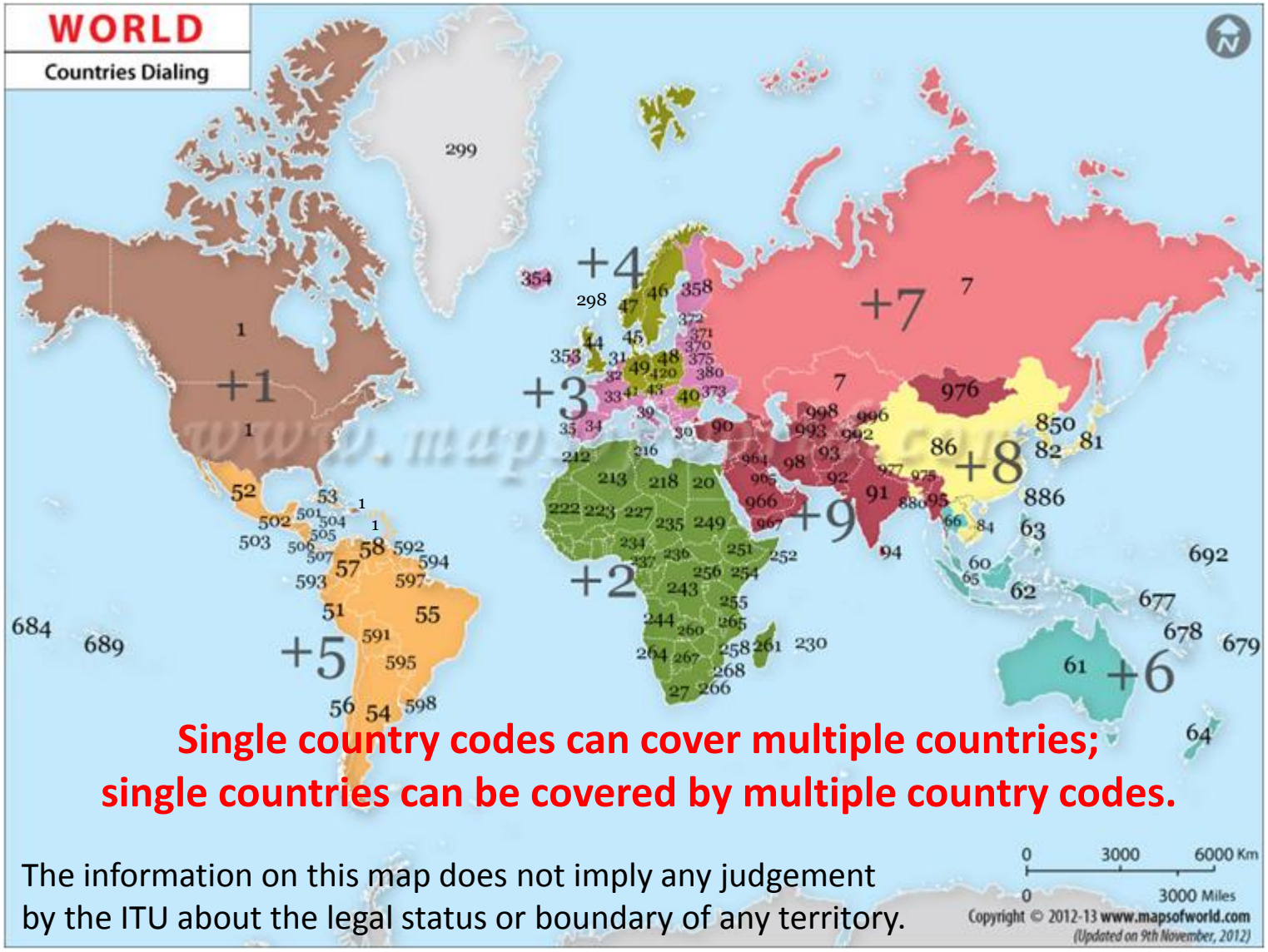


- **Prefixes:**
  - **International prefix, usually '00', attached to an International Public Telecommunication Number for international dialling.**
  - **National prefix (or trunk prefix), usually '0', attached to a National Significant Number for national dialling.**





Country code distribution for E.164



Details beyond E.164

- National Significant Numbers can be divided into:
  - Fixed [service] numbers (or geographic numbers).
  - Mobile [service] numbers (or mobile non-geographic numbers).
  - Other [service] numbers (or other non-geographic numbers).
- To be internationally accessible, E.164 numbers should be National Significant Numbers and should have suitable commercial arrangements.
- There can be numbers such as short codes that are not National Significant Numbers (and not internationally accessible).
- There can be prefixes such as carrier selection codes that are not the international and national prefixes.
- A dialling plan specifies the sequences of digits (and perhaps '*' and '#') that can usefully be input by a user of terminal equipment.

In this presentation we do not distinguish the dialling plan from the numbering plan.

The meaning of “numbering plan”

- A numbering plan covers at least the expected number length and number usage (indicated by the leading digits).
- In some countries the numbering plan lists the number blocks allocated to particular operators, with their purposes. These form the numbering register.
- In some countries the numbering plan includes statements about how numbers are administered and managed. These form the numbering regulation.
- Also, numbering forms help with supplying the information needed by the numbering regulation.
- Typically the plan and the regulation are changed only after public consultations, but the register is changed more often, when numbers are allocated.

In this presentation we regard the plan, the register and the regulation as separate.

An example of a numbering plan (Denmark)

Den overordnede disponering for den nationale nummerplan for telefoni, ISDN og mobilkommunikation, specificeret på a- og b-ciffer
3. august 2012

a \ b	0	1	2	3	4	5	6	7	8	9
0	Udlandspræfix	Reserve (*)								
1	4-cifrede operatørforvalgs-koder	3-cifrede kortnumre		Reserve (*)			5-cifrede netadgangs-koder	Reserve (*)	4-cifrede kortnumre	Reserve (*)
2	Fortrinsvis mobilkommunikation									
3	Fortrinsvis mobilkommunikation		Fortrinsvis telefoni/ISDN					12-cifrede M2M-numre	Fortrinsvis telefoni/ISDN	
4	Fortrinsvis mobilkommunikation			Fortrinsvis telefoni/ISDN						
5	Fortrinsvis mobilkommunikation				Fortrinsvis telefoni/ISDN					
6	Fortrinsvis mobilkommunikation		Fortrinsvis telefoni/ISDN					Reserve (*)		Fortrinsvis telefoni/ISDN
7	Fortrinsvis telefoni/ISDN	Fortrinsvis mobil-kommunikation	Fortrinsvis telefoni/ISDN							
8	Numre gratis for kaldende slutbruger	Fortrinsvis mobil-kommunikation	Fortrinsvis telefoni/ISDN	Reserve (*)			Fortrinsvis telefoni/ISDN			
9	Overtakserede tjenester	Fortrinsvis mobilkommunikation			Reserve (*)		Fortrinsvis telefoni/ISDN			

At en nummerserie er afsat til reserve betyder, at der på nuværende tidspunkt ikke tildeles numre fra den.
Ikke alle reserverede nummerserier fremgår direkte af oversigten, da denne kun er specificeret på de to første cifre.
- Nummerserier markeret med (*) er afsat til brug for ekstra kapacitet. Dette gælder tillige nummerserierne 108-109, 164-169 og 906-908.
- Nummerserier med førsteciffer 2-9 og tredjeciffer 0 er afsat til fremtidig udvidelse af nummerplanen. Disse fremgår ikke af oversigten.
- Nummerserien 116 er reserveret til brug for europæisk harmoniseret anvendelse af kortnumre på seks cifre til tjenester af samfundsmæssig betydning. Kortnummeret 116 112 kan ikke tildeles eller bruges af nogen tjeneste.
- Nummerserierne 2599 og 6988 vil kun blive tildelt udbydere med et minimalt nummerbehov. Der vil kun blive tildelt nummerserier på 1.000 numre. Nummerserierne 2598 og 6989 er afsat til reserve for udbydere med et minimalt nummerbehov, men disse serier vil først blive taget i brug, når det skønnes nødvendigt.
- Nummerserierne 3711-3719 og 372-379 tages først i brug, når det skønnes nødvendigt.

Greenland and the Faroe Islands have their own country codes and numbering plans.

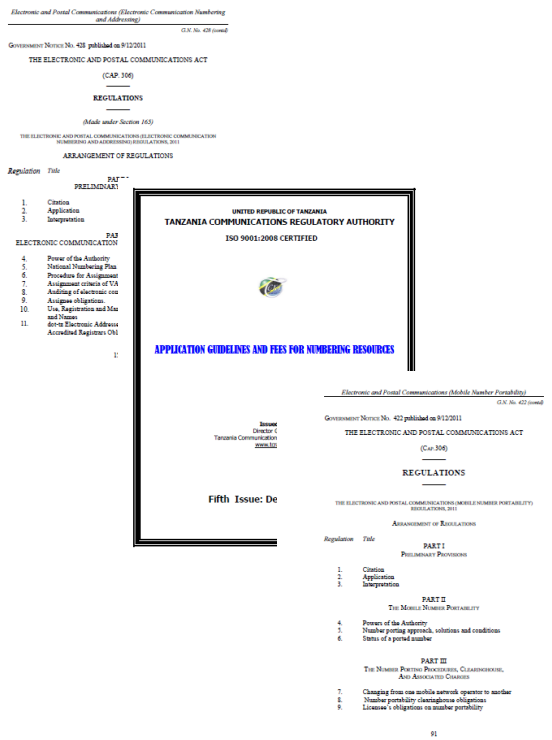
An example of a numbering register (Denmark)

1	Nummerserie Number Series	Tildelt til / Øremærket Assigned to / Earmarke	Fortrinsvist til brug for Mainly used for		Pris (kr.) Price (DKK)
553	1892		4-digit service number	10	kr 20,000.00
554	1893		4-digit service number	10	kr 20,000.00
555	1894		4-digit service number	10	kr 20,000.00
556	1895		4-digit service number	10	kr 20,000.00
557	1896		4-digit service number	10	kr 20,000.00
558	1897		4-digit service number	10	kr 20,000.00
559	1898		4-digit service number	10	kr 20,000.00
560	1899		4-digit service number	10	kr 20,000.00
561	19cdefgh		Reserve	1000	kr 2,000,000.00
562	200defgh		Reserve	100	kr 200,000.00
563	201defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
564	202defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
565	203defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
566	204defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
567	205defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
568	206defgh	Telenor	Mainly mobile communications	100	kr 200,000.00
569	207defgh	Telenor	Mainly mobile communications	100	kr 200,000.00
570	208defgh	Telenor	Mainly mobile communications	100	kr 200,000.00
571	209defgh	Telenor	Mainly mobile communications	100	kr 200,000.00
572	210defgh		Reserve	100	kr 200,000.00
573	211defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
574	212defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
575	213defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
576	214defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
577	215defhg	TDC A/S	Mainly mobile communications	100	kr 200,000.00
578	216defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
579	217defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
580	218defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00
581	219defgh	TDC A/S	Mainly mobile communications	100	kr 200,000.00

This spreadsheet has nearly 5,000 rows and changes often.

Some typical topics in a numbering regulation

- **Almost always:**
  - **Allocating numbers.**
  - **Conditions on the use of numbers.**
- **Very often:**
  - **Auditing numbering records.**
  - **Secondary allocation.**
  - **Number trading**
  - **Rights to the use of numbers.**
- **(Topics that are complicated or specialised, such as fees and portability, might be covered separately.)**



Please say what deserves most attention today.

Outline: part 2

1. Numbering overall
2. Numbering planning
   - Expectations from numbering
   - Numbering plans
   - Number formation
3. Numbering in relation to services
4. Numbering inventory management
5. Numbering user protection
6. Numbering user support
7. Numbering variants

User expectations from numbering

- **Making calls correctly:**
  - **Fairly short numbers (for ease of remembering and dialling).**
  - **Uniform number lengths and codes (even if they need longer numbers).**
- **Receiving calls correctly:**
  - **Infrequent number changes.**
  - **Options to keep numbers when changing premises or networks.**
  - **Avoiding numbers like ones called often (such as those of big hospitals).**
  - **Options to have memorable numbers.**
- **Deciding correctly whether and how to call:**
  - **Easily recognised information about services, locations and tariffs.**

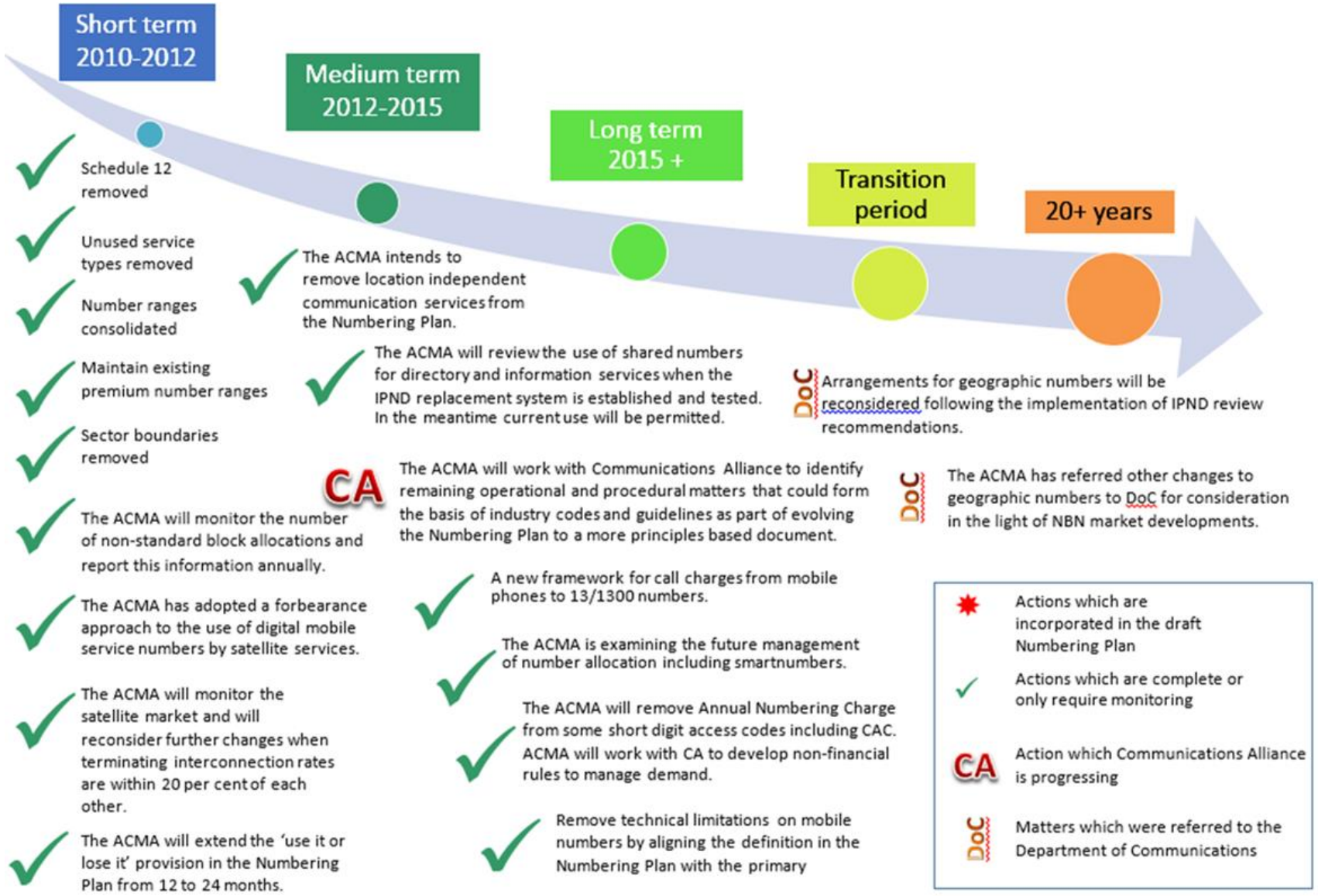
Operator expectations from numbering

- **Efficient network operation:**
  - **Information about routing and tariffs in the leading digits (for some technologies).**
  - **Uniform number lengths and codes (even if they need longer numbers).**
  - **Infrequent number changes.**
  - **No number clashes.**
- **Traffic stimulation:**
  - **Plentiful number supply.**
  - **Numbering encouraging network use.**
- **Reliable allocation process:**
  - **Fairness.**
  - **Simplicity.**

Regulator expectations from numbering

- Happy users and operators.
- Effective competition:
  - Number portability between access service providers (when the time is right).
  - Ability for callers to select long-distance service providers.
  - Harmonised short codes for essential services.
  - Some short codes for new uses.
- Easy administration and management:
  - Convenience in making careful allocations.
  - Sharing of codes between similar services.
  - Use of digits without waste.
  - Plentiful number supply.
  - Long term flexibility.
- No unnecessary complications.

