A Research for
Geographic Entity Object Code Systems
And Evaluation Perspectives

The GEOCODE Encyclopedia

Version 1.1

November 12, 2009

Naoki Ueda, MBA

Chief executive officer

Locazing Inc. (LocaPoint.com)

Contents

1. Objectives

The report has three purposes:

1. Giving an overview of "what is GEOCODEs".
2. Giving an insight or perspectives to evaluate 'GEOCODEs' for appropriate purpose.
3. Listing up and Introducing GEOCODE as guidance.

2. Introduction

"**Where ?**"

Asking place is very fundamental question in daily life. However, the answer to this question is not always as simple as the answer to the question, "When?"

When people start having watch, and learn how to express it, such as "9:00 am", society can move forward to era of the Industrial Revolution. Before that, people follow the Sun and 'Time' was always rough and not precise in the era of Agriculture.

After 911 in 2001, importance of 'locating' someone is rising. Today, 2009, almost all mobile phone has GPS locating device in most advanced countries. In a long history of human, it is the first time, or the first opportunity, that people are able to know where they are exactly. Location Based Services (LBS) market is about to expanding and Search and Rescue mission in natural disaster become more precise and effective.

However, traditional coordinate system, such as "Latitude North40.749370° and Longitude West073.968952° " is not as easy as "9:00 am". People still use 'rough' expressions such as "I'm in front of UN (Landmarks)" or "My home is 2153-405 Kawaraguchi Kashiba (mailing address)" when they want to show 'where'.

Recently various coding system are invented and introduced to show "Where". All of them took slightly different approach, but they all have a common goal – make 'Where' as simple/easy as possible. In this report, overview of GEOCODEs is explained. In addition, some perspectives or criteria to evaluate GEOCODEs will be introduced. The author of this report is an inventor who designed some of GEOCODE in this document and also a researcher of GEOCODEs. This report is written as neutral as possible, and giving a general idea how you can choose appropriate GEOCODE for your purpose.

3. Contribution and Importance

This report is a part of contribution for “Applied Technology for Humanitarian Action” (http://hhi.harvard.edu/events/humanitarian-action-summit/working-groups/applied-technology-for-humanitarian-action) sub working group in Harvard Humanitarian Initiative (http://hhi.harvard.edu/), to help member to choose appropriate coding system.

4. What is GEOCODEs

There are almost twenty coding system that represents geographic location. In Wikipedia, they are introduces as GEOCODE (Geographic entity object code). However, these codes do not even have a commonly-agreed category name. Every inventor call them as different name “geo-code”, “location code”, “address code”, “place code”, “universal address”, etc.. It is like ‘car’ wasn’t common category name yet and everyone call it “motor wagon”, “auto vehicle”, or whatever they want to call. In this report, I call them as “GEOCODE” in capital alphabet.

I have to mention that, in generally speaking, the ward “geocode” means converting postal address to geographic coordinates (latitude and longitude), and this is different from GEOOCDE in this report.

Anyway, every GEOCODEs are trying to make latitude and longitude (such as North35.12345, West135.12345) into shorter or easier code as possible.

5. Notice

Note: All GEOCODEs those are used as an example in this document will be introduces later part of this document.

All GEOCODEs introduced in this document may patented or have copyrighted by developers or companies. You must have confirm its license and terms of use to right holders, before start using GEOCODEs.

6. Basic Theories behind GEOCODEs

1. How to make it short

Generally speaking, making something simple or short is considered as “compressing”. Thus, first of all, “Data compression” technology is considered to make latitude/longitude shorter. However, data which is target of compression is only a set of latitude and longitude- only two numeric values. So it is very difficult to apply usual data compression method, such as Hoffman-compression, ZIP, etc.

Assume that the Earth’s meridian is 40,000,000 meters, and the equator is also 40,000,000 meter. To identify location with 1 meter by 1 meter precision,

20,000,000 meter (a half of meridian) multiplied by 40,000,000 meter = 8 * 10^14 combinations are needed. This is equal to:

$\log_2 (8 * 10^{14})$ = 49.507 bit of information amount

Now, there are two approaches to make it short.

The first approach is reducing the amount of information, by limiting area, or reducing precision.

For example, “MapCode” reduce the amount of information needed, by limiting a cover area for only land area in Japan, and decrease precision to 30meter. Then MapCode™ can locate anywhere in Japan with only 10 digit of numbers. This is suitable foe car navigation purpose.

Another approach is called “Length compression”. To express 49.507 bit of information amount, 50 digits needed in binary expression. 15 digits needed as decimal. In Theory, if you use notation system that base radix is higher than 10, it should be shorter than latitude and longitude, because they are in decimal.

Base of Radix	Digits length needed	Example of letter used	Example
2 (Binary)		0,1	01101010011001 00101100111001 00101011100100 10100101
10(decimal)	15	0-9	35.12345, 135.12345
16(hexadecimal)	13	0-9 and A-F	3745CD874E6A1
26	11	A-Z	ESQANYGFRG
36	10	0-9 and A-Z	HESB6D3F5L
60	9	0-9, A-Z, a-x	gyFuJ8y1c
10000	4	Chinese Kanji	

Figure 1: Base radix and code length needed

Decimal based GEOCODE, including latitude/longitude coordinate, needs 15 numbers to express about 1 by 1 meter precision. 15 numbers is almost the same length of credit card number (16 numbers), and it is hard to handle for human without a tool. Hexadecimal based GEOCDE realize 13 digits, but it usually become like "28a6f6b021cf3", and it is still difficult to handle. If you use 10000 different characters like Chinese Character Set, only 4 letters can express location. However, it must be hard to recognize or remember 10000 different Kanji Characters.

As table above and following chart shows, increasing radix base number does not have linear effect for its length. If radix base is more than 36 or 60, the effectiveness of rising radix base number won't decrease code length effectively.

Some GEOCODEs, such as LocaPoint, LP-Address, and Maidenhead Locator System, used complex-radix notation. In short, they use different radix-base for different digits in its format. However, they are still following the same rule.

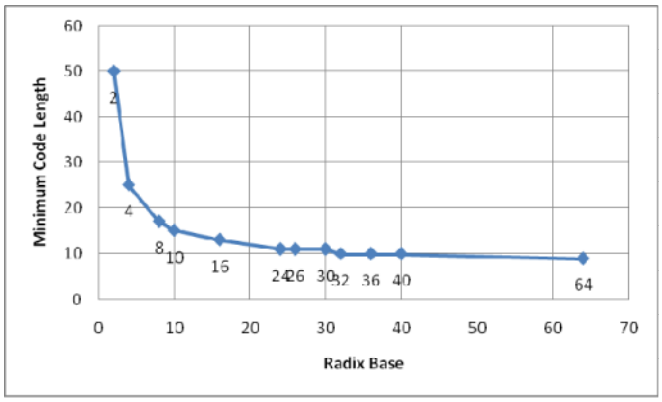


Chart 1: Radix base and minimum length for 800000000000000 values.

2. Trade-offs

If you make GEOCODE shorter it should be easier and simpler. But if your GEOCODE covers global location, length should be longer than regional code. If you want your code to show more precise location, length must be longer. So, there should be following trade-offs among length, easiness, precision, and coverage.