An example of forward planning (Australia)

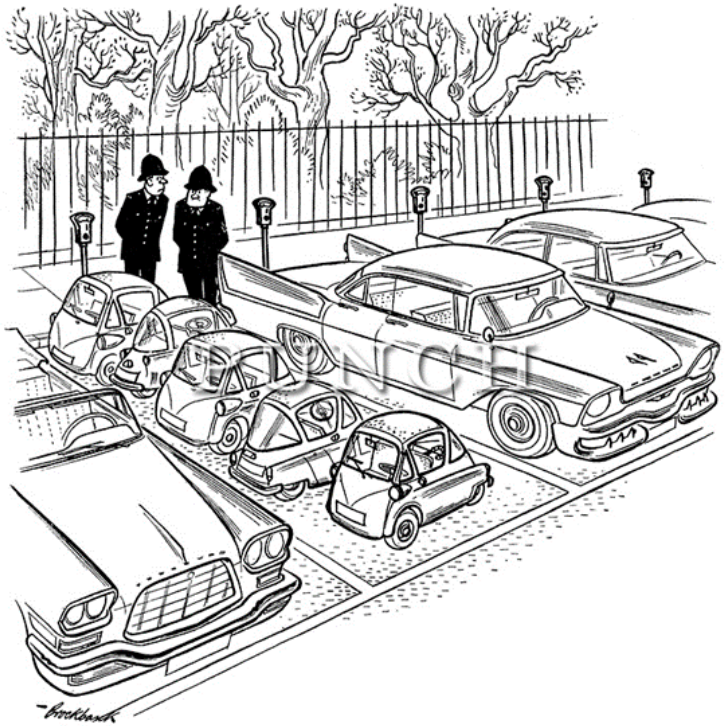


Good numbering plans are illustrated by tidy vegetable gardens

- Designate space for specific crops.
- Keep space for new crops.
- Let some crops grow upwards, while others grow along the ground.

Using digits without waste makes the supply of numbers last longer

- **One number with three digits takes as much space as one thousand numbers with six digits.**



Sharing codes between similar services makes things easier for users

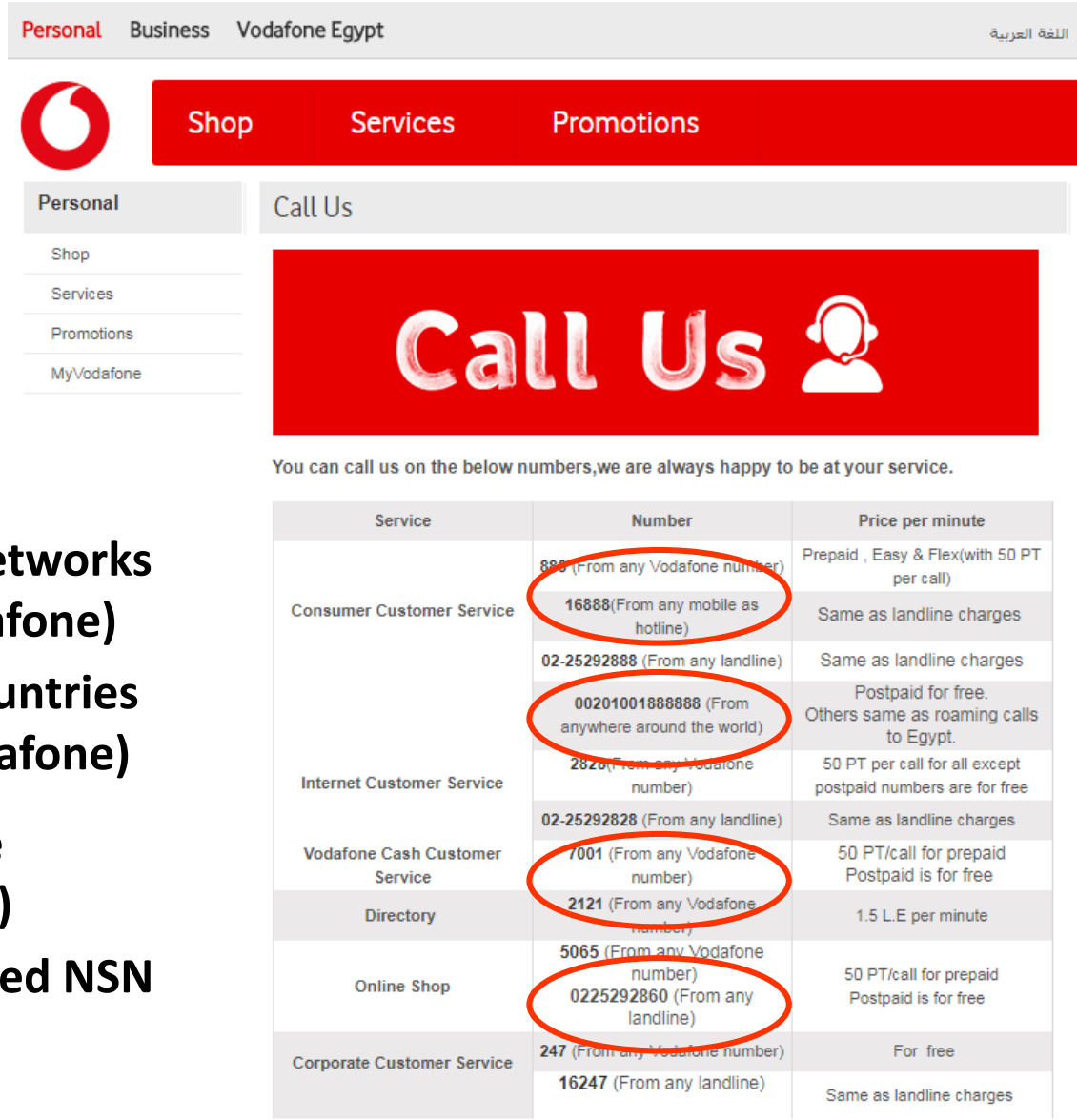
Numbering plans: recommendations

- **Allow for the unforeseen and for expansion some decades ahead:**
  - **Leave a way for any future number change to minimise disruption.**
  - **Leave some spare space for each first digit.**
- **Adopt good husbandry:**
  - **Make only helpful distinctions between services, locations and tariffs.**
  - **Ensure economical use of all allocations.**
- **Avoid unjustified divergences between countries:**
  - **Conform with appropriate ITU recommendations (on '00' and '0', in particular).**
  - **Keep in touch with other countries about numbering developments.**
- **Aim to meet the expectations of:**
  - **The users.**
  - **The operators.**
  - **The regulator.**

Number formation: codes

Country	Length				First digit			
	National Significant Number			Short Code	National Significant Number			Short Code
	Fixed	Mobile	Other		Fixed	Mobile	Other	
Bahrain	8	8	8	3-5	1	3	8, 9	0, 1, 8, 9
Burundi	8	8		3	2	6, 7		1, 7
Djibouti	8	8		2-4	2	7		1, 7
Egypt	7, 8, 10	10	7, 8, 10	3-6	2-9	1	7-9	1-9
Eritrea	7	7			1, 8	7		
Ethiopia	9	9	9	3	1-5	9	9	9
Ghana	9	9	9	3-6	3	2, 5	7-9	1, 4, 6
Jordan	8	9	8, 9	3-6	2, 3, 5, 6	7	7-9	1, 9
Kenya	6, 7, 8, 9			3-5	2, 4-6	1, 7	8, 9	1-9
Morocco	9	9	9	2-5	5	6, 7	8	1-9
Nigeria	7, 8, 10			3-5	1-9	7-9		1-9
Oman	8	8	8	2, 4-7	2	1	8, 9	0, 1, 9
Qatar	8	8	7	3-5	4	3, 5-7	8, 9	1, 9
Rwanda	8, 9			3	2	7	0, 8, 9	1, 4
Saudi Arabia	9	9	10, 12	3-6	1	5	8	1, 5-9
South Africa	10, 14			3-6	1-5	6-8	8, 9	1, 3, 4
Tanzania	9, 10			3-5	2	6, 7	4, 8, 9	0, 1
Tunisia	8	8	8	3-6	3, 7	2, 4, 5, 9	8	0, 1, 8
Uganda	6, 7, 8, 9			3-4	2-4	7	8, 9	1, 2, 6-9

Number formation: diversity



Personal Business Vodafone Egypt اللغة العربية

Shop Services Promotions

Personal

- Shop
- Services
- Promotions
- MyVodafone

Call Us

Call Us

You can call us on the below numbers,we are always happy to be at your service.

Service	Number	Price per minute
Consumer Customer Service	888 (From any Vodafone number)	Prepaid , Easy & Flex(with 50 PT per call)
	16888(From any mobile as hotline)	Same as landline charges
	02-25292888 (From any landline)	Same as landline charges
	00201001888888 (From anywhere around the world)	Postpaid for free. Others same as roaming calls to Egypt.
Internet Customer Service	2828(From any Vodafone number)	50 PT per call for all except postpaid numbers are for free
	02-25292828 (From any landline)	Same as landline charges
Vodafone Cash Customer Service	7001 (From any Vodafone number)	50 PT/call for prepaid Postpaid is for free
Directory	2121 (From any Vodafone number)	1.5 L.E per minute
Online Shop	5065 (From any Vodafone number) 0225292860 (From any landline)	50 PT/call for prepaid Postpaid is for free
Corporate Customer Service	247 (From any Vodafone number)	For free
	16247 (From any landline)	Same as landline charges

16: start of short codes on other networks (resembling a prefix to access Vodafone)

00: international prefix in many countries (followed by a mobile NSN for Vodafone)

2121: short code (not among those specified on the regulator web site)

0: national prefix (followed by a fixed NSN for Vodafone in Cairo)

Number formation: prefixes

Country	Prefixes	
	National	Inter-national
Bahrain	-	00
Burundi	-	00
Djibouti	-	00
Egypt	0	00
Eritrea	0	00
Ethiopia	0	00
Ghana	0	00
Jordan	0	00
Kenya	0	000
Morocco	0	00
Nigeria	0	009
Oman	-	00
Qatar	-	00
Rwanda	-	000
Saudi Arabia	0	00
South Africa	0	00
Tanzania	0	000
Tunisia	-	00
Uganda	0	000

Number formation: confusion

Communication of 20.VII.2014:

The *National Telecommunication Regulatory Authority (NTRA)*, Giza, announces updated ITU-T E.164 National Numbering Plan for Egypt.

a) General Survey:

Minimum number length (excluding country code): 3 digits
Maximum number length (excluding country code): 11 digits

NDC – National Destination Code or leading digits of N(S)N National Significant Number	*N(S)N Number Length*		*Usage of E.164 number*	*Additional Information*
	Maximum Length	*Minimum Length*		
1XX	3	3	Non-geographic number	Emergency Numbers
16XXX	5	5	Non-geographic number	Short Numbers
19XXX	5	5	Non-geographic number	Short numbers
0777	8	8	Non-geographic number	Free internet Numbers
0707	8	8	Non-geographic number	Free internet Numbers
0800	11	11	Non-geographic number	Premium rate numbers
0900	9	9	Non-geographic number	Premium rate numbers
010	11	11	Non-geographic number - Mobile telephony service	Vodafone
011	11	11	Non-geographic number - Mobile telephony service	Etisalat Masr
012	11	11	Non-geographic number - Mobile telephony service	Mobinil
2	9	9	Geographic Area Code	Cairo
3	8	8	Geographic Area Code	Alexandria
13	9	9	Geographic Area Code	Elqalubia

00: international prefix
20: country code for Egypt

Would a caller abroad dial 00 20 122?
122: "NSN" for police

Would a caller abroad dial 00 20 010 01888888?
010: "NDC" for Vodafone
01888888: service

Source: The ITU *Operational Bulletin*, 15 August 2014

Number formation: recommendations

- **Move towards lengths of numbers that are:**
  - **Uniform for all numbers having the same use and structure.**
  - **No longer than needed for the size of the population and the demand for numbers.**
- **Move towards codes in numbers that are:**
  - **Widely used.**
  - **Just those making distinctions helpful to users.**
- **Avoid confusing similarities between numbers by ensuring that:**
  - **NSNs and short codes do not start with the national prefix.**
  - **NSNs and short codes are not the same as the leading digits of other numbers.**
- **Promote one format for presenting numbers (or perhaps the two formats of E.123) showing clearly that:**
  - **Dialling from outside the country omits the national prefix before the NDC.**
  - **National dialling requires the national prefix before the NDC.**
- **Simplify contact details by arranging that everywhere inside the country:**
  - **Dialling as if from outside the country is permitted.**
  - **National dialling is permitted.**

Outline: part 3

1. Numbering overall
2. Numbering planning
3. Numbering in relation to services
   - Fixed numbers
   - Mobile numbers
   - Other numbers
   - VOIP numbers
   - IOT numbers
4. Numbering inventory management
5. Numbering user protection
6. Numbering user support
7. Numbering variants

Fixed and mobile numbers: current quantities

Country	Inhabitants (thousands)	Subscriptions per thousand inhabitants		Sq km area (thousands)	Subscriptions per thousand sq km area		Subscription ratio	
		Fixed	Mobile		Fixed	Mobile	Fixed/ Mobile	Mobile/ Fixed
Bahrain	1,448	170	1,630	1	321,778	3,085,281	0.104	10
Burundi	9,824	2	480	28	706	169,416	0.004	240
Djibouti	961	27	378	23	1,118	15,658	0.071	14
Egypt	89,125	71	1,136	1,002	6,315	101,044	0.063	16
Eritrea	6,895	10	73	118	584	4,266	0.137	7
Ethiopia	99,391	11	505	1,104	990	45,464	0.022	46
Ghana	27,043	11	1,385	240	1,239	156,061	0.008	130
Jordan	9,516	39	1,450	89	4,154	154,442	0.027	37
Kenya	45,533	2	813	580	157	63,825	0.002	407
Morocco	34,854	59	1,260	447	4,600	98,246	0.047	21
Nigeria	181,563	1	818	924	196	160,734	0.001	818
Oman	4,630	107	1,496	310	1,598	22,343	0.072	14
Qatar	2,570	145	1,761	12	32,164	390,624	0.082	12
Rwanda	11,324	1	699	26	430	300,534	0.001	699
Saudi Arabia	31,742	117	1,387	2,150	1,727	20,477	0.084	12
South Africa	54,957	66	1,424	1,221	2,971	64,094	0.046	22
Tanzania	51,046	2	744	945	108	40,189	0.003	372
Tunisia	11,118	86	1,258	164	5,830	85,283	0.068	15
Uganda	37,102	9	551	242	1,380	84,476	0.016	61

Fixed numbers: observations

- **Fixed number demand:**
  - **Remains relatively high where broadband is provided over fixed access.**
  - **Often needs too many small NDCs (reflecting previous distance-dependent tariffs).**
  - **Often takes too much numbering space, sparsely.**
- **Fixed number leading digits:**
  - **Indicate location and perhaps operator, technology or tariff.**
  - **Sometimes structure locations as trees (of regions, districts, switches, and cabinets).**
  - **Often start with lower first digits (‘1’, ‘2’, ‘3’,…).**
- **Location indications take priority over operator indications, as they help with:**
  - **Recognition of called locations.**
  - **Re-allocation of numbers already assigned by operators that fail.**
  - **Operator number portability.**
- **Location indications can be inaccurate, if they provide for:**
  - **Mobile access (in some countries and companies where called parties pay).**
  - **Nomadic access (by wireless local loops with limited mobility or otherwise).**
  - **Out of area access (for companies using central PBXs for local offices, for example).**

Fixed numbers: recommendations

- Estimate the maximum demand for fixed numbers from known data, such as:
  - The quantity of inhabitants.
  - The quantity of urban households.
  - The quantity of mobile subscriptions.
- Expect demand to be highest in national (or even provincial) capitals due to:
  - Assignments of large blocks (with 1,000 numbers, for example) to large companies.
  - Preferences for “capital” numbers if location indications can be inaccurate.
  - Higher proportions of smaller households (in some cases).
  - Extent of fixed broadband use (in some cases).
- Allow some fixed numbers having inaccurate location indications by being assigned outside the areas covered by their NDCs.
- Protect numbers having some leading digits, so that fixed numbers can be moved to free their numbering space for other uses.

Mobile numbers: observations

- **Mobile number demand:**
  - **Is likely to stay higher than for other numbers in many countries.**
  - **Needs increasing proportions of the numbering space, if subscriptions grow fast.**
- **Mobile number leading digits:**
  - **Indicate “mobile” and perhaps operator, technology or region.**
  - **Often start with higher first digits (‘7’, ‘8’, ‘9’,...).**

Mobile numbers: recommendations

- **Note that often adults form half the population and could need two or three SIMs each, especially if there is no number portability.**
- **Take account of numbers awaiting assignment in sales channels.**
- **Remember that more numbers might be needed if credit is to last for longer.**

Other numbers: observations

- Specific new services can have specific numbering requirements that need separate consideration.
- Some new services need distinctive numbers for ease of recognition. For instance:
  - '800' (or the variant '1800' or '0800') is often adopted for toll free services.
  - '900' is sometimes adopted for premium rate services.
- In many countries a first digit (or, failing that, NDCs with second digit '0') can be set aside for distinctive numbering for new services.
- Often few new service numbers actually become used. Such cases can include:
  - Corporate numbers (as in Netherlands).
  - Personal numbers (as in the UK).
  - Mass calling numbers (as in Australia).
  - Location independent numbers (as in Ireland).

Other numbers: recommendations

- **Protect numbers having certain first and second digits (typically ‘x0’) to allow new services to be given distinctive numbering if necessary.**
- **Introduce number ranges for new services only when demand is known, matching choices to specific service requirements.**

VOIP numbers: observations

- **Over-The-Top (OTT) services use the internet for communications but avoid the conventional operator switches.**
- **Some Internet Of Things (IOT) services are OTT services; others might be services that use existing fixed and mobile numbers.**
- **Voice Over IP (VOIP) services (with calls and messages) are the best known OTT services that sometimes need new numbers.**

VOIP numbers: sources of demand

Class	Mode of use	New numbers	Examples
Virtual number	Callers (typically abroad) dial it to be connected by forwarding to the number holder whose number has been associated with it.	One per customer	Skype Number, Google Voice, WeChat, Viber
Customised access number	The number holder dials it to be connected to someone (typically abroad) whose number has been associated with it.	One per average quantity of callers likely to fill a switch port	Skype To Go, Rebtel
Identification number	The holder of an existing number supplies it in order to subscribe to, or validate access to, the services.	None	WhatsApp, Viber

VOIP numbers: arguments for and against having a new range

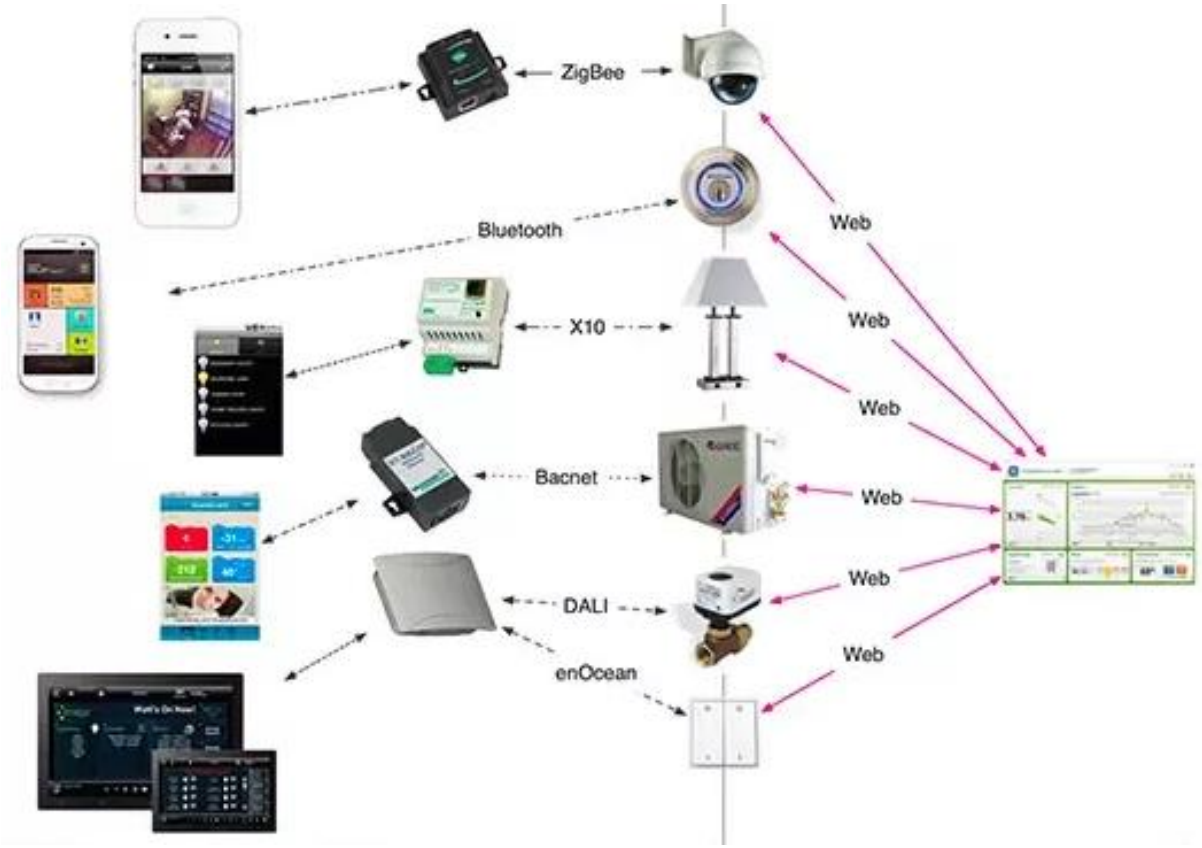
Argument	Claim
The numbers can indicate service intentions (location independent, personal, …).	For
The numbers can indicate media qualities (delay, noise, …).	For
Demand for fixed numbers in major cities does not grow unnecessarily.	For
Route determination in operator exchanges is not complicated further.	For
Fixed numbers can continue to be associated with fixed locations.	For
Users will expect the tariffs for the numbers to be like those for mobile numbers.	Against
Demand for the numbers will be low if it resembles that found elsewhere.	Against
Fixed numbers are not portable to and from the numbers.	Against

VOIP numbers: recommendations

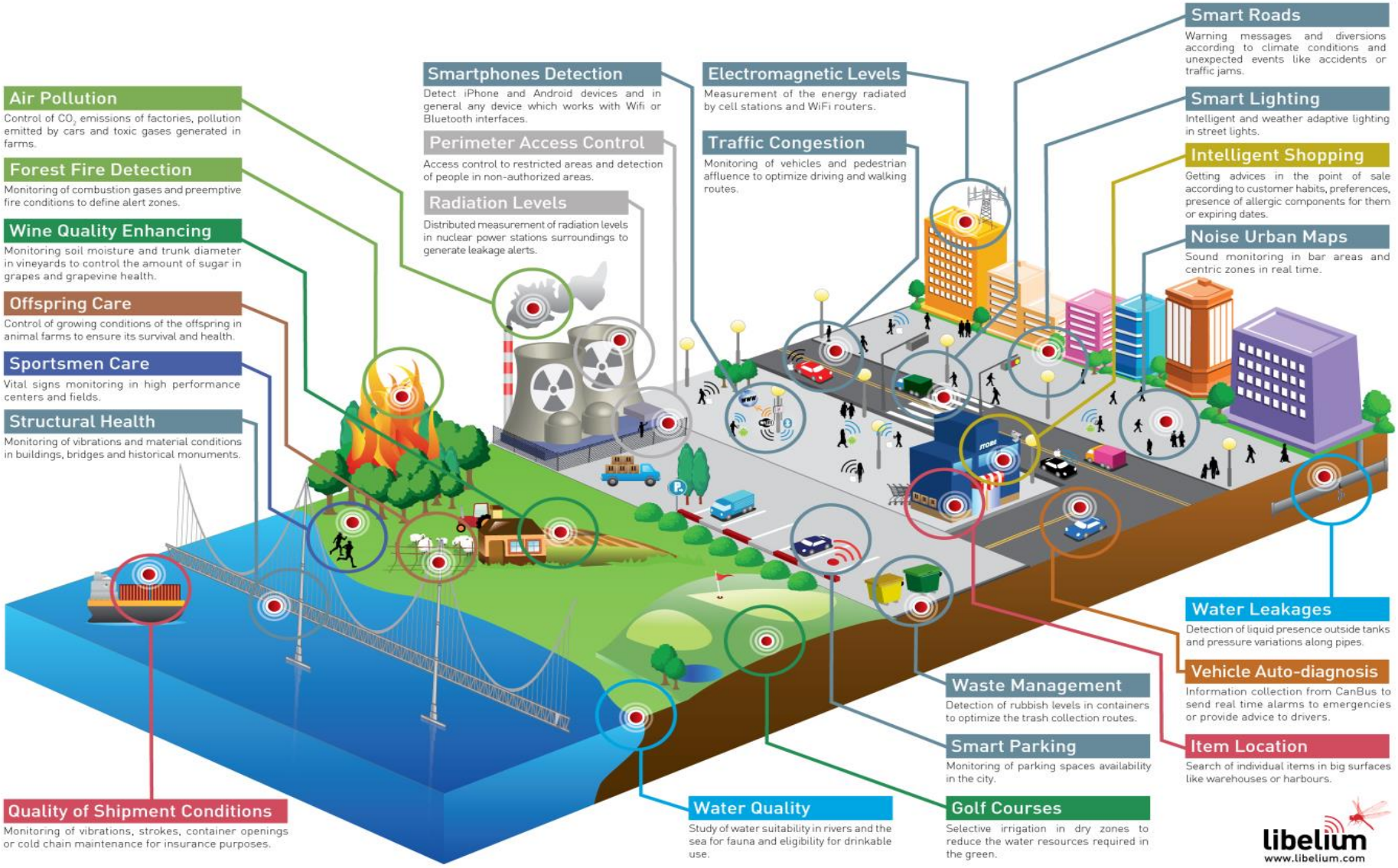
- **Introduce an NDC for location independent services, with typical mobile NSN length, only if there is a clear demand from users for which fixed numbers are unsuitable.**
- **Let VOIP use fixed NDCs even if there are location independent NDCs.**
- **Ensure that the tariffs associated with location independent NDCs are no higher than those for fixed NDCs.**

IOT numbers: observations

- The Internet Of Things (IOT) is likely to need billions of addresses worldwide.
- Many of these addresses are, or will be, Internet Protocol (IP) addresses; some are, or will be, phone numbers.
- IOT numbers can be used for existing machine related services, such as voice mail, as well as for new services.



IOT numbers: potential deployments



IOT numbers: arguments for and against having a new range

Argument	Claim
The services can have human-unfriendly numbers with 12 digits because machines have no difficulty in remembering or dialling long numbers.	For
The services might require billions of numbers (though demand could be very low for some years).	For
Users would be confused by accidentally making calls to, or receiving calls from, the numbers if they looked like conventional phone numbers.	For
Users will understand that the tariffs for the numbers will not be like those for mobile numbers.	For
Demand for the numbers will be high only until IP addresses with 128 bits are widely adopted.	Against
Devices such as wearable watches and fitness checkers do not always use phone numbers even when among the billions connected by mobile networks.	Against
Devices such as vehicle trackers and house alarms already use phone numbers without apparent harm.	Against
There are partial substitutes, such as adopting numbers under a shared mobile country code that is administered by ITU and provides international connectivity.	Against

IOT numbers: alternatives to using the numbers of national operators

- An IOT appliance manufacturer (such as a car maker) that uses current mobile networks can exploit existing mobile network mechanisms, such as:
  - Roaming, often still with high call and message charges, to deploy appliances temporarily or permanently outside their countries of origin.
  - Over-The-Air (OTA) programming of SIMs that are embedded UICCs, to have number portability in changes between operators.
- Frequently discussed alternatives are:
  - Using a shared mobile country code administered by ITU (to provide international connectivity without roaming between home and visitor networks).
  - Letting IOT appliance manufacturers have mobile network codes as if they were network operators (to provide number portability without OTA programming).
- Both alternatives entail:
  - Reducing the stocks of mobile country codes and mobile network codes.
  - Changing the assignment principles in E.212.