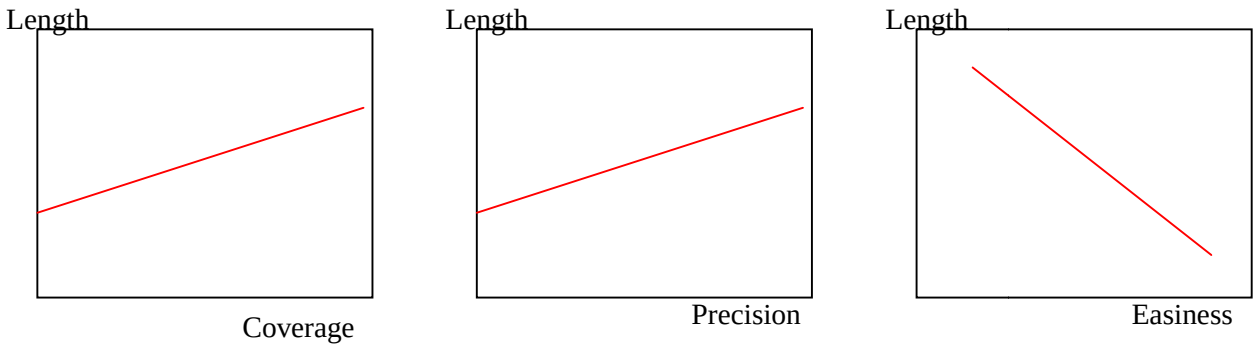


Chart 2: trade-offs in designing GEOCODE

3. Basic categories of GEOCODEs

Most GEOCODE can be divided into three types. Some of them are something between, and some are totally different. But these basic categorization would help to evaluate new GEOCODE.

1. Mesh-code type GEOCODE:

   This type of GEOCODEs divides cover area into multiple areas by mesh, and use mesh id as a code. Many GEOCODEs take this approach.

2. Encrypted type GEOCODE:

   This type of GEOCODEs use specific algorithm to calculate GEOCODE from latitude and longitude value. Code presentation is almost nothing to do with physical area, so it is hard to match code with printed map. They are designed on assumption of using computer.

3. Database assisted type GEOCODE:

   This type of GEOCODEs use a database to store a part or whole location data, and use a identification key to access its data as s code. For example Navigation-Code™ uses database to store integer part of latitude and longitude degree part, and use city name as a key to recall it. Yahoo!WhereOnEarthID(WOEID)™ is 32 bit integer number that is a key to get geographic location from Yahoo! Services.

These three types have different merits and demerits.

	Mesh code type	Encrypted type	Database assisted type
Shorter length	Not Good	Good	Good
Readability	Good	Not Good	Good
Maintenance ability	Good	Good	Not Good

Figure 2; Strength and Weakness of basic GEOCODE types

7. Ten Perspectives to Evaluate GEOCODEs

There are many perspectives to categorize GEOCODEs. You have different weight of importance of each perspective, according to your purpose. It is very important that to clearly know which perspective is important to your purpose, before you start evaluating GEOCODEs. In most cases, there are many trade-offs. Being good at in one perspective usually results in being not good at other perspective.

1. Perspective One: Cover Area (Regional, or Global)

If code is regional or limited, code length could be shorter than global code or one covers wider area, because amount of information needed is smaller. If you are looking for a code that covers only one country, there should be simpler and smaller code available. However, if you need global code, your code must be longer and more complicated than regional code.

For example, “MapCode®” covers only Land area in Japan to decrease information amount needed. So, it only needs 10 digits of numbers. If you try to cover global area with numeric code, it needs 15 digits code for 1x1 meter accuracy.

2. Perspective Two: Intuitiveness and Human-Friendliness

Every GEOCODEs try to be simple and short. But purpose is vary.

Some GEOCODEs are designed for computer usage only, and others are designed for human usage. For human use, code must be “readable coordinates” and should be reflected to printed map, intuitively.

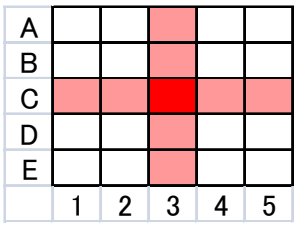


Figure 3

Guide Map Style

NAC, LocaPoint, LP-Address, N-Code have a code format that have latitude part and longitude part, separately. It gives intuitive interface like guide maps. I have to mention that N-Code use only numbers in purpose of children’s use.

Munich Orientation Convention (StatusQuo) has unique intuitive interface. It uses polar-style coordinates, like orientation methods. Unlike other code has Guide Map style (X-Y style) guidance, StatusQuo provide angle in time format (3:00 for East, 6:00 for South, etc) and distance from origin point that is defined for each city. If city structure is not X-Y shape, and is polar shape like Rio de Janeiro or Paris, StatusQuo Code follows city road structure and more intuitive. StatusQuo is designed for illiterate or children who can only read numbers and clock in developing countries.

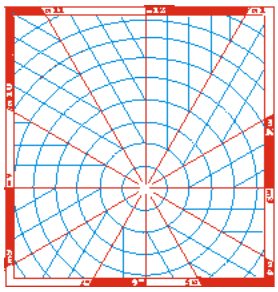


Figure 4:Polar Style

©M u n i c h Orientation Convention

Non-intuitive GEOCODES are not designed for human handling. It is very difficult to handle for human. Instead, it can be more "compressed" and shorter. For example, SONY's code is made through bit operation, and human can't tell where the code shows directly. Similarly, GeoPo try to make code as short as possible, because GeoPo is designed for Twitter usage and try to save character length due to Twitter's length limit.

3. Perspective Three：Database assisted, or pure calculated code

Some code needs database access, or at least have pattern table, in order to encode/decode. For example, MapCode™ needs data of the first mesh coordinate, StatusQuo needs information of origin point of each cities.
Database assisted type can be make code shorter, and can be asymmetric. It is possible to assign short code for cities, and long code for ocean, etc. However, database should work with it, and it may require network communication. In case of disaster and communication line is disabled, it is difficult to use.

Other codes can be encoded/decoded by pure calculation only with latitude/longitude. For example, NAC, LocaPoint, LP-Address, GeoPo, and N-Code etc. can be converted directly from latitude and longitude with some simple equations. This makes implementation easy, and can be independent from network connection status.

4. Perspective Four: Affinity to IT system

There are two points to see its affinity to the information technology system. One is the radix base number of its notation.

Most code use higher number of base radix notation. For example, SONY's code use 37^{th} radix notation. However, it is not friendly for system and its engineers. LocaPoint uses 26^{th} radix, too. Easiest notation is 2^{nd} radix (known as Binary), 8^{th} radix, 10^{th} radix (known as Decimal notation or natural number), 16^{th} radix(known as HEX decimal), 32^{nd} radix, 64nd radix.
BINGEO(4^{th} radix), GeoPo(64^{th} radix), and Geohash(32^{nd} radix) is also system friendly, because computer is binary.

The other point of affinity is an existence of aliquant part in calculation.
For example, LocaPoint has a resolution of 0.00000787787542452995343 degree in longitude. This makes aliquant part in most calculations, and may cause rounding error.
On the other hands, LP-Address has a resolution of 0.00001 degree, so it is convenient for calculation.

NAC Also used 30th radix, and this provide aliquot part in some calculations, because longitude degree is 360° bases.

5. Perspective Five: Altitude consideration

Currently, only NAC has an extension to handle altitude. XX code also has it. To handle altitude, you need to be careful that altitude from sea level, from geoid level, or from ground. Also, it could be negative number. Sometimes, it is more convenient to use floor number than altitude in meter or feet.

Most GEOCODEs can handle only latitude and longitude.

6. Perspective Six: Area-code concept

Some code has an "area code concept" like area code of telephone number. If code is divided into area code first, then assign local code inside of it, people is getting familiar with area code, and usually do not use area code for regional or local usage. Even if code is long, as long as people already know area code and use code within same area, they only have to handle local code. This makes code shorter, practically.

Most code has a hierarchical area structure and very flexible, but does not give an area code concept clearly.

N-Code, LocaPoint, and LP-Address have an area code concept.

7. Perspective Seven: Fault tolerant mechanism

In the critical situation like search and rescue mission, incorrect location may results in a tragedy.

As long as coordinate is transferred from machine to machine, there is very little need for fault tolerant mechanism. However, it coordinate information goes through human, like telephone, walkie-talkie, radio, paper message, etc, there always is a possibility of "messaging game" type of error.