IOT numbers: recommendations

- **Introduce an NDC for IOT services, with maximum permitted NSN length, only if there is a clear demand for which mobile numbers are unsuitable.**
- **Encourage the conservation of existing number ranges.**

Outline: part 4

1. Numbering overall
2. Numbering planning
3. Numbering in relation to services
4. Numbering inventory management
   - Allocating numbers
   - Recycling numbers
   - Secondary allocation
   - Auditing numbering records
   - Charging for numbers
   - Changing numbers
5. Numbering user protection
6. Numbering user support
7. Numbering variants

The role of the regulator in numbering

- In monopoly days the incumbent operator looked after the numbering plan.
- If there is competition, neutral administration and management are needed.
- The regulator providing these is usually a government body of some kind.
- The duties include:
  - Developing the numbering plan for the short term and the long term.
  - Consulting all concerned, to meet the needs of users and operators.
  - Maintaining an accessible numbering register.
  - Implementing a clear numbering regulation.
  - Allocating and withdrawing numbers.
  - Resolving disputes.
- The work might be reduced by:
  - Appointing an agent (as with NANPA in North America).
  - Having an industry body open to all (as with WASPA in South Africa).
  - Delegating allocation (so large operators sub-allocate to smaller ones).
  - Automating systems.
  - Allocating larger blocks.

Delegation and automation are not simple solutions…

Activities in numbering

Task	Administrative →				Managerial
Frequency	High →				Low
Regulator	Publishes the numbering register	Keeps records of allocated numbers; allocates numbers	Audits the numbering register	Consults on numbering plan and numbering regulation	Determines changes to numbering plan and numbering regulation
Operator	Keeps records of assigned numbers; assigns numbers	Applies for allocations of numbers; provides connections for numbers	Reports the quantity and use of numbers	Highlights future needs for numbers	Implements changes to numbering plan and numbering regulation

The numbering regulation formalises the responsibilities for such activities.

Allocating numbers: principles

- The regulator protects numbers from allocation, if for example:
  - The numbers are not needed yet.
  - The numbers are easy to confuse with some that can be used.
- The regulator frees numbers for allocation, if for example:
  - The numbers are likely to be needed soon.
- [The regulator reserves numbers for an operator, if for example:
  - The numbers are likely to be used in the same ways as adjacent allocated numbers.
  - The numbers are proposed to be used in a competing bid to serve a company.]
- The regulator allocates numbers to an operator, if for example:
  - The numbers are projected to be used within a limited period (such as 6 months).
- The regulator withdraws numbers from an operator, if for example:
  - The numbers are not used.
  - The numbers are used for inappropriate services or with inappropriate pricing.

Allocating numbers: states

Protected from allocation

Free for allocation (for a particular use)

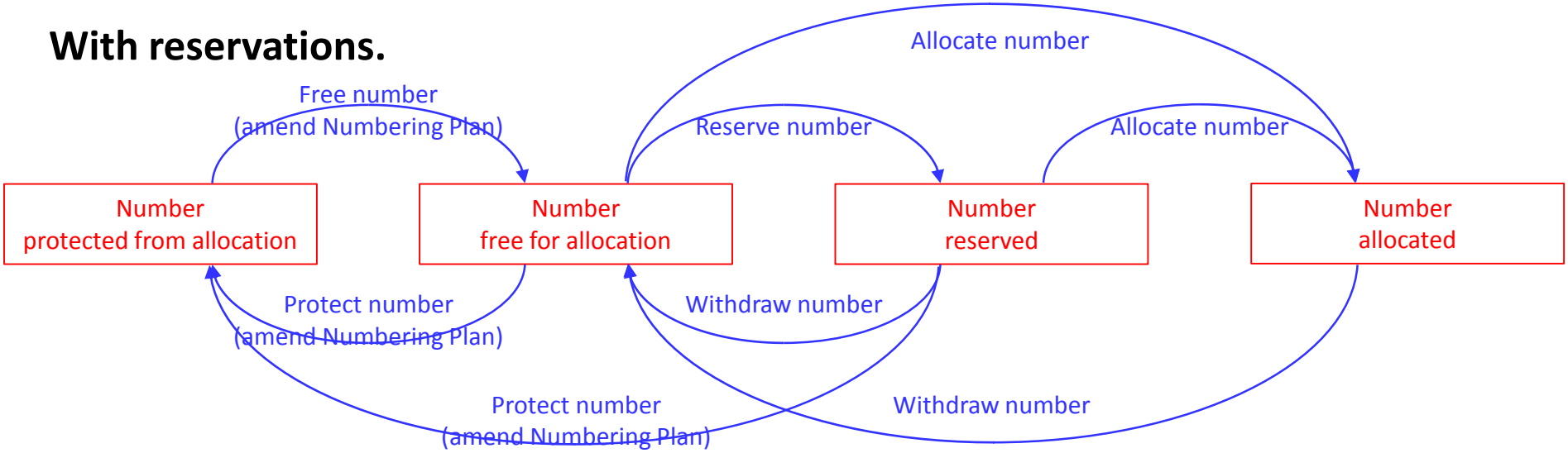
[Reserved (for a particular operator)]

Allocated (to a particular operator)

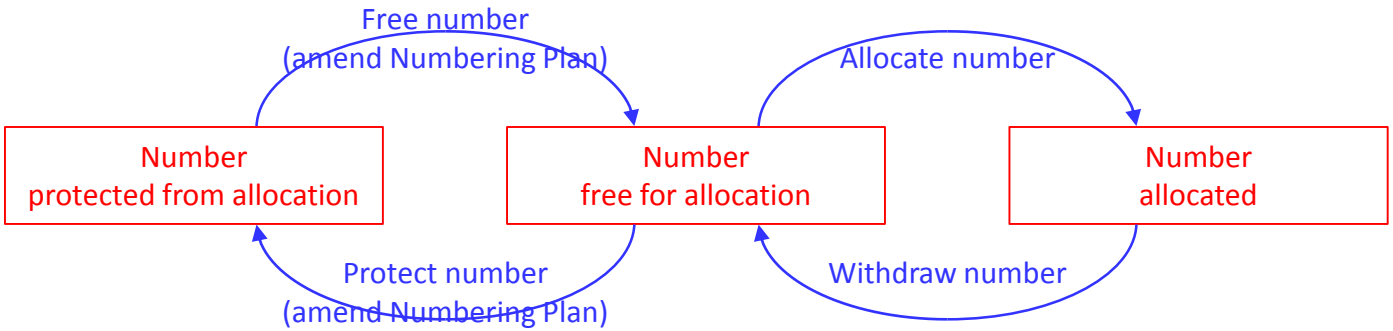
Assigned (to a particular user)
(distinguished from other 'allocated' statuses only in the records held by the operator)

Allocating numbers: transitions

With reservations.



Without reservations.



All transitions require updates to the numbering register.

Reservations are rarely used enough to justify the complication of having them.

Utilisation thresholds: observations

- The utilisation is the proportion of a number allocation that is used.
  - Numbers assigned to users count as “used”.
  - Numbers in sales channels waiting for assignment sometimes count as “used”.
- Existing number allocations might need to reach a utilisation threshold before new allocations are allowed to that operator for that service.
- When expansion is fast many unassigned numbers are in sales channels, but:
  - If the numbers count as “used”, thresholds can lose their meanings.
  - If the numbers do not count as “used”, thresholds might need to vary by operator (and in time) to be fair.
- An alternative to reaching a utilisation threshold is forecasting few months to exhaust (used by NANPA). This seems to be fair and quite stable over time but needs reasonable estimates of likely demand for numbers.

Block sizes: observations

- The length of a number is the quantity of digits in it.
- Often numbers are allocated in solid blocks from 000… to 999… for n 0's and 9's (giving 10^n numbers of length n in the block). For instance:
  - There are 10^4=10,000 numbers having length 4 in the solid block from 0000 to 9999.
- The block size here is 10^n.
- If numbers are allowed to be shorter than n then there will be fewer of them in the block). For instance:
  - If '112' is used in the solid block from 0000 to 9999 there are only 10,000-9=9,991 numbers (as '112x', with four digits, is not available).
- The block size for an allocation depends on:
  - The use and structure of the numbers.
  - The availability of numbers with the same use and structure.
  - Any limits on where (or even when) the numbers can be used.
  - The speed of development of the service.
  - Any special conditions on the service (for premium rate purposes, for example).

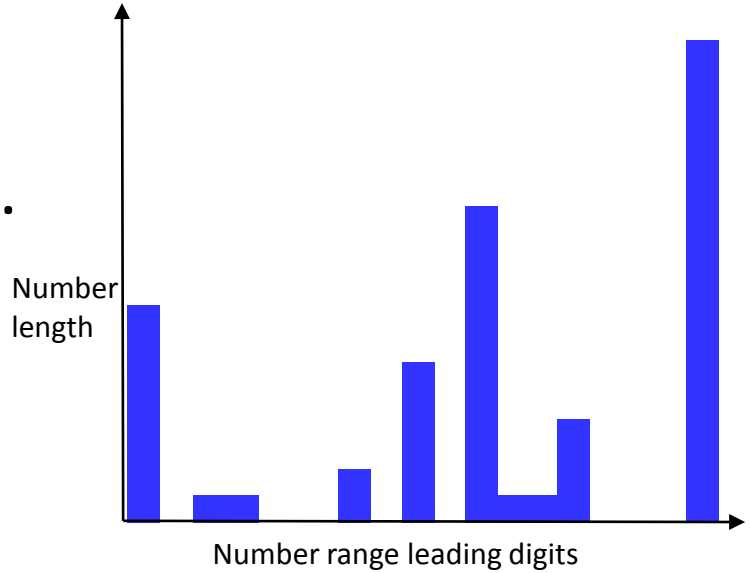
Allocating numbers: thresholds and sizes

Countrys	Lowest utilisation threshold				Lowest block size			
	National Significant Number			Short Code	National Significant Number			Short Code
	Fixed	Mobile	Other		Fixed	Mobile	Other	
Bahrain					10,000	10,000	1,000	1
Burundi								
Djibouti								
Egypt					10,000	100,000	1	1
Eritrea								
Ethiopia								
Ghana								
Jordan	70%	80%	80%	100%	10,000	100,000	100	1
Kenya	80%	80%	80%	100%				
Morocco								
Nigeria								
Oman					1,000	100,000	1	1
Qatar	70%	70%	70%	100%	1,000	100,000	1	1
Rwanda	70%	70%	70%	100%	10,000	10,000		
Saudi Arabia	65%	65%	75%	100%	1,000	100,000	1,000	1
South Africa	60%	80%	60%	100%				1
Tanzania								
Tunisia	90%	90%	90%	100%				1
Uganda	75%	75%	75%	100%	10,000	10,000	1,000	1

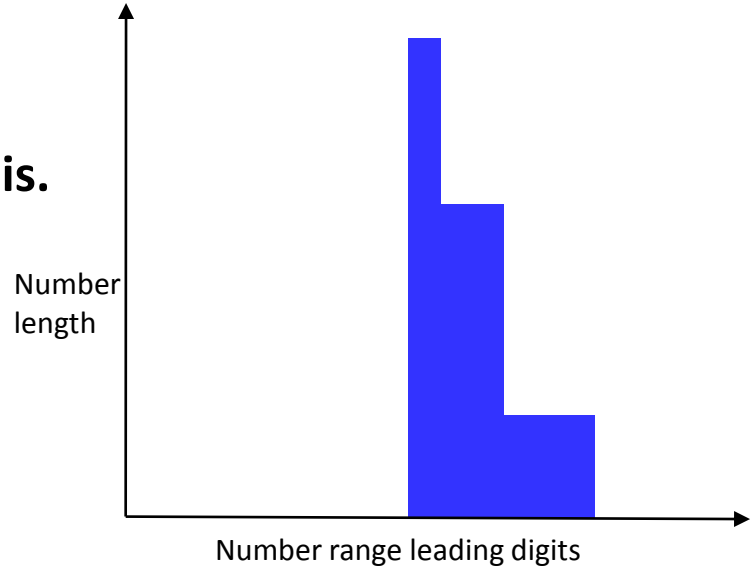
Where a threshold or size does not seem to have been set the entry is blank.

Good numbering plans are illustrated by tidy vegetable gardens

Not like this.



More like this.



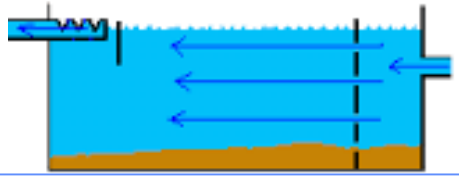
Allocating numbers: recommendations

- Use the states ‘protected’, ‘free’ and ‘allocated’ (but not ‘reserved’).
- When assessing applications for new numbers, establish need by looking at utilisation of existing numbers or at time to exhaust.
- Put new allocations alongside existing allocations with the same use and block size.
- Grant or refuse applications for allocations within 30 days of receiving them, unless they need changes to the numbering plan or numbering regulation.
- Withdraw allocated blocks if after a lengthy period none of the numbers have been assigned.

Recycling numbers: statuses

From Not distributed to Not sold

From Not sold to Active



‘Use it or lose it’

From Deactivated to Cooled after cooling period

From Cooled to Not distributed

From Active to Deactivated after inactive period

Here, “Assigned” means “Active or Deactivated or Cooled”

Recycling numbers: periods

- Churn feeds the pool of numbers for recycling: if calls are not made to or from numbers for an inactive period the numbers can be successively:
  - Deactivated (when they can no longer be used to make calls except emergency calls).
  - Cooled (when they are no longer likely to receive calls for the previous user).
  - Returned to the number supply pipeline.
- Longer inactive and cooling periods need more numbers, but:
  - Longer inactive periods are more likely to let former users spend their credit.
  - Longer cooling periods are more likely to leave new users free from nuisance.
- If there is no shortage of numbers, there are reasons for:
  - Favouring user-friendliness over economy in number use.
  - Limiting regulatory intervention to actions to ensure competitive fairness.
- These call for:
  - Imposing a minimum inactive period to help users recover their numbers.
  - Imposing a maximum cooling period to prevent number hoarding.
- However, counting the quantities of active subscribers needs an inactive period that is independent of the operators.

Recycling numbers: recommendations

- **Adopt a minimum inactive period such that (as in India):**
  - **"Activity" includes receiving and making calls, sending texts and topping up credit.**
  - **A user has at least 90 days from the last activity to be warned of impending deactivation and at least 15 days thereafter to stop deactivation.**
  - **Deactivation does not happen if the credit balance is higher than USD 0.3 (say) or the user subscribes to a number retention scheme.**
  - **All this is made clear to the user.**
- **Adopt a maximum cooling period of a calendar year but change it (after consultation) if there are good reasons for doing so.**

Secondary allocation: observations

- **Responsibilities for allocating numbers can be delegated:**
  - **A primary allocation is an allocation of numbers by the regulator to an operator (who becomes the number holder).**
  - **A secondary allocation is an allocation of numbers by an operator to someone for providing public telecommunications services (not for connecting their premises).**
- **Secondary allocations can avoid burdensome applications for small quantities of numbers:**
  - **By payphone operators that need only few numbers in each geographic area.**
  - **By service resellers that leave network operations completely to the operators.**
  - **By value added service providers that offer content to specialised groups or for limited times (to provide world cup results, for example).**

Secondary allocation: recommendations

- **Let number holders make secondary allocations, in which they allocate to others some of the numbers that they hold.**
- **Require number holders to remain responsible for compliance with the numbering regulation for any numbers that they allocate to others.**

Auditing numbering records: observations

- The sources of information on the numbers held by operators include:
  - The ITU *Operational Bulletin* (published fortnightly).
  - The ITU web site on national numbering plans.
  - The details of advertisements and directories.
  - The price tables of international call resellers.
- These are not always up-to-date.
- One authoritative national numbering register is needed to:
  - Eliminate negotiations about numbering between operators.
  - Make space available for new operators and new uses.
  - Avoid clashes between new uses and existing uses.
  - Allow the planning of future developments.

New number allocations are not safe if existing number allocations are not recorded.

Auditing numbering records: recommendations

- **Compile the numbering register first from the records held by the operators.**
- **Conduct regular audits to keep consistency between the numbering register and the records held by the operators.**
- **Keep number holders responsible for reporting on any secondary allocations made from their primary allocations.**
- **Examine current and projected utilisations.**

Charging for numbers: observations

- Charges are becoming more usual but remain fairly low.
- Charges might be levied:
  - Initially (at the time of application or at the time of allocation).
  - Annually.
- Charges might relate to:
  - Administrative cost.
  - Economic value.
  - Number scarcity (as in the UK in some cases).
  - Number length (as in Australia and Saudi Arabia in some cases).

Charging for numbers: fees

Country	Lowest initial fee (USD/number)				Lowest annual fee (USD/number)			
	National Significant Number			Short Code	National Significant Number			Short Code
	Fixed	Mobile	Other		Fixed	Mobile	Other	
Bahrain	0.0065	0.0065	0.0065	65	0.26	0.26	0.26	260
Burundi								
Djibouti								
Egypt								
Eritrea								
Ethiopia								
Ghana	0	0	0	22	0.014	0.072	8.80	33
Jordan								
Kenya								
Morocco								
Nigeria	3	3			0	0		
Oman	0.065	0.065	65	650				
Qatar	0	0	0	0	0	0	0	0
Rwanda	0.006	0.006	0.006		0.96	0.96	0.96	
Saudi Arabia	0.027	0.027	0.027	1,350	0.081	0.081	0.081	405
South Africa	0	0	0	0	0	0	0	0
Tanzania	0	0	2,000		0.20	0.20	1,000	
Tunisia	0	0	0		0.06	0.10	0.40	
Uganda	0	0	0	0	0	0	0	0

Where a fee does not seem to have been set the entry is blank.

Charging for numbers: arguments for and against introducing it

Argument	Claim
Charges provide revenues for the regulator.	For
Charges encourage the conservation of numbers (if they are high enough).	For
Charges can help to remove inappropriate competitive advantages (when one operator has shorter numbers than another, for example).	For
Charges encourage the use of numbers in those ways that are most highly valued (if they reflect actual values).	For
Sales taxes can achieve the same result as charges.	Against
There is no shortage of numbers.	Against
The administrative burdens for the regulator and the operators are unnecessary, because revenue is raised also in other ways.	Against
Payment could suggest ownership, not just granting of rights of use, as warned by the Federal Communications Commission (FCC) of the United States (US).	Against

Charging for numbers: recommendations

- **Review regularly whether incentives for avoiding the waste of numbers are needed.**
- **Retain powers to charge for numbers, at levels expected to avoid the waste if the incentives are needed.**
- **Charge every allocation as if it has the size determined by the maximum length stated in the numbering plan for numbers in the allocation (if charges exist).**

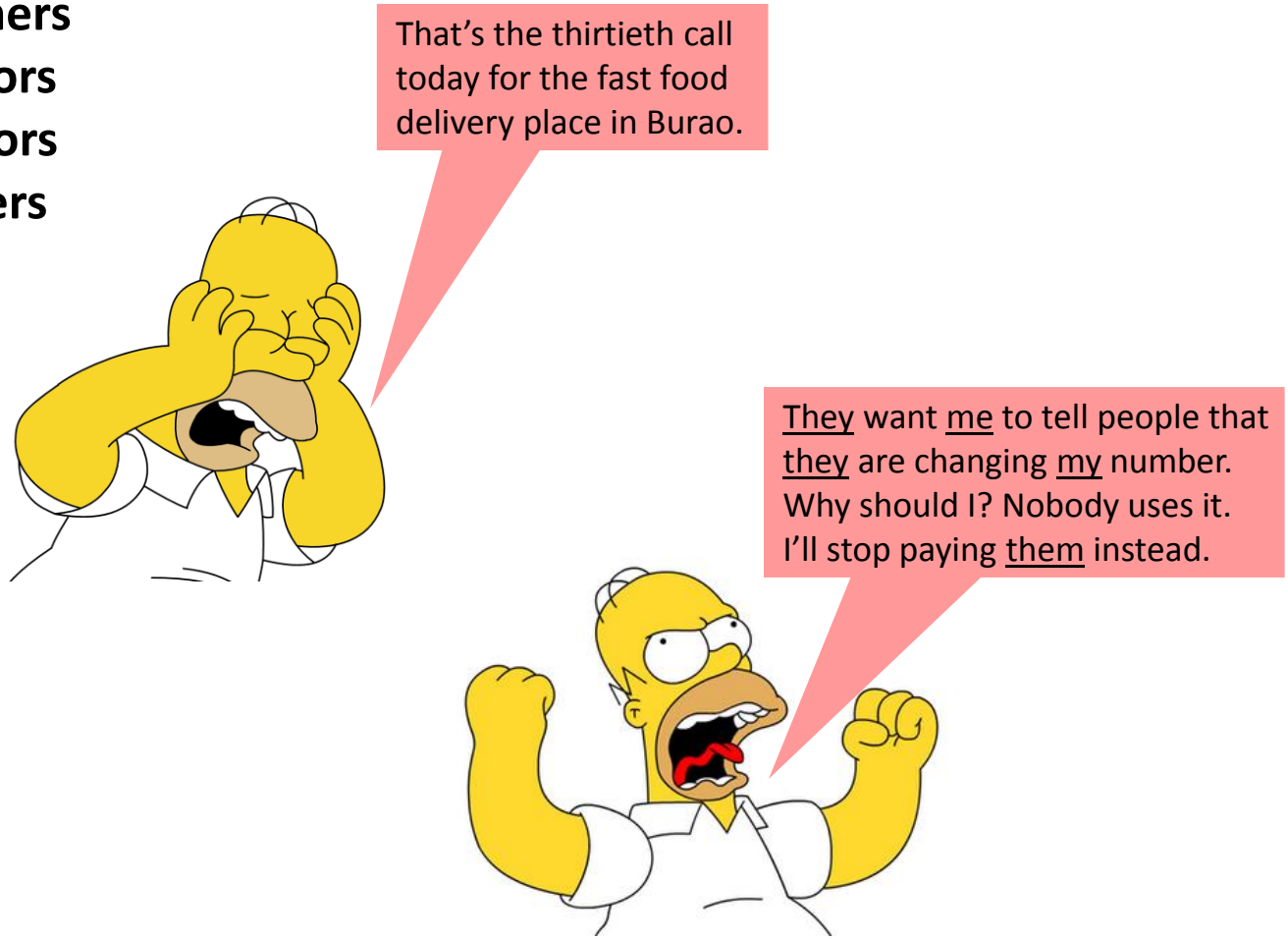
Changing numbers: motivations

Reason for number changes	Alternative to number changes
Introduce attractive spaces for new services	Change NDCs but not subscriber numbers
Create new contiguous numbering spaces	Conserve existing contiguous numbering spaces
Create new matching subscriber numbers in different NDCs	Conserve existing matching subscriber numbers in different NDCs
Make subscriber number lengths uniform	Require uniform lengths in new allocations
Merge NDCs to reduce their quantity	Move subscriber numbers between NDCs
Align NDCs with administrative areas	Cut long-distance tariffs for callers nearby
Identify nodes from subscriber numbers	Improve the operator data base system
Make all subscriber numbers be different	Disallow local dialling
Reduce number range charges on equipment	Negotiate with vendors of equipment

The objectives of changing numbers can often be achieved in other ways.

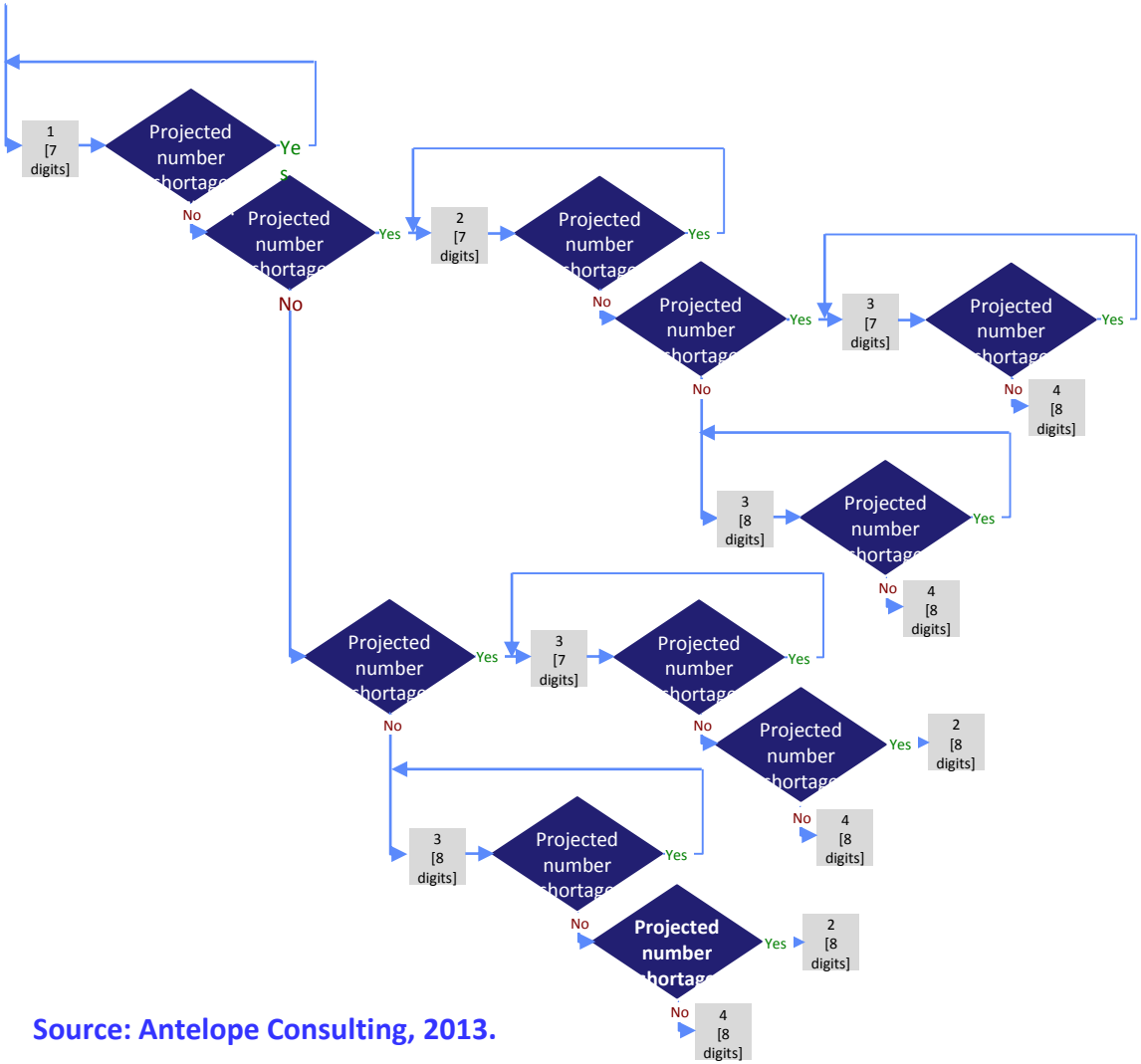
Changing numbers: implications

- **Costs to customers**
- **Costs to operators**
- **Error by operators**
- **Loss of customers**



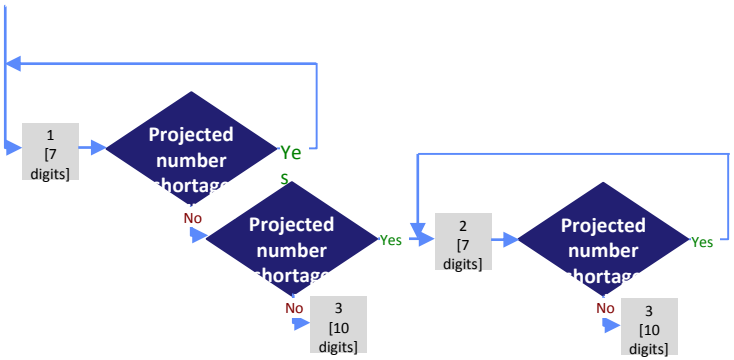
Some plans are harder to change than others

Options for changes to fixed numbers in Ireland



Source: Antelope Consulting, 2013.

Options for changes to mobile numbers in Ireland



Source: Antelope Consulting, 2013.