Some code has a structure that prevents or detect fault. SONY's code has an extension that needs one more letter as a check digit. If code is input incorrectly, it detects invalid code. This is a same mechanism as that is used in bar-code, incase bar-code is dirty and miss-reading occurs.

LocaPoint and LP-Address have a different type of fault tolerant mechanism. They use cognitive psychology approach. They always have specific pattern (Alphabet, Alphabet, and Number) to create some kind of rhythm, to help brain's cognition process easier. Brain is not good at random information, but very good at pattern recognition. It also prevents I-1 and O-0 mistake because position in format indicates number of alphabet. That

minimizes human error in reading, listening, writing, or inputting.

Many of GEOCODEs are trying to eliminate these errors as possible. GeoPo, Microsoft compact text encoding, NAC are not using I and O to prevent usual I-1 and O-0 mistake.

NAC also prevent using bowel, since their 'sounds' confusing among languages.

8. Perspective Eight: Precision and scalability

Precision of code is trade off with cover area and length of code. Some code choose flexible code schema like decimal value. For example, NAC can express about 1.6 by 1.6 meters by 10 digits, but can be 0.05 by 0.05 meter with 12 digits. N-Code, GeoPo are the same.

Some code have fixed precision and fixed format. LocaPoint express 0.4 by 0.8 meters with 12 letters, LP-Address expresses 1.1 by 1.1 meters with 12 letters, and MapCode express 30 by 30 meter with 10 numbers.

9. Perspective Nine: Licenses and Cost

Some GEOCODEs are patented. BINGEO and SONY'code are patented in US, MapCode and LocaPoint are patented in Japan. Since it is difficult to get patent for design, most GEOCODEs are in patent pending or rejected state. Most GEOCODEs are licensed with copyright and trademarks.

Some GEOCODEs such as LP-Address, GeoPo, declare open license and cost for free.

10. Perspective Ten: Datum

In order to express pinpoint location, latitude and longitude are not enough information, technically. Latitude and longitude needs information of Datum or geographic Datum. Datum is a basic factor of earth emulation, so same latitude and longitude shows slightly different location if you use different datum. In US, NAD27, NAD83, and WGS84 datum co-exists. In Japan, there are two datum, WGS84 datum became de facto standard because GPS system use it. Most code specifies which datum should be used. For example, NAC, GeoPo, LocaPoint, LP-Address, and most GEOCODEs specifies WGS84 datum. However, it is very important that which datum is the base of GEOCODE.

8. The GEOCODE Encyclopedia

Here is a list of GEOCODEs that the author knows at 31 May, 2009.

This chapter is provided only to grasp a rough concept of each GEOCODEs. Each GEOCODE is introduces in one page, equally. Therefore, this document is NOT going to provide in detail for any GEOCODEs. Please follow provided link for original website for details, options, applications, and updated specifications..

I have to mention that pictures to explain code are copied from original web site, and they are not modified in purpose of transferring information as correct as possible. Therefore, copyrights of pictures are reserved by original copyright holder.

Explanation text is written by author unless citation source is notified..

BINGEO

BINGEO is introduced in United States Patent 6,552,670 ("Location Encoder"[i]) Filed on May 23, 2001, Invented by Vale Sundaravel and Bejamin J. Paul.

Sample Code: 49CCAC4

Basic concept is, two bit (0 and 1) can divide some are into four areas.

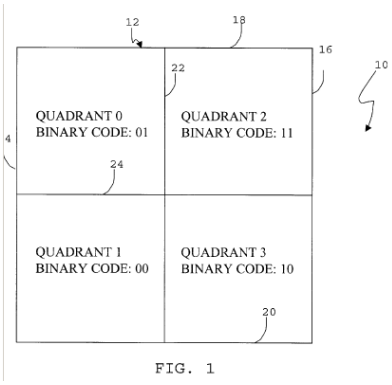


FIG. 1

©US patent and trademark office

In BINGEO, assume whole world is square as if Mercator projection, and divide into 4, hierarchically until required precision. The result is in binary.

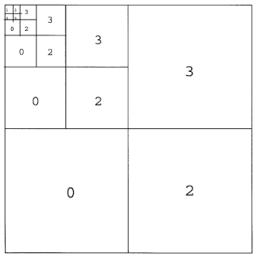


FIG. 2

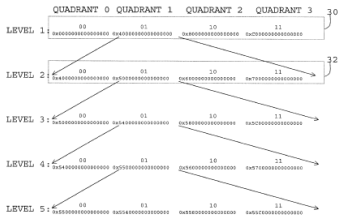


FIG. 3

©US patent and trademark office ©US patent and trademark office

Than interpret this binary value to HEX decimal value.

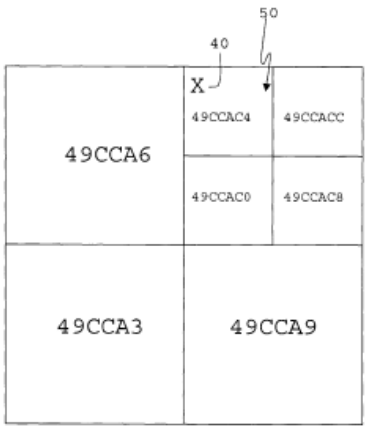


FIG. 5

©US patent and trademark office

Compact text encoding of latitude/longitude coordinates (By Microsoft)

US Patent 7302343

It is almost the same as Natural Area Coding System(NAC). According to NAC Geographic products, after NAC contact to Microsoft and rejected their offer, Microsoft applied this patent by their own, and NAC declare that it is infringed[ii]. Differences between NAC and Microsoft's is,

1. NAC use capital alphabet, Microsoft use small alphabet
2. NAC does not use, 'A','E','I','O','U' and 'Y'. Microsoft does not use 'a','e','i','o','u', and 'l'.
3. In NAC, latitude comes first. In Microsoft code, longitude comes first.
4. In Microsoft, there is no space between latitude part and longitude part.

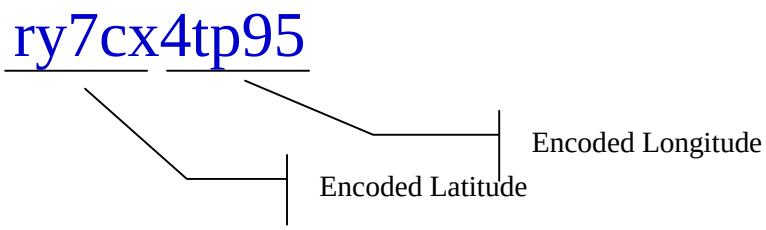
Otherwise, all are the same as NAC including its concept.

Following a base 32 table used

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	1	2	3	4	5	6	7	8	9	b	c	d	f	g
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
h	j	k	m	n	p	q	r	s	t	v	w	x	y	z

Letter not to be used "a", "e", "i", "o", "u" and "l"