Changing numbers: implementation

- **Users want:**
  - **Advance publicity (far enough ahead for diary publishers).**
  - **Parallel running (which can influence the chosen change).**
  - **Changed number announcements or other warnings of incorrect dialling.**
  - **Support for changes to their equipment (such as payphones and automatic alarms).**
- **Operators should think about how number changes affect:**
  - **Exchanges of different types (with changes phased to reduce risk).**
  - **Operational support systems that store or use phone numbers.**
  - **International exchanges of overseas correspondent operators.**
- **Regulators should ensure that there is:**
  - **Wide consultation before making decisions.**
  - **Convincing public justification.**
  - **Sufficient advance notice.**
  - **Widespread clear publicity.**

Changing numbers: recommendations

- **Require good cost-benefit or social arguments for changes, especially as:**
  - **Changes cost very much more for users than for operators.**
  - **Changes cost more than ways of conserving or introducing numbers.**
- **Make any changes easy for users to accept by, for example:**
  - **Minimising how many small businesses are affected.**
  - **Having the same changes throughout one NDC.**
  - **Changing just the leading digits.**
  - **Doing all changes together.**
- **Ensure that after all this effort and expense there are enough numbers for the foreseeable future.**

Outline: part 5

1. Numbering overall
2. Numbering planning
3. Numbering in relation to services
4. Numbering inventory management
5. Numbering user protection
   - Rights to the use of numbers
   - Misuse of numbers
6. Numbering user support
7. Numbering variants

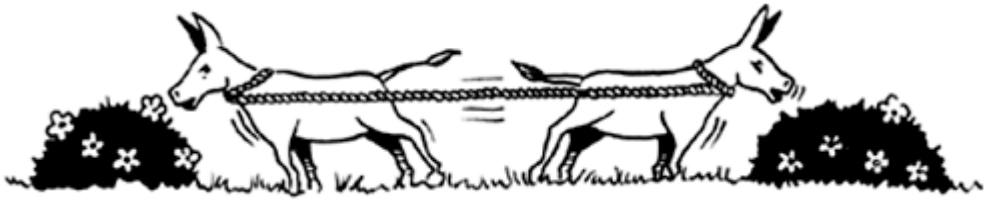
Widespread rights of customers with assigned numbers

- **Having uninterrupted use of unchanged numbers, subject to:**
  - **Adherence to the contract.**
  - **Compliance with the numbering plan and numbering regulation.**
  - **Practical considerations (such as exchange areas and portability details).**
- **Publicising and hiding numbers through the use of advertisements, directories and 'do not call' registers (for both fixed and mobile numbers).**
- **Avoiding unwanted calls, whether inconvenient, malicious, fraudulent, from sales people, or for popular incorrectly dialled numbers.**
- **Keeping inactive numbers, subject to:**
  - **Any 'enhanced rights of use', lengthening the 'use it or lose it' period.**
  - **Controls on number hoarding.**
- **Choosing preferred numbers.**
- **Using numbers as identifiers.**
- **Buying and selling numbers.**

The rights are held by the customers, not the operators.

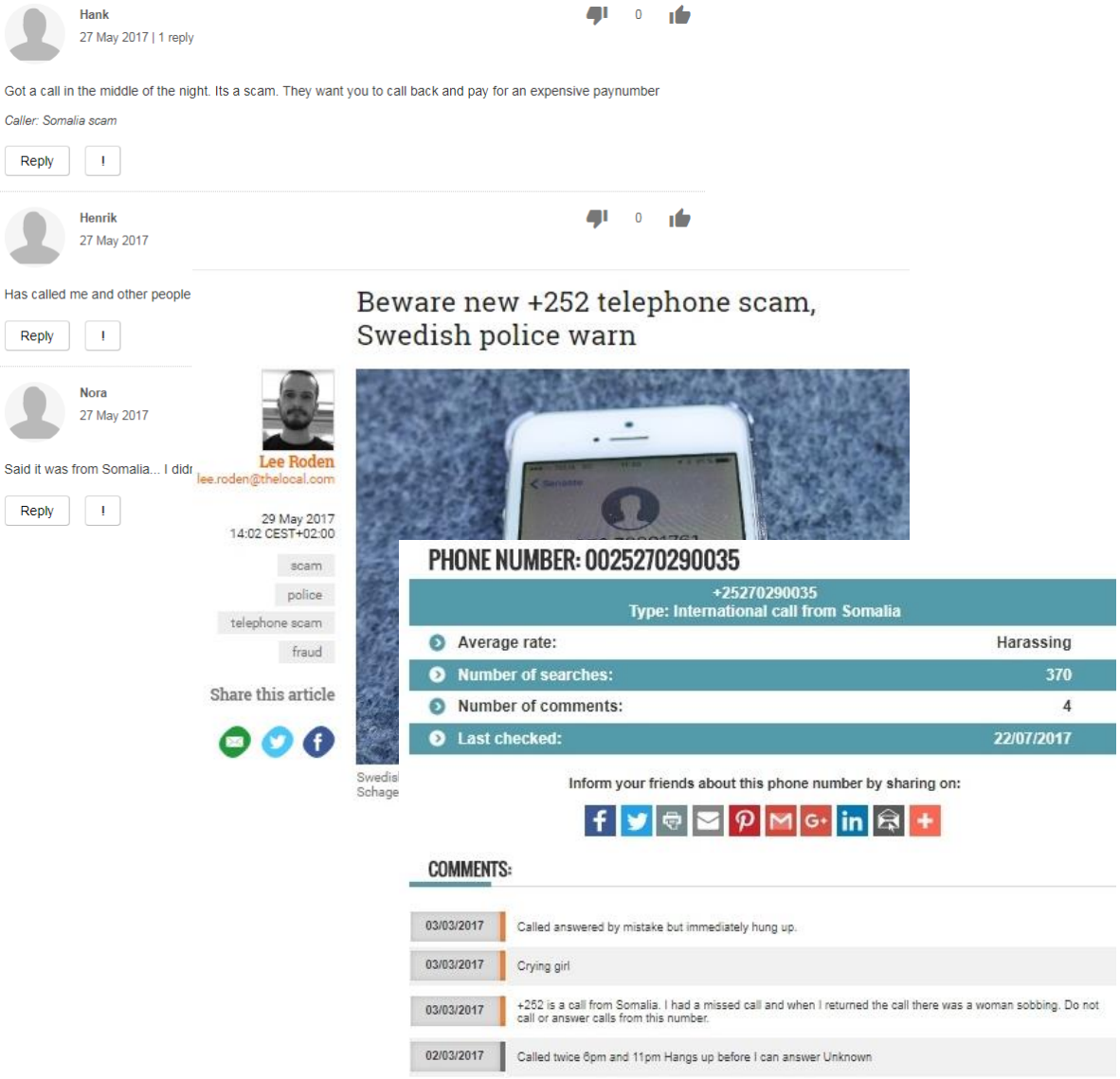
Widespread rights of callers

Right	Problem
Having access to directories of numbers, both fixed and mobile	Conflict with the right of others to hide their numbers
Recognising useful information (such as call costs) in numbers	Loss of such information in calls to numbers ported off-net without keeping on-net prices
Hiding calling numbers to prevent inconvenient or malicious calls back	Evasion of checks on calling numbers by call centres making unwanted calls

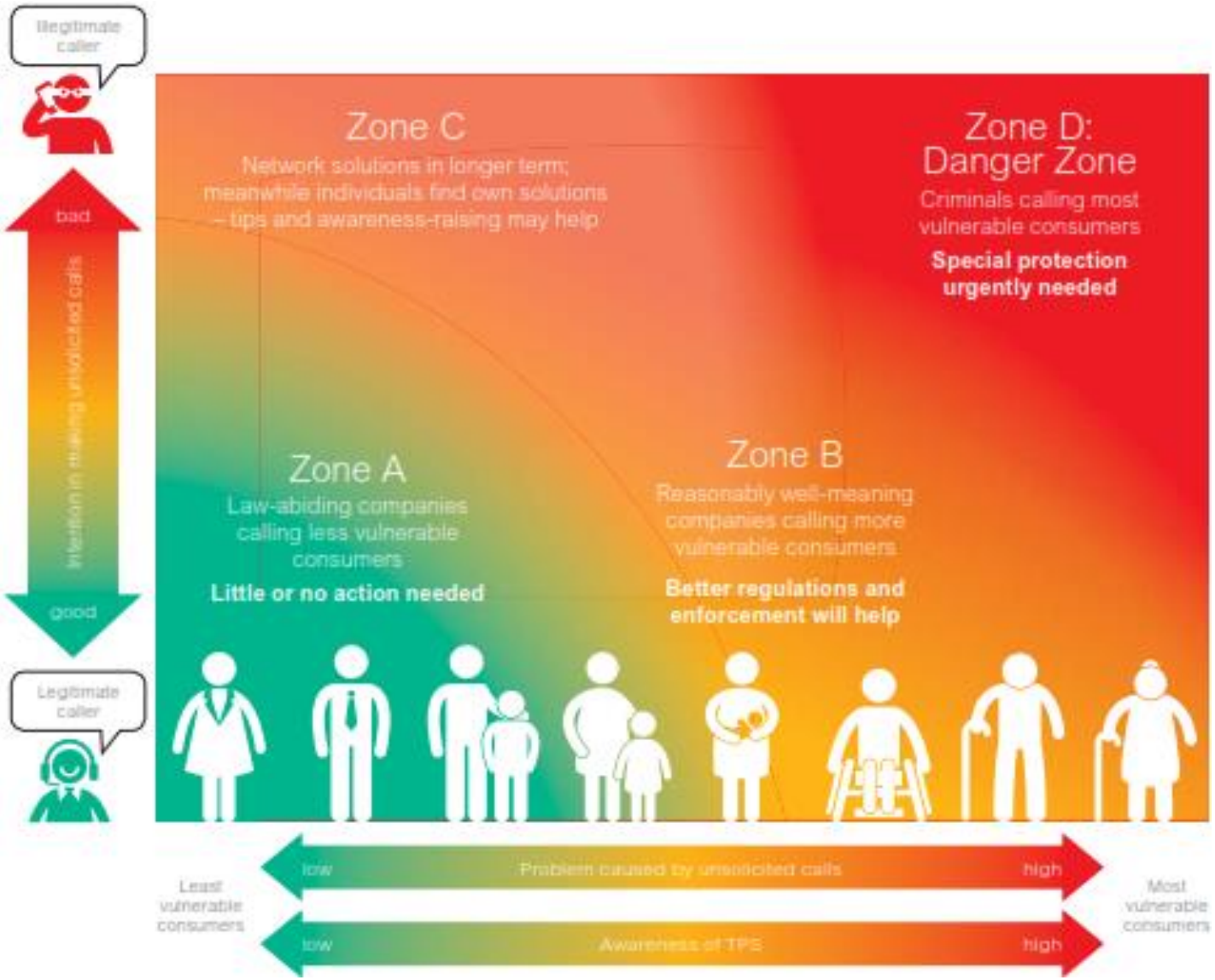


Misuse of numbers: observations

- One current problem is that users are tricked into calling back numbers to which high tariffs apply.
- An earlier problem was that content service providers used international numbers to evade premium rate service rules.
- Several such problems are discussed in E.156.
- The problems, and the solutions, are often not just related to numbering.



Misuse of numbers: two problem dimensions



Hiding or falsifying calling numbers: one case

- **Criminal activities:**
  - **Make calls from numbers appearing to be those for banks, couriers or government offices.**
  - **Get ("check") the security details and personal information.**
  - **Empty any associated accounts.**
  - **Sell the personal information.**
- **Regulatory possibilities:**
  - **Protect from allocation potentially misleading numbers.**
  - **Warn people to check incoming call numbers.**
  - **Divert incoming calls from suspect origins.**

SINGAPORE: The police have issued an advisory to remind the public to be wary of receiving calls from unknown parties, citing a re-emergence of phone impersonation scams.

Members of the public have received calls purportedly from courier companies or government officials, the police said in their advisory on Thursday (Dec 7).

In one scenario, the caller claimed that a parcel under the recipient's name containing illegal goods was detained by the Chinese Customs. The call was then transferred to another person who identified himself as a police officer.

In other cases, the caller alleged that the recipient had committed a criminal offence and was required to assist in criminal investigations.

The scammer would then direct the recipient to provide his personal details, including Internet banking credentials and one-time passwords (OTP), to the "government officer" for investigation purposes.

A sum of money would then be transferred out of their bank account into other unknown bank accounts.

Source: *Channel News Asia*, 7 December 2017

Hiding or falsifying calling numbers: further cases

- **Activities with bad intentions:**
  - **Launching floods of calls to prevent the receipt of legitimate calls.**
  - **Dialling automated sales and marketing calls and messages.**
  - **Causing electricity and water to be disconnected.**
  - **Prompting responses to fictitious emergencies.**
  - **Breaking into voice mail systems that rely just on calling numbers for identification.**
- **Activities with good intentions:**
  - **Call and message forwarding.**
  - **Staying safe from violent former partners.**
  - **Preserving privacy after using personal phones for work.**
  - **Presenting client company numbers in calls from call centres.**

Calling numbers might be omitted or falsified for good or bad reasons.

Hiding or falsifying calling numbers: checks for suspect origins

- **Calls and messages with suspect origins:**
  - **Can arise in many ways, especially as PBXs with IP can 'spoof' calling numbers.**
  - **Must not be barred (in some countries) .**
  - **Might be diverted.**
- **Checks on calling numbers:**
  - **Might detect suspect origins.**
  - **Do not distinguish between good and bad reasons for hiding and falsifying numbers.**
  - **Can be difficult or impossible to make except near the originators.**

Check on calling numbers	Knowledge needed
Present	
Conforming with E.164	List of E.164 country codes
Allocated or free for allocation	Numbering plan for the originating country
Allocated	Numbering register for the originating country
Assigned to a user	Information confidential to the originating operator

Hiding or falsifying calling numbers: alternatives to simple checks

- Checks on calling numbers can produce false positives and false negatives.
- Possible ways of detecting calls and messages that should be diverted are:
  - Certification of calling numbers from near the originators of calls and messages (with protocols and organisations as specified by STIR and, in the US, SHAKEN).
  - Classification according to arrival patterns and metadata (such as calling numbers) but not according to content (by contrast with statistical classification of email).
- These ways rather resemble those of detecting email that is spam.

Wangiri (Japanese "one [ring] and hang up"): one case

- **Criminal activities:**
  - **Leave 'missed call' messages, usually from premium rate numbers.**
  - **Collect revenues when people call back, optionally 'stopping the calls short' before they reach the country.**
- **Regulatory possibilities:**
  - **Require services to be prepaid.**
  - **Bar international calls to premium rate numbers.**
  - **Withdraw from allocation unused numbers.**
  - **Lower international call termination charges.**
  - **Divert incoming calls from suspect origins.**
  - **Bar outgoing calls to suspect destinations.**

Thousands of phone users across all the Irish mobile networks have been targeted since the beginning of the week in a telephone scam which sees fraudsters dialling from numbers in Liberia and Chad and immediately disconnecting in the hope those who are targeted will call back.

Once they do return the missed call they will be re-routed to premium rate number overseas and will be subsequently billed exorbitant sums for the privilege of listening to pre-recorded messages.

The scam, commonly known as Wangiri fraud, sees scam artists use phone numbers bought on the dark web (where criminals trade in illegal goods and services) to dial phone users in other countries and then immediately disconnect the calls to them.

The aim of the scam is to encourage those who see a missed call on their phone to ring the number, after which they will be ripped off.

When this newspaper called a Liberian number on Wednesday afternoon to ascertain the nature of the scam, we were connected to an automated conversation featuring a woman who appeared to be speaking Arabic.

In order to avoid being scammed, the best and only advice is to not to do what *The Irish Times* did.

People who receive a call from an international number, including those with +269 (Comoros), +231 (Liberia), +216 (Tunisia) and +682 (Cook Islands) prefixes that they don't recognise, should not return the call. If it is important or legitimate the caller will either ring back or leave a message.

Source: *The Irish Times*, 18 October 2017

Wangiri (Japanese “one [ring] and hang up”): figures for one country

- One web site alone lists 300 ‘+252’ numbers used for scams.
- This damages the reputation of the industry in the country.

First digit of National Significant Numbers	Proportions of misused numbers with this digit (%)
1	2
2	18
3	16
4	13
5	18
6	10
7	8
8	2
9	12

Source: Who calls me?, 2017.

First and second digits of National Significant Numbers	Proportions of misused numbers with these digits (%)
99	9
70	5
50	4
30	4
20	4
55	3
44	3
61	3
37	3

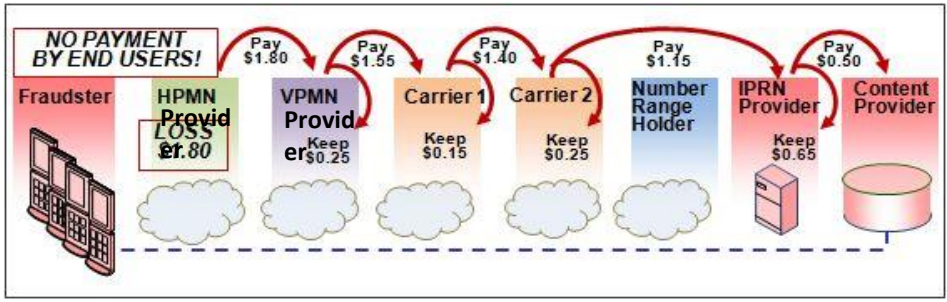
Source: Who calls me?, 2017.

First, second and third digits of National Significant Numbers	Proportions of misused numbers with these digits (%)
991, 994	8
703, 701	4
506, 504	2
301	3
207	2
558	2
448, 442	2
615	2
370, 378	2

Source: Who calls me?, 2017.

Colluding calling and called parties

- **Criminal activities:**
  - **Obtain SIMs from the HPMN (Home Provider Mobile Network).**
  - **Make calls from the VPMN (Visited Provider Mobile Network) in another country.**
  - **Collect revenues from the IPRN (International Premium Rate Network).**
- **Regulatory possibilities:**
  - **Require services to be prepaid.**
  - **Withdraw from allocation unused numbers.**
  - **Bar roaming calls to premium rate numbers.**
  - **Bar outgoing calls to suspect destinations.**



Source: Yates Fraud Consulting Limited

Outline: part 5

1. Numbering overall
2. Numbering planning
3. Numbering in relation to services
4. Numbering inventory management
5. Numbering user protection
6. Numbering user support
   - Number trading
   - Local dialling
   - Short code harmonisation
   - Carrier selection
   - Number porting
7. Numbering variants

Numbering capabilities: widespread practices

- **Number trading.**
- **Local dialling (where NDCs are already known to the networks). For instance:**
  - **21249 instead of 485 21249 in Mbarare (Uganda).**
- **Cross-border dialling (where country borders are nearby). For instance:**
  - **9 2044 0471 instead of 009 227 2044 0471 from Katsina (Nigeria) to Maradi (Niger).**
- **Short code harmonisation (when dialling in different situations). For instance:**
  - **456 or *456# instead of 730 000 456 for Airtel (Rwanda).**
- **Carrier selection (when dialling nationally or internationally). For instance:**
  - **0175 28 250 5081 instead of 0 28 250 5081 from Kigoma (Tanzania) to Mwanza (Tanzania).**
- **Secondary allocation.**
- **Number porting.**

Convenience for users can encourage market growth and competition.

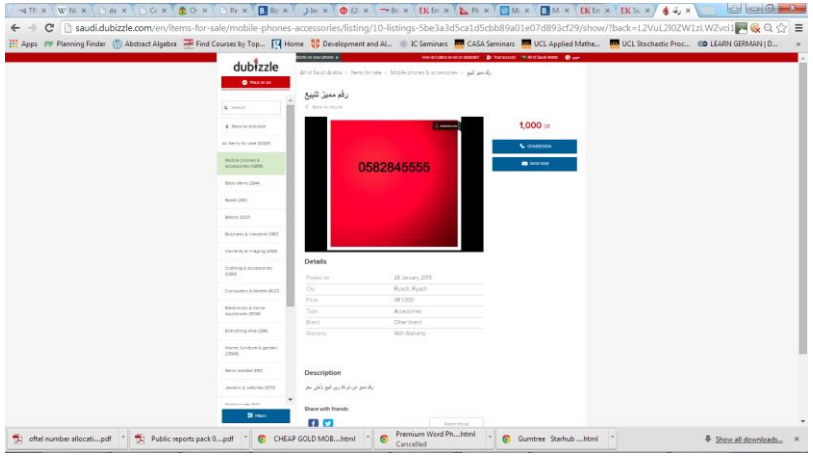
Numbering capabilities: possible facilities for users

Country	Number trading	Local dialling	Cross-border dialling	Short code harmonisation	Carrier selection	Secondary allocation	Number porting	
							Fixed	Mobile
Bahrain	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Burundi		No	No	No			No	No
Djibouti		No	No	Yes	No	No	No	No
Egypt	Yes	Yes	No	No	No		No	Yes
Eritrea			No	Yes	No	No	No	No
Ethiopia		No	No	Yes	No	No	No	No
Ghana	Yes	Yes	No	Yes	No		No	Yes
Jordan	No	Yes	No	No	Yes	No	No	Yes
Kenya	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Morocco		No	No	No	Yes		No	Yes
Nigeria	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Oman	Yes	No	No	No	Yes		No	Yes
Qatar	No	No	No	Yes	Yes	No	Yes	Yes
Rwanda	No	No	Yes	Yes	Yes		No	No
Saudi Arabia	No	Yes	No	Yes	Yes	No	Yes	Yes
South Africa	No	Yes	No	Yes	Yes	Yes	Yes	No
Tanzania	No	Yes	Yes	Yes	Yes	No	No	Yes
Tunisia	Yes	No	No	Yes	Yes		Yes	No
Uganda	No	Yes	Yes	Yes	No	No	No	No

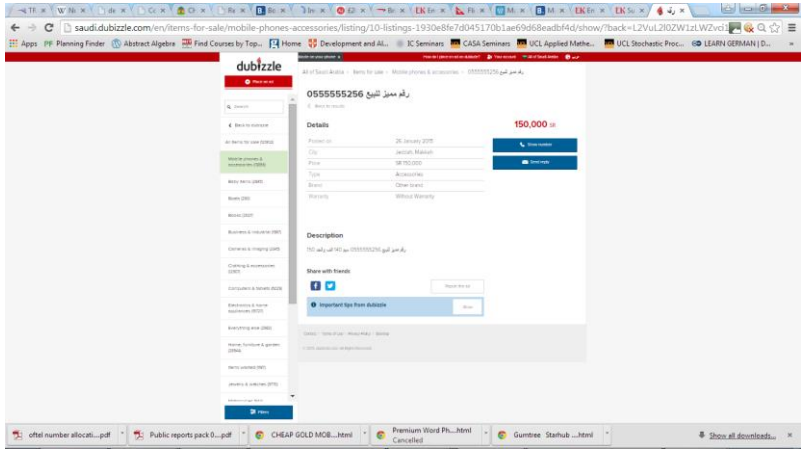
Where a capability is not clearly available (“yes” above) or prohibited (“no” above) the entry is blank.

Number trading: prices of golden numbers

‘0**58284555**5’ SAR 1,000 = USD 266



‘0**555555256**’ SAR 150,000 = USD 40,000



TheNational | UAE

Handout image of the Dh8 million phone number auction. Courtesy Emirates Auction Company

‘Unique’ mobile number fetches nearly Dh8 million at UAE auction

Roberta Pennington

March 9, 2014 *Updated: March 10, 2014 12:37 AM*

Related

- Bidder pays Dh2.3 million at charitable auction for phone number

ABU DHABI // The mobile phone number 050-777-7777 was auctioned off for Dh7.877777 million following a heated bidding war in Abu Dhabi and Dubai over the weekend.

Number trading: formats for golden numbers

Principle	Examples
Digits mapping to letters on key pads	'800 FLOWERS' (generic) '800 SAMSUNG' (branded)
Digits looking like letters	'88' could be 'double joy' in Mandarin '800 848135' could be '800 BABIES' in English
Digits sounding like letters	'8' could be 'to get rich' in Mandarin '207090' could be 'twenty seventy ninety' in English
Cultural references	The Beijing Olympics started on 08/08/08 at 08:08:08 '4' or '13' is lucky for some but unlucky for others '786' '108'
Personal references	Birth and marriage dates
Numerical patterns	'**222222**', '**22722**9' '**234567**', '**765432**', '**23745**9', '**54732**9', '**24768**9', '**86742**9' '**242424**', '**24724**9' '**224499**', '**22744**9' '**25759**5'

No simple set of rules will cover all of the formats for golden numbers.

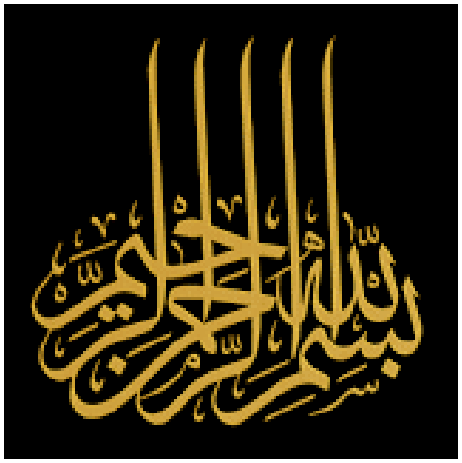
Why people like ‘8’ and dislike ‘4’ (in China)

八	發
8	to get rich
bā	*fā*

	囍
88	double joy
	shuāng xǐ

四	死
4	death
sì	*sǐ*

Why people like ‘786’ (in India, Pakistan, Bangladesh and elsewhere)



بسم الله الرحمن الرحيم

40+10+8+200+30+1+50+40+8+200+30+1+5+30+30+1+40+60+2=786

786=2+60+40+1+30+30+5+1+30+200+8+40+50+1+30+200+8+10+40

bismallāh ir-raḥmān ir-raḥīm

غ	ظ	ض	ذ	خ	ث	ت	ش	ر	ق	ص	ف	ع	س	ن	م	ل	ك	ي	ط	ح	ز	و	ه	د	ج	ب	ا
1000	900	800	700	600	500	400	300	200	100	90	80	70	60	50	40	30	20	10	9	8	7	6	5	4	3	2	1
gh	*ẓ*	*ḍ*	*dh*	*kh*	*th*	*t*	*sh*	*r*	*q*	*ṣ*	*f*	*‘*	*s*	*n*	*m*	*l*	*k*	*y/ī*	*ṭ*	*ḥ*	*z*	*w/ū*	*h*	*d*	*j*	*b*	*’/ā*

Number trading: treatments of golden numbers

Treatment	Regulator	Operator
Ignored	Australia, Bahrain, Belgium, Bhutan, Egypt, France, Iraq, Ireland, Kuwait, Lebanon, Norway, Pakistan, Qatar, Thailand, UAE, UK	Belgium, Bhutan, France, Ireland, Thailand
Defined	Hong Kong, Malaysia, Saudi Arabia	
Recognised in number block charges	Singapore	
Supplied on payment of extra charges	Oman	Australia, Bahrain, Iraq, Lebanon, Norway, Oman, Pakistan, Qatar, Saudi Arabia, Singapore
Included in certain tariff packages		Bahrain, Egypt, Kuwait, Malaysia, UAE
Auctioned		Qatar, Saudi Arabia, UAE

In all of these countries users buy and sell numbers despite any rules.

Number trading: charges and auctions for golden numbers

- Regulatory charges for golden numbers are:
  - Rather rare.
  - Inconsistent between countries.
  - Administratively very burdensome.
  - Dependent on defining the number formats.
  - Difficult to set rationally (especially as there are no substitute goods).
- Regulatory auctions are becoming ever less likely (with their abolition in Australia and their disuse in Singapore).
- Extra regulatory charges and auctions work best with number portability, as it:
  - Lets customers keep expensive numbers when changing operators.
  - Tends to use database systems like those for individual number allocation.
- The prices of a monopoly supplier must usually be based on cost; the regulator is a monopoly supplier of numbers.

Extra regulatory charges and auctions for golden numbers create challenges.

Number trading: buying and selling golden numbers

- **Trading in numbers is usually:**
  - **Widespread.**
  - **Difficult to stop.**
  - **Not against the law.**
  - **Helpful to competition.**
- **Hoarding of numbers is unlikely to cause problems if there are:**
  - **High charges for numbers.**
  - **Large supplies of numbers.**
- **Enhanced rights of use, lengthening the 'use it or lose it' period, are:**
  - **Rather rare.**
  - **Complicated for people having them.**
  - **Confusing for people having or not having them.**

Prohibitions of number trading tend to be unnecessary and ineffective.

Number trading: recommendations

- **Allow number trading by all parties.**
- **Do not have regulatory rules about which numbers are golden numbers.**
- **Do not have extra regulatory charges or auctions for golden numbers.**
- **Keep rights of use uniform, without enhanced rights of use for golden numbers.**
- **Require operators and number traders to publicise ‘use it or lose it’.**
- **Tax sales of numbers according to the selling prices.**

Local dialling: arguments for and against keeping it

Argument	Claim
Local dialling is now established for fixed numbers and perhaps for mobile numbers.	For
Numbers are shorter with local dialling, so they are easier to remember and use.	For
Numbers are written very often already in formats intended for national or even international dialling.	Against
The shortening due to local dialling is typically only by 1 digit out of 7 for fixed numbers and 2 digits out of 9 for mobile numbers.	Against
The formats presenting numbers intended for local dialling create confusion over which numbers can be dialled validly.	Against
Local dialling prevents the introduction of some short codes and the insertion of some extra digits in numbers.	Against
Local dialling (or having many short codes) requires keeping the national prefix, which might otherwise be removed or made optional.	Against

Local dialling: recommendations

- **Keep local dialling, which omits NDCs that are known to the networks, only if:**
  - **Users are not confused about when NDCs are needed.**
  - **There is no number portability between numbers with explicit NDCs.**
  - **The supply of numbers would not meet demand even if there were no local dialling.**

Short codes: observations

- **Short code leading digits:**
  - **Can be provided most easily if there is a national prefix.**
  - **Are standardised, but not always operating, for emergency calls in many countries (using GSM and European standard '112' and NANP '911'), for example).**
  - **Often start with '1', or failing that '0', if they are intended for essential services.**
  - **Should not be the leading digits of longer numbers, even if dialled digits are sent from phones as completed numbers, not one-by-one.**
- **If an industry body manages short codes (as in South Africa, for example), regulatory supervision is still needed, because short codes:**
  - **Form a scarce resource which must be managed carefully.**
  - **Need non-discriminatory allocation to value added service providers.**
  - **Are often used for premium rate services that point to caller protection.**
  - **Justify harmonisation, so that users are not confused and value added service providers can brand and port services.**
- **Sometimes short codes of the form '1xx' (accompanied by '*' or '#') for GSM Unstructured Supplementary Service Data (USSD) have similar supervision.**

Short codes: typical classes

Type	Provision required	Use of a particular number required	Example		
			Number	Source	Service
A	Yes	Yes	112 911	GSMA/ITU NANP/ITU	Emergency Emergency
B	No	Yes	116… 118…	EU EU	Social value Directory enquiry
C	No	No			Sports results Weather forecast

Several similar classifications exist.