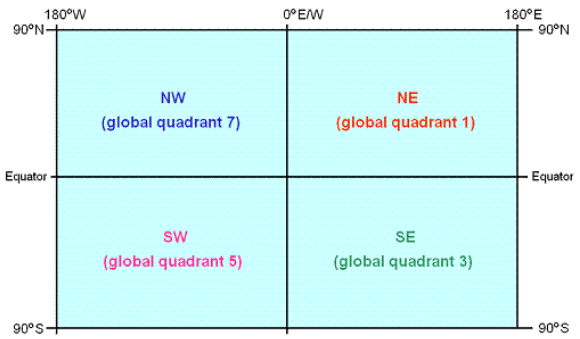
Sample Code

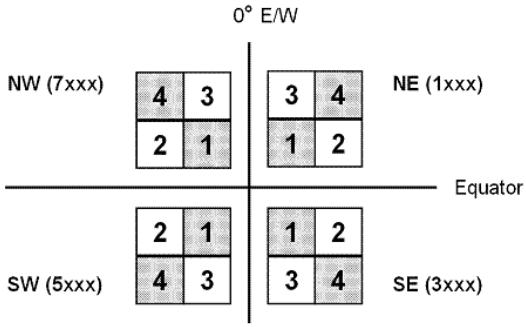


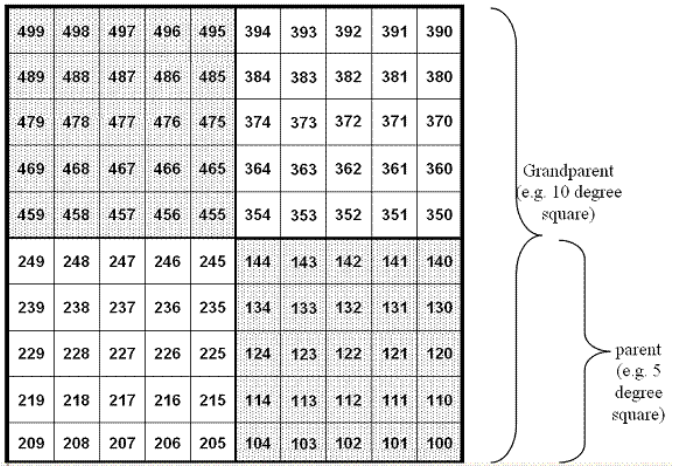
C-squares

C-Square is developed by Marine and Atmospheric Research, Australia.

http://www.marine.csiro.au/csquares/spec1-1.htm







Sample Code

10 degree square code: 7307 (1 cycle, 4 characters)

5 degree square code: 7307:4 (1+ cycles, 6 characters)

1 degree square code: 7307:487 (2 cycles, 8 characters)

0.5 degree square code: 7307:487:3 (2+ cycles, 10 characters)

0.1 degree square code: 7307:487:380 (3 cycles, 12 characters)

0.05 degree square code: 7307:487:380:1 (3+ cycles, 14 characters)

0.01 degree square code: 7307:487:380:143 (4 cycles, 16 characters)

Geohash

http://en.wikipedia.org/wiki/Geohash

Geohash is proposed to be used for geotagging.

Geohash is very simple algorithm, and concept is very similar to BINGEO.

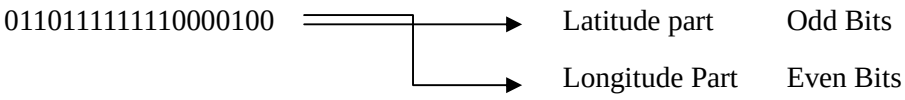
Sample Code

u4pruydqqvj

Use 32base decoding defined follows, convert it into binary string.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	2	3	4	5	6	7	8	9	b	c	d	e	f	g
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
h	j	k	m	n	p	q	r	s	t	u	v	w	x	y	z

Letter not to be used "a", "i", "l", and "o"



The first bit represents that target location belongs to upper half or lower half of area. The second bit represents which half part of first selected area, and continue until required precision is satisfied.

GeoHex

http://geogames.net/labs/geohex

GeoHex is introduced in Nobember 2009. It covers land and sea area in Japan. However, this concept could be applicable for other region.

GeoHex devide whole target area (Japan region) into honeycomb geometry regions. In other words, GeoHex use regular hexagonal grid instead of usual square or rectangle grid.

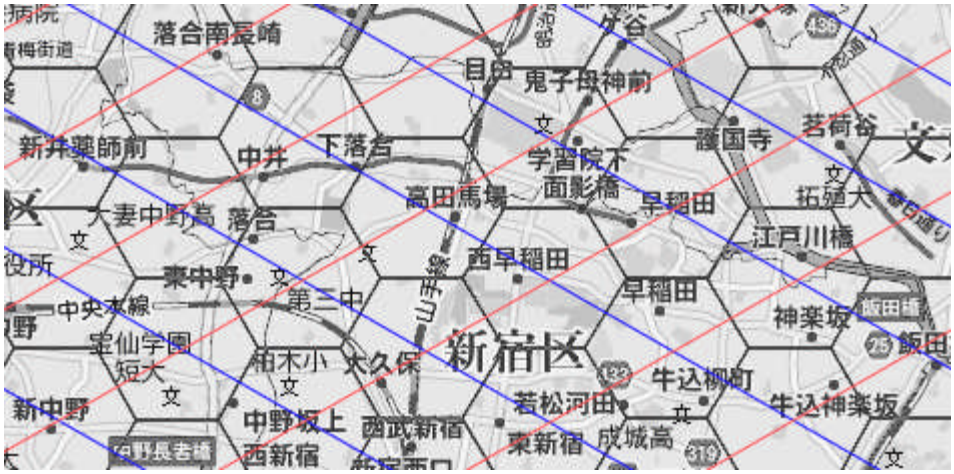
©sa2da

＜GeoHex Coding System＞

A: Hex Level

B-D: Coordinates. Number of digits vary according to Hex Level

This style of dividing has been very popular in the world of video games, but GeoHex is the first application to apply hexagon dividing to real geographic world.



©sa2da

GeoHex code is calculated form/to latitude/longitude directly..

Sample Code:

310fMwD

GeoPo

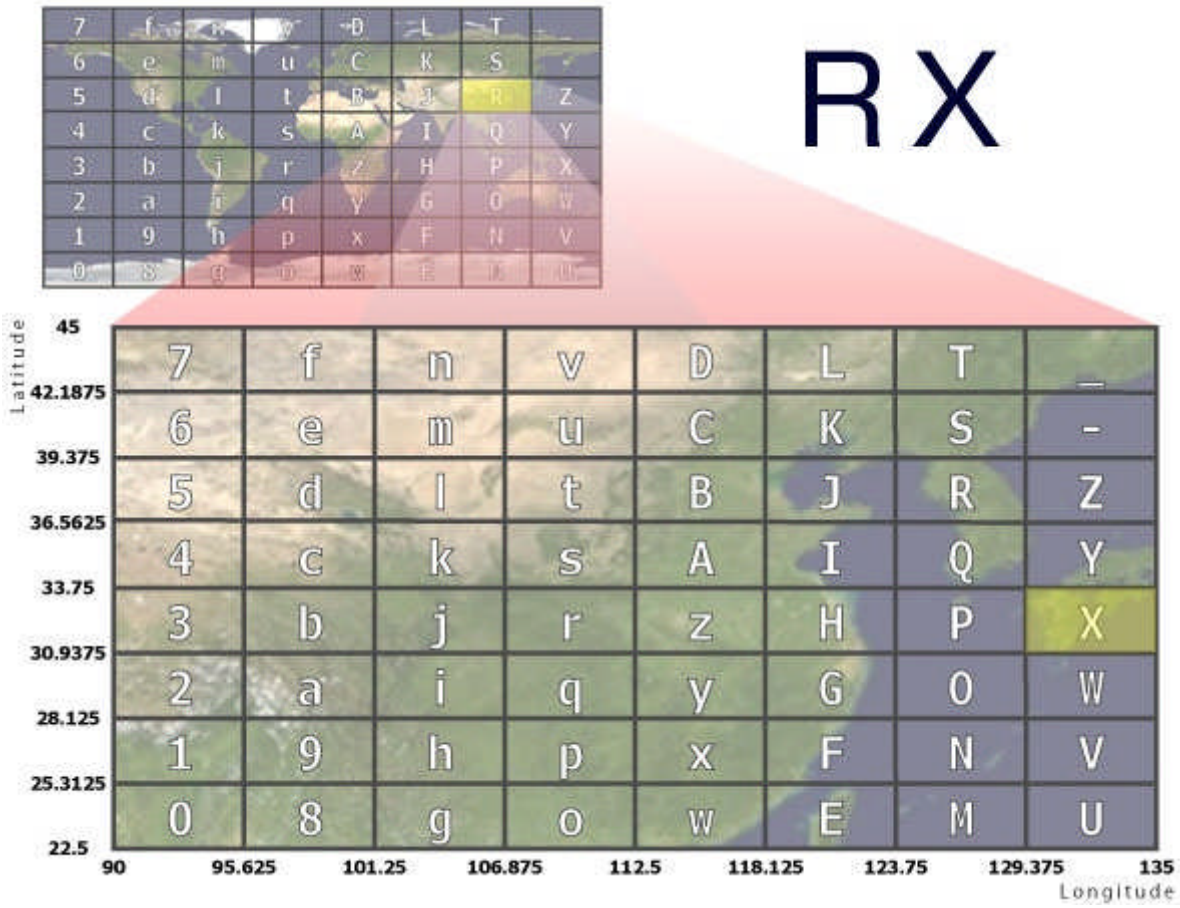
http://geopo.at/intl/en/

GeoPo is developed by Creco Inc in Japan in 2009. It is designed for Twitter usage. Coding method is not so unique, but GeoPo include http://geopo.at/ as a code. This makes GeoPo code linkable. Creco declare Free License for GeoPo code.

It assumes that whole world is square area in Mercator projection.

Divide it into 8x8=6 hierarchically until required precision.

Use [0-9,A-Z,-_] to express which part of 64 areas. Even one character can means location (or area).



©creco

Sample Code:

http://geopo.at/Z4RHXX

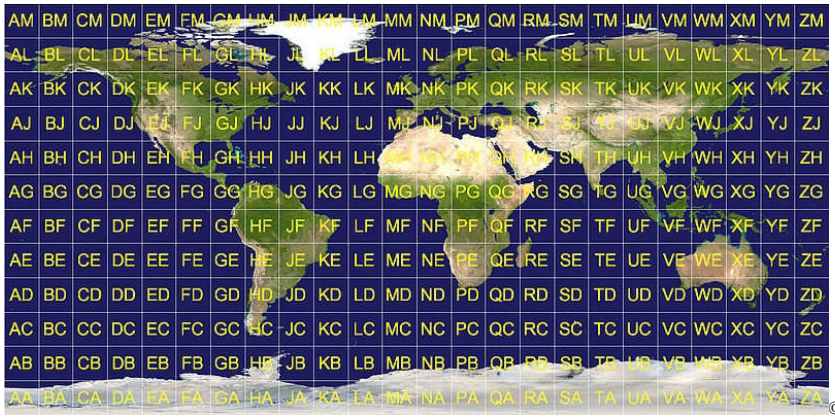
Georef

http://en.wikipedia.org/wiki/Georef

http://www.map-reading.com/ch4-4.php

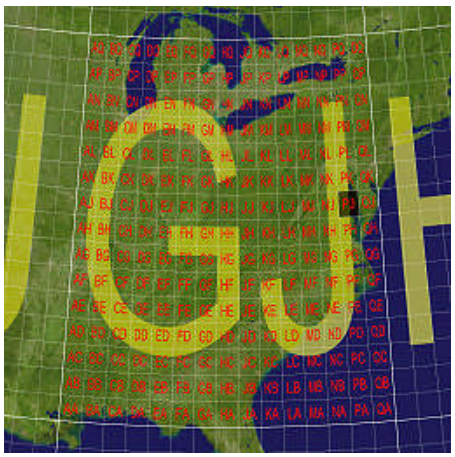
Georef is also assuming whole area on earth as a rectangle in Mercator projection.

First, divide latitude into 12 , and longitude into 24 as following figure.



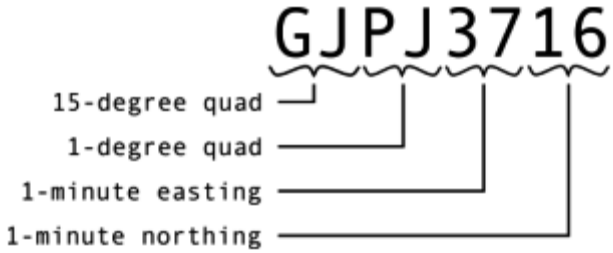
©Wikipedia[iii]

Then, divide subsequently into 1 degree by 1 degree area. Then, add ‘minutes” part.



©Wikipedia

Sample Code: GJPJ3716



©Wikipedia

LocaPoint (Obsolated due to LocaPoint2 is in public)

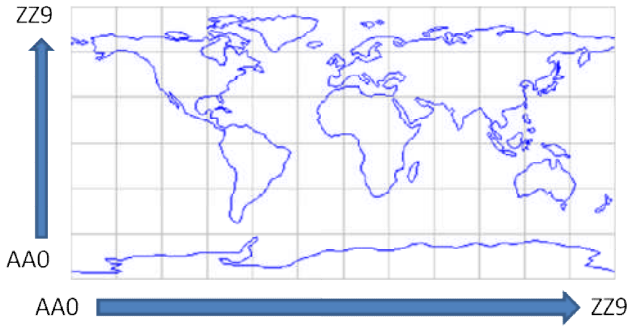
http://www.locapoint.com/en/index.html

http://www.locapoint.com/publicutil/lpillustrated.htm

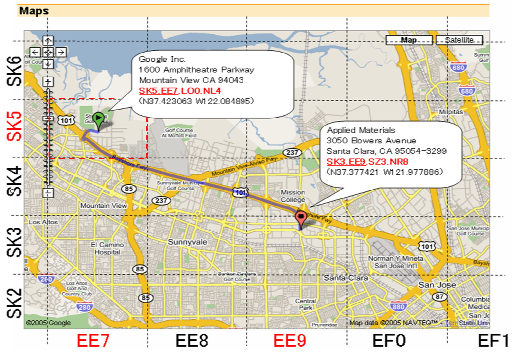
LocaPoint is developed by Locazing Inc. Japan patent 3885157 and patent pending in US and EU.

It is unique that LocaPoint create “Rhythm” by format pattern, - Alphabet, Alphabet, and Number-, to help brain’s pattern recognition process for human-error prevention, and computer detection.

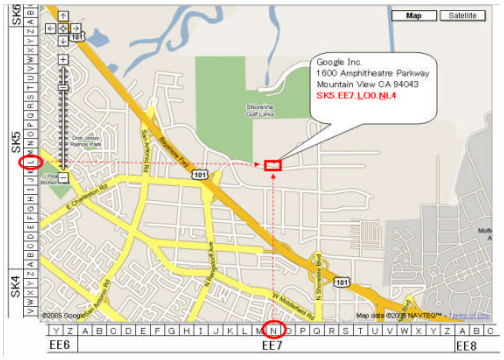
Like other GEOCODEs, assume whole area on earth rectangle in Mercator projection. Divide latitude into 6760 area and represents from “AA0” to “ZZ9”. Divide longitude in the same way.



©Locazing

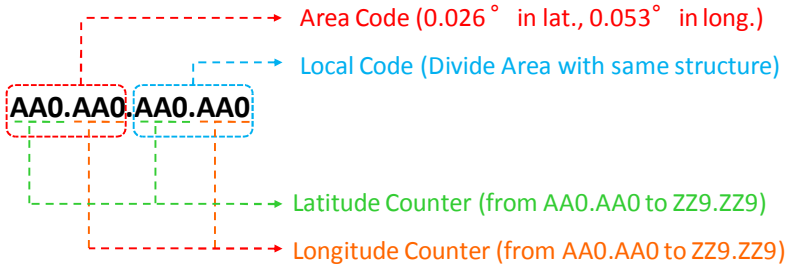


©Locazing



Divide area subsequently into 6760 by 6760 in the same way. These four code construct LocaPoint code as following.