Short code harmonisation: codes

Country	Generic emergency	Specific emergency	Child helpline	Customer care	Credit recharge	Balance check	Voicemail deposit	Voicemail retrieval
Bahrain	112, 999	199, 990		196				
Burundi	112		116					
Djibouti	112, 113	17, 18, 119						
Egypt								
Eritrea								
Ethiopia		900-919		996				
Ghana	112, 999	190-199	116	100	134	124	108	109
Jordan	112	911						
Kenya	112, 999	110, 121	116	100	130	131		
Morocco		15, 19, 177						
Nigeria	115							
Oman	112							
Qatar	112, 999	991, 992						
Rwanda	112	110-111	116	100-102	130	131	121	123
Saudi Arabia	112	996-999	116					
South Africa	112			135	136	137	134	132
Tanzania	112	110-111	116	100, 101	130, 105	131, 103	121	123
Tunisia		190-199						
Uganda	112, 999	911	116	100	130	131	121	123

Where there is no code clearly required (but not necessarily operational) the entry is blank.
Only some required codes are shown in certain countries.

Short code harmonisation: recommendations

- Protect short codes for emergency services such as ‘112’ against different uses.
- Identify customer services justifying harmonised short codes, such as:
  - Fault reporting.
  - Directory enquiries.
  - Calling number hiding.
- Harmonise short codes for essential and customer services where justified:
  - Between operators, both fixed and mobile.
  - Between voice, text and USSD (for credit balance checks, for example).
  - Between countries (if no users suffer and enough travellers gain, as in East Africa).
- Ensure off-net access to short codes for customer services so, for example:
  - ‘072 0000 144’ (with NSN ‘72 0000’) or ‘172 144’ (with carrier selection code ‘172’) could let faults be reported to operator ‘72’ with on-net fault reporting code ‘144’.
- Use short codes for services only if:
  - International access is not wanted.
  - Variants of the services do not need different numbers.
  - The leading digits of the possible short codes are not needed for NSNs.

Carrier selection: evolution

- **Carrier selection:**
  - **Call-by-call carrier selection for each call separately (by dialling a code).**
  - **Carrier pre-selection for all calls by default (without dialling a code).**
  - **Carrier pre-selection with over-ride call-by-call (by dialling a code).**
- **Carrier selection:**
  - **Use of first digit '1' most common (with '0' potentially confusing).**
  - **Alternative of dialling special numbers with low tariffs (followed by dialling desired numbers).**
  - **Migration to public call boxes and mobile phones with calling cards.**
  - **Updating through mobile phones with apps.**

Access Code	Type	Service
1xx(x)	A	Emergency Services
911		Emergency Services
12xx	B	Customer Care Services
15xx		Carrier selection and carrier pre-selection 'independent' billing services
18xx		Carrier selection and carrier pre-selection 'consolidated' billing services
13xx		Operators' in-house and on-network services, such as testing and customer services
14xx		
16xx		
17xx		

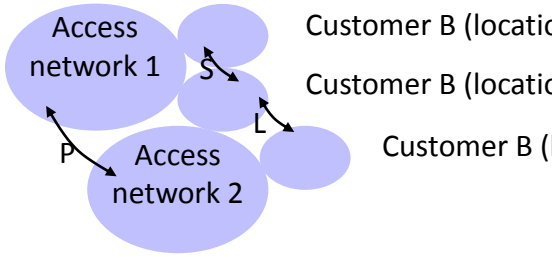
Carrier selection: recommendations

- **Ensure that calling cards and mobile phones with apps can be used instead.**

Number portability: distinctions

- **Operator Number Portability:**
  - **Keeping the same phone number when changing between operators.**
- **Location Number Portability:**
  - **Keeping the same phone number when changing between locations (usually in the same area).**
- **Service Number Portability:**
  - **Keeping the same phone number when changing between services (from analogue to digital mobile telephony, for example).**

The distinction between operator number portability, location number portability and service number portability



O: Operator number portability lets customer B change from being connected to access network 1 to being connected to access network 2 without changing phone number s.
L: Location number portability lets customer B change from occupying location 1 to occupying location 2 without changing phone numbers.
S: Service number portability lets customer B change from taking service 1 to taking service 2 without changing phone numbers.

Operator mobile number portability is the one likely to be wanted first.

Number portability: arguments for and against introducing it

Argument	Claim
Number portability is widely regarded as a right of customers, especially as it relieves small businesses of a major disincentive to changing between operators.	For
Number portability boosts competition (and perhaps demand), both before and after being introduced.	For
Market power can become more concentrated if wholesale termination charges are high and one operator is already larger than the others.	Against
Number portability boosts competition for existing (relatively high value) customers, not provision of services for customers with low incomes or outside cities.	Against
The few available skilled staff and the little available investment funding become diverted from priorities such as improving network coverage.	Against
Many prepaid customers simply discard their SIMs (and therefore their numbers) after some months of use.	Against
Customers might not use porting much, because of the complications of porting numbers and the costs of making calls to ported numbers.	Against
There are partial substitutes, such as assigning to a customer the same subscriber number in different networks.	Against

Number portability: alternatives to introducing it

- **Number portability is by now well understood and widely implemented, at least on mobile networks.**
- **However, possible interim alternatives are:**
  - **Setting aside the same subscriber number block in different networks, so a customer that is assigned a number from the block for one network can be automatically assigned the same subscriber number from the blocks for them all (for example, a customer might be assigned '71 345 6789', '72 345 6789' and '73 345 6789' by three operators holding numbers in NDCs '71', '72' and '73').**
  - **Providing changed number announcements when customers change their operators (though systems providing such personal announcements in the past have often had limited capacities and high prices).**
- **Both alternatives would reduce the stocks of numbers that are free for assignment.**

Number portability: recommendations

- **Introduce operator number portability if:**
  - **The networks serve enough customers with low incomes and outside towns.**
  - **Interconnection charges are not so high, and the largest operators are not so large, that they might increase market concentration instead of increasing competition.**
  - **The value of number portability is widely publicised and well known.**
  - **Porting is simple, quick and free for the customer, involving only one point of contact (with the operator to whom the number is being ported).**
  - **Customers can terminate contracts without incurring disproportionate charges for giving up services or keeping subsidised handsets.**
- **Consider as an interim alternative to operator number portability an arrangement in which all of the operators set aside the same subscriber number block, so a customer assigned a number in the block by one of them can be assigned the same subscriber number by all of them.**
- **Note that, with a next generation network, location number portability, in which customers change their locations without changing their numbers, should be very easy to provide, at least throughout each NDC.**

Outline: part 6

1. Numbering overall
2. Numbering planning
3. Numbering in relation to services
4. Numbering inventory management
5. Numbering user protection
6. Numbering user support
7. Numbering variants
   - ENUM
   - Other kinds of numbering

ENUM: purpose

- ENUM is intended to help in relating phone numbers to IP communications.
- ENUM defines how to represent a phone number as a domain name uniquely.
- This domain name is used for finding a list of communication services with an order of priority chosen by the holder of the phone number.
- There can be several communication services, indicating, for example:
  1. First try the phone number +252 72 345 6789
  2. If that fails, try the SMS number +252 72 345 6789
  3. If that fails, try the SIP address rem@antelope.so
  4. If that fails, try the email address rem@antelope.so
  5. If that fails, try the web site www.antelope.so
- ENUM is not a VOIP service or a numbering plan (but might appear in both).

ENUM: operation

- The user dials a phone number (72 345 6789, for example).
- The user terminal or a gateway represents the phone number as a domain name.
- 72 345 6789 is represented as 9.8.7.6.5.4.3.2.7.2.5.2.e164.arpa by:
  - Completing the phone number with the country code: +252 72 345 6789
  - Deleting all characters except for the digits: 252723456789
  - Putting '.' between the digits: 2.5.2.7.2.3.4.5.6.7.8.9
  - Reversing the order of the digits: 9.8.7.6.5.4.3.2.7.2.5.2
  - Attaching '.e164.arpa' at the end: 9.8.7.6.5.4.3.2.7.2.5.2.e164.arpa
- The user terminal sends the domain name to a domain name server.
- The domain name server sends a list of identifiers of communication services, with an order of priority, to the user terminal, such as:
  1. tel:+252 72 345 6789
  2. sms:+252 72 345 6789
  3. sip:rem@antelope.so
  4. mailto:rem@antelope.so
  5. http://www.antelope.so
- The user terminal tries the communication services in their order of priority.

ENUM: observations

- ENUM (now often called ‘user ENUM’) has several problems with:
  - Using e164.arpa with existing internet governance institutions.
  - Preventing harvesting of information by spammers.
  - Allowing users to put information into the domain name service.
  - Getting users to keep the information up-to-date.
  - Getting operators to provide full information for their customers.
  - Getting vendors of terminals and gateways to provide it.
  - Using the domain name service for dynamic ‘find me/follow me’ services.
  - Providing personal identifiers in households having single or unlisted phone numbers.
- Trials (in China, Japan and Malaysia, for example) have often not been followed by deployments.
- User ENUM does not meet the needs of operators that just want interconnection.
- Variants of user ENUM called ‘carrier ENUM’ or ‘infrastructure ENUM’ do meet those needs and are simply implementation techniques needing no regulation.
- Carrier ENUM can be used in, for example, the Pathfinder service, potential Next Generation Networks having IP Multimedia Subsystems, and number portability.

ENUM: recommendations

- Do not designate numbers specifically intended for ENUM.
- Discourage the introduction of user ENUM.
- Encourage the introduction of a shared carrier ENUM system if:
  - User information is not accessible from the public internet.
  - Only numbers allocated in the national numbering plan are handled.
  - The name server operator is selected openly and reviewed periodically.
  - All operators can get information from the system with non-discriminatory pricing.
  - All operators using the system supply correct, complete and up-to-date information.

Other kinds of numbering: observations

- **Other kinds of numbering could create problems of:**
  - **Competition, when an operator withholds information about allocations.**
  - **Scarcity, when an operator creates shortages by having wasteful allocations.**
- **Some kinds of numbering for routing or administration do not follow or imitate international standards but must be managed nationally and distinguished from allocated numbers embedded in the signalling. For instance:**
  - **In some implementations of number portability, number portability codes identify the recipient nodes.**
  - **In some implementations of carrier preselection, carrier preselection codes identify the selected networks.**

Other kinds of numbering: standard codes

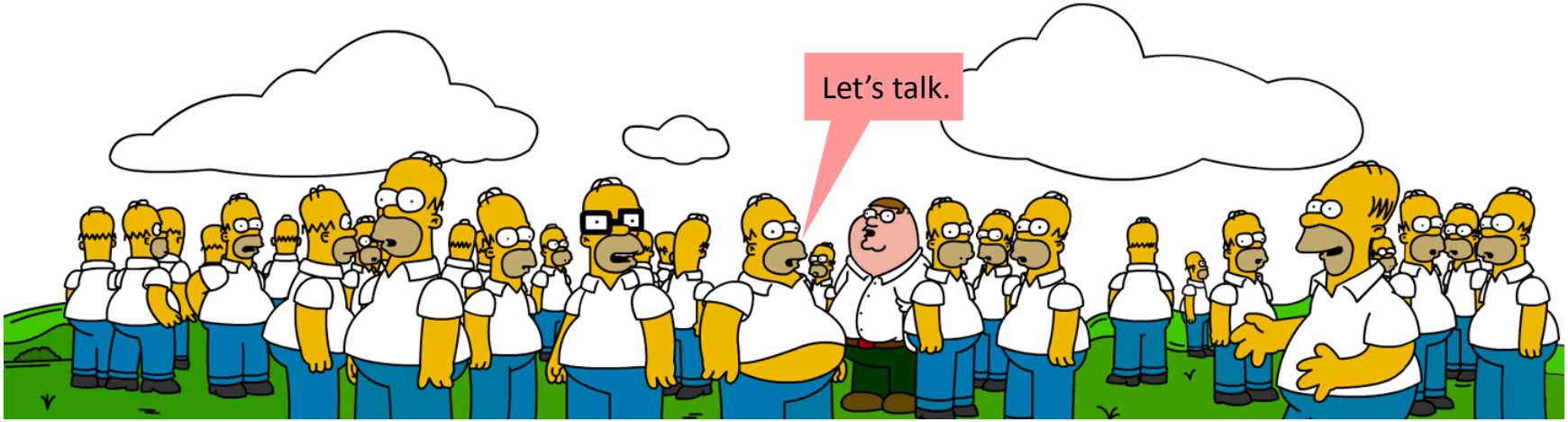
Structure	Identified entity	Allocation duties	Limits	Standard
International Signalling Point Code (SPC) = Signalling Area Network Code (SANC) + Signalling Point Identification (SPI).	A source or destination in a signalling network	ITU: SANCs, Regulator: SPIs	1,536 SANCs, 8 SPIs per SANC	Q.708
National Signalling Point Code (SPC) = Signalling Area Network Code (SANC) + Signalling Point Identification (SPI).	A source or destination in a signalling network	Regulator: SANCs, Operator: SPIs		
International Mobile Subscription Identity (IMSI) = Mobile Country Code (MCC) + Mobile Network Code (MNC) + Mobile Subscription Identification Number (MSIN).	A home country, a home network and a roaming subscriber	ITU: MCCs, Regulator: MNCs, Operator: MSINs	1000 MCCs, 100 or 1,000 MNCs per MCC, 10,000,000,000 or 1,000,000,000 MSINs per MCC	E.212
Data Network Identification Code (DNIC) = Data Country Code (DCC) + Network Digit (ND), Network Terminal Number (NTN)	A source or destination in a public data network	ITU: DCCs, Regulator: NDs, Operator: NTNs	900 DCCs, 10 NDs per DNIC, 10,000,000,000 NTNs per ND	X.121
Telex Network Identification Code (TNIC) = Telex Destination Code (TDC) + Telex Number (TN)	A source or destination in a telex network	ITU: TNICs, ITU: TDCs Regulator: TNs, Operator: TNs		F.69

National SPCs do not always have the structure and allocation duties above.

Other kinds of numbers: recommendations

- **Agree which ranges of national SPCs should be allocated by operators under delegation from the regulator.**
- **Agree which, if any, national standards for signalling and internal network codes need to be developed.**
- **Require that potential problems with existing ways of allocating codes should be reported to the regulator as soon as they arise.**
- **Review trends in demand from operators for codes annually.**

Conclusion



Thank you for your comments today.
Please feel free to contact us.