©Locazing



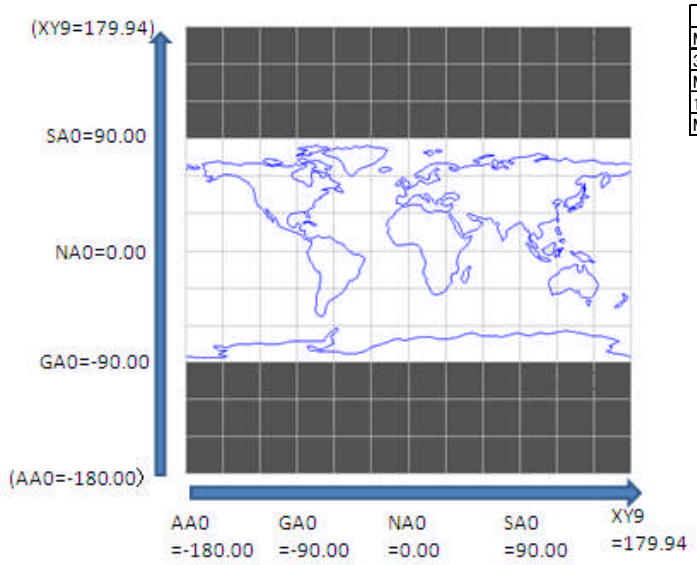
Sample Code

SW8.HQ9.CS6.PQ8

SD9.XC4.FE1.CV4

LP -address (LocaPoint2)

LP-Address is based on LocaPoint, and improves system affinity. Minimum unit is exactly 0.00001 degree in both latitude and longitude for easier converting.



	Code	Integer	Degree
Max	XY9	5999	179.9400
3/4	SA0	4500	90.0000
Mid	NA0	3000	0.0000
1/4	GA0	1500	−90.0000
Min	AA0	0	−180.0000

Difference between LocaPoint:

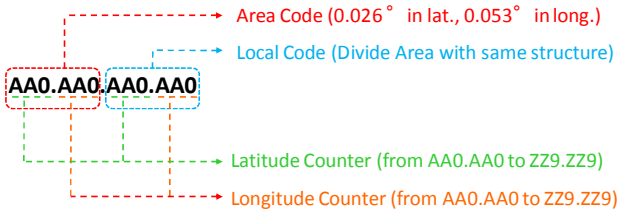
In LP-address, user can define 'private' code for any location, regardless geographic coordinates. For example, it can be used for 'location' in your shop, location of each floor of a building, relative location inside moving train, airplane, or ships, etc.

As long as code starts with "Z" and keep "AAN" rhythm, there is no limitation. It is like IP-address '192.168.0.xxx' can be used as "local address'. However, you need to prepare your own encoder/decoder for your 'private' LP address.

	Precision	1 unit step of code	Letter Used	License	Custom code
LocaPoint	0.04m in lat. 0.08m in lon.	0.00000780202° 0.00000393901°	A-Z,A-Z,0-9 for 0 to 6759	Patent Applied	Forbidden
LP-Address	1.1m in both Lat. and lon.	0,00001°	A-X,A-Y,0-9 for 0 to 5999	Patent Opened	Code start with "Z"

In LP-Address,

- An area code represents 0.06 degree by 0.06 degree area.
- A local code represents 0.00001 degree by 0.00001 degree area.



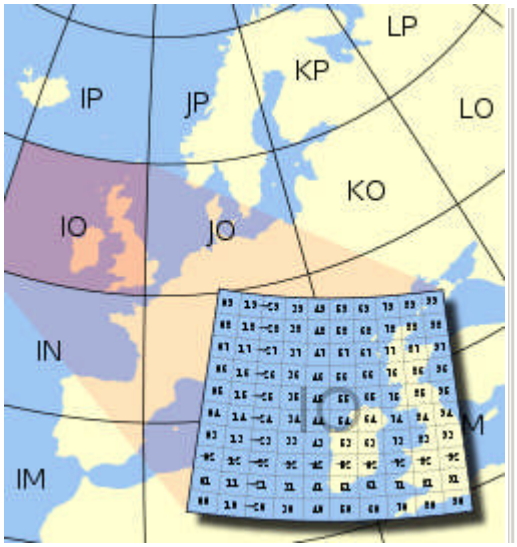
Sample Code

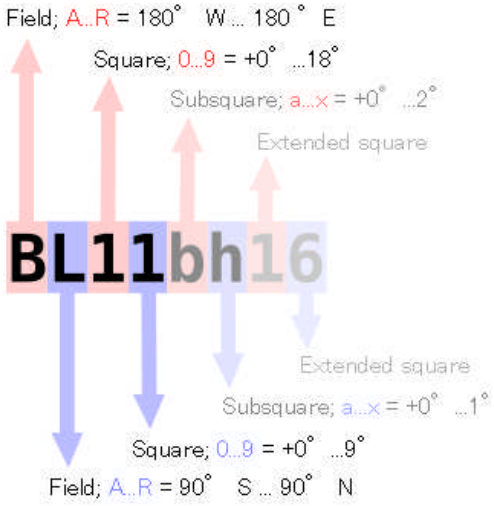
SW8.HQ9.CS6.PQ8

SD9.XC4.FE1.CV4

Maidenhead Locator System

http://en.wikipedia.org/wiki/Maidenhead_Locator_System





©Wikipedia[iv] ©Wikipedia

Character pairs encode longitude first, and then latitude.

The first pair (“field”) encodes with base 18 and the letters "A" to "R", representing 10° band for latitude, and 20° band for longitude

The second pair (square) encodes with base 10 and the digits "0" to "9”, representing 1° band for latitude, and 2° band for longitude

The third pair (subsquare) encodes with base 24 and the letters "A" to "X", representing 2.5 minutes band for latitude, and 5 minutes band for longitude

The fourth pair (extended square) encodes with base 10 and the digits "0" to "9", representing 0.25 minutes band for latitude, and 0.5 minutes band for longitude

The fifth and subsequent pairs are not formally defined, but recycling the third and fourth pair algorithms is one possible definition:

Sample Code:

BL11bh16
BL11bh16oo66

MapCode

http://guide2.e-mapcode.com/

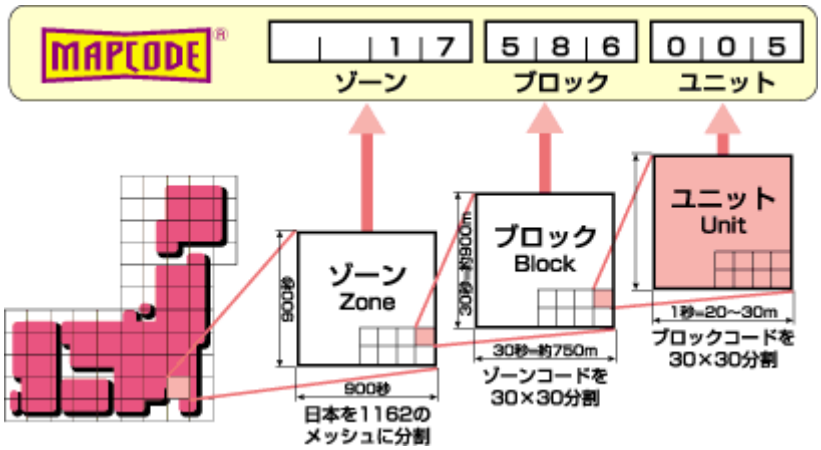
http://guide2.e-mapcode.com/application/menu01_02.html

MapCode was developed by DENSO Corporation, one of a Toyota group company.

Divide Japanese Land into many square shapes. Divide each square into 30x30=900 sub-square areas, in three times. It shows about 30meters by 30 meters area with 10 digit of integer numbers. MapCode is mainly developed to use car navigation interface. Thus, precision is reduced to 30 meter range which is still useful for car navigation purpose, and shorten code length as short as possible.

MapCode also use a data table that assign smaller number for Tokyo and some major cities. It can show Tokyo's location by only 6 numbers. In accurate, Tokyo's number is like 0000123456, but you can say it like 123456. This method is a same as G-Code of video recording. G-code uses small number for frequently watched time and duration.

Currently, MapCode is the most successful GEOCODE because almost all car navigation system in Japan has a MapCode input interface. However, it is yet far from "de facto standard".



©Denso Corporation

Sample Code:

586 005 (for Tokyo region)

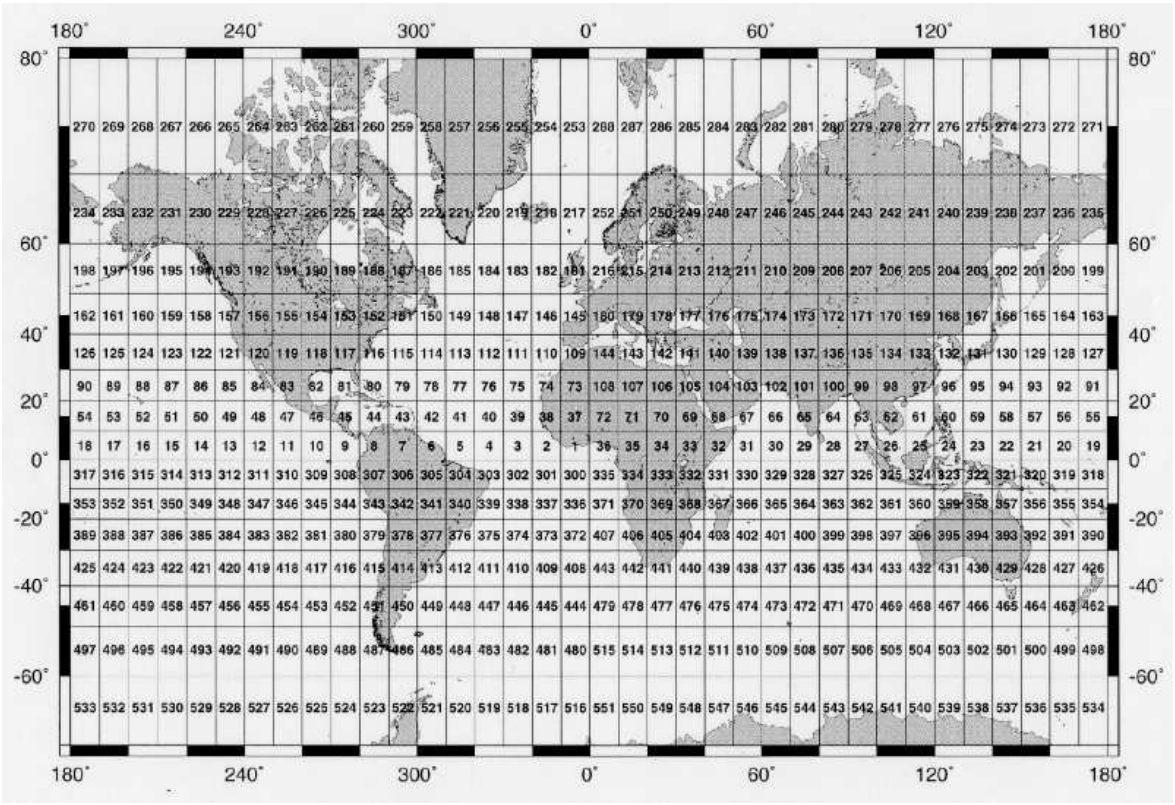
1234 567 890 (Standard)

1234 567 890*12 (higher precision)

Marsden square

http://en.wikipedia.org/wiki/Marsden_Square

Marsden Square covers from Latitude south 70 degree to North 80 degree, and stretched in latitude direction. Divide area described above into 10° latitude by 10° longitude areas. Each area has unique ID number from 1 to 288 and from 300 to 551. Each area can be divided into 100, one-degree squares numbered from 00 to 99.



IMPORTANT:

Munich Orientation Convention (StatusQuo)

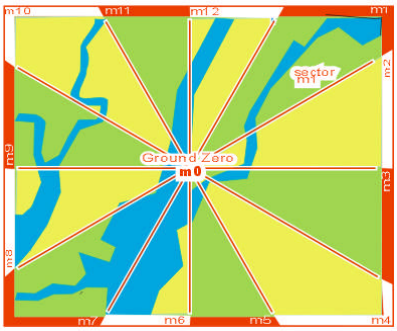
http://www.volksnav.com/

Munich Orientation Convention is unique GEOCODE since it uses polar coordinates system, dislike most of other GEOCODEs. It is designed for everyone including children and illiterate people who can read only number and clock.

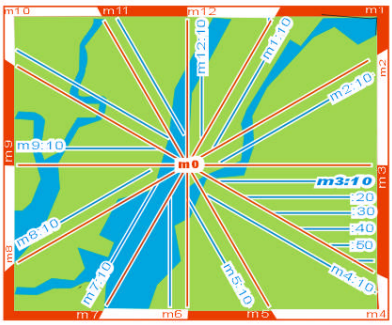
Munich Orientation Convention is a set of some navigating tools and method. Please visit their site for detail. In this document, their GEOCODE, “StatusQuo” is introduced.

StatusQuo defined “origin” or “center” point for each city. Any location will be expressed by angle and distance from center. Angle is expressed in “Time” format. For example, east is “3:00” and south is “6:00”.

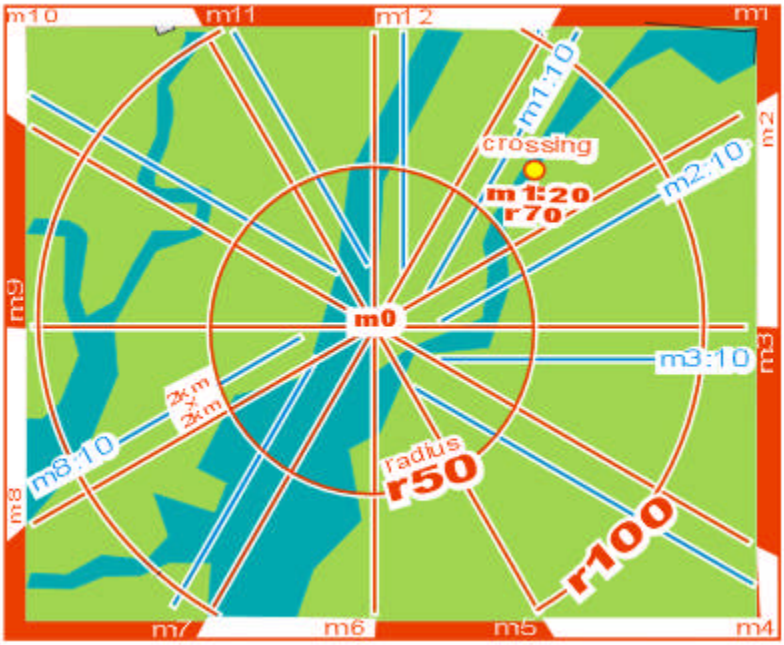
Status Quo is designed by orientation method, so it is very intuitive for city that has a polar style road design, such as Paris or Rio de Janeiro.



© Munich Orientation Convention



© Munich Orientation Convention



© Munich Orientation Convention

Sample Code: m4:6 r20

Natural Area Coding System (NAC)

http://www.nacgeo.com/nacsite/

The Natural Area Coding System (NAC) is developed by Dr. Xinhang Shen of NAC Geographic Products Inc. (Canada).

This code assumes that whole area on earth is rectangle in Mercator projection.

Divide latitude into 30 area and express in base 30 using table below. Then divide it subsequently by 30 again, and repeat until required precision.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	1	2	3	4	5	6	7	8	9	B	C	D	F	G
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
H	J	K	L	M	N	P	Q	R	S	T	V	W	X	Z

Letter not to be used ″A″, ″E″, ″I″, ″O″, ″U″ and ″Y″

Divide longitude value in the same way separately.

Longitude part, space, and latitude part consists NAC code.

I'd like to mention that NOT using bowl is a good idea. First, I and O usually trigger errors as 1(one) and 0(zero). Second, sounds of bowl may differ and confusable among various languages.

It is unique that NAC has a option for altitude information.

Sample Code:

8KDB PGFD

8KD8 PGGK H000 (With Altitude option)

Altitude Part

Latitude Part

Longitude Part

Navigation Code
by Aishin-AW

Navigation code is developed by Aishin A.W.corporation in Japan.

Japan patent pending　H11-184374.

Sample Code

Tokyo-34'24″-52'42″

Express latitude and longitude in degree-minute-second format. Then replace degree part with text string that is a key to the record to store degree integer part of latitude and longitude.

It needs database to decode, and pre-defined combination of key string and coordinates.

In short, concept is "CityName, min, sec, min, sec".

New-geocode
by Asian Aero Survey

New –geocode is developed by Asian Aero Survey Company.

Japan patent pending 2003-186391

Divide into world area into tile shape, escalatory and express in binary. Usually, tile areas are not exactly mesh-type dividing like other GEOCODEs, and have some overwrap part. This does some correction to make target area nearly square. (Simple dividing without correction causes divided area into trapezoid shape.)

Finally, use 64 kinds of Japanese Hiragana characters, translate each 7 bit binary into one Hiragana Characters. This makes total code length short, and convenient if code is used in Japan.

Sample Code: (Japanese Hiragana characters)

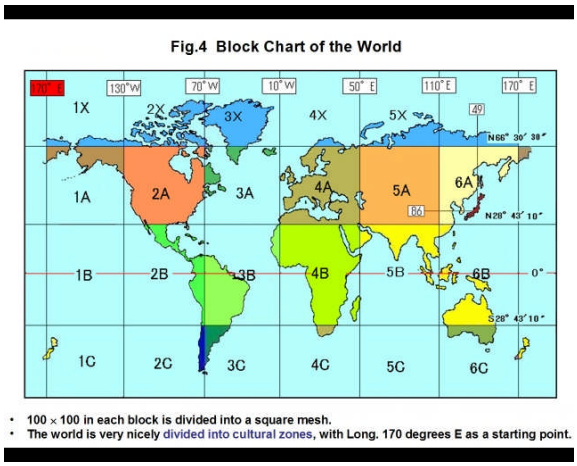
もいろぞちわもぞ

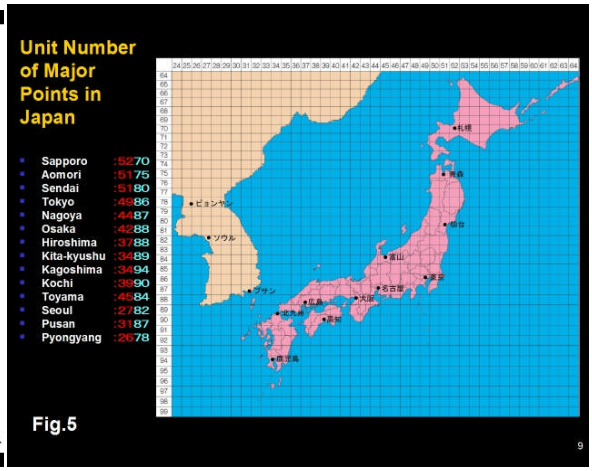
N-Code

http://www.ncproject.jp/main_e.htm

N-Code is developed by NC project Inc, in Japan. This code is designed for child safety, and use only numbers that even children who does not learn English alphabet can read it code.

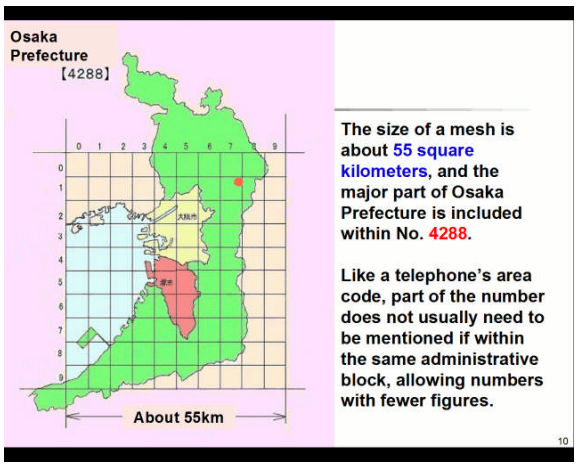
Divide into global area as follows. Please refer N-Code specification for initial dividing formula.





©NC Project ©NC Project

Initial area is divided 100 by 100 area. This size is about 55 kilometer by 55 kilometer, so N-Code suggest use this code as an area code, so regional user does not have to handle this.



©NC Project ©NC Project

In one area code, are divided into 1000 by 1000. It represents 5 meter by 5 meter area. If divided 10000 by 10000, it could be 0.5 meter precision. In this figure, code is 6A, 4288/471-530. But usually, 471-530 is enough for regional usage because other "471-530" points are farther than 50 kilometers.

Sample Code

6A, 4288/471-530 (Global Usage)

471-530 (Regional Usage)

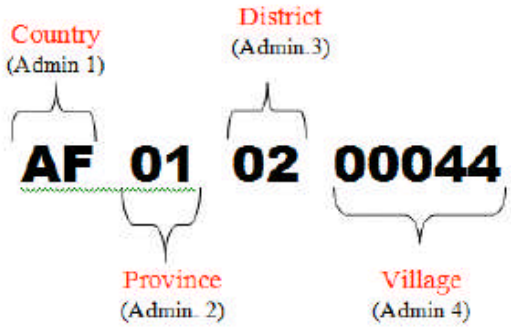
P-code

P-Code is a regional specific code developed by UN. P-Codes are reflects geographic coordinates, but reflects point of interests (POI) such as province or village.

Following explanation is fully cited from document “Place-Codes/Geo-Codes – Quick Guide:”

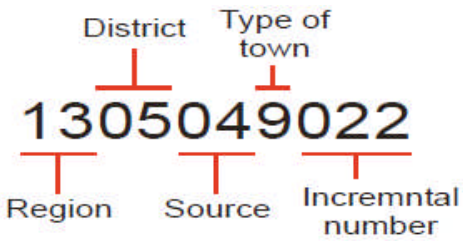
P-Codes for Afghanistan

The scheme was developed by a coalition of GIS experts and field officers from OCHA and other UN agencies to rapidly developing spatial data information for the Afghanistan humanitarian response activities of 2001.



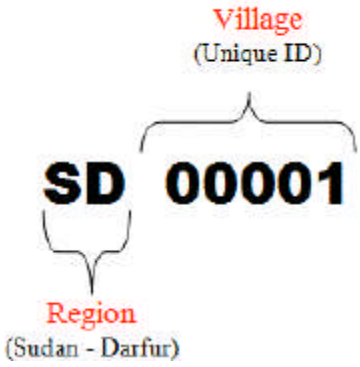
P-Codes for Somalia

This code was endorsed by the Government of Somalia in 1986.



P-Codes for Darfur region of Sudan

The government of Sudan had no unique identifiers for villages available. The HIC-Darfur created a unique code as a temporary measure so that humanitarian actors could begin sharing their information. SD was used so that there would be no confusion with the p-codes already in use for south Sudan.



SONY's geocode

US Patent 6,005,504

1. Latitude(-90 to 90 degree)→Integer Steps (0.1sec unit, from 0 to 6480000) →23 bit Binary
2. Longitude(-180 to180 degree)→Integer Steps (0.1sec unit, from 0 to 12960000) →24 bit Binary
3. Concatenate 23 bit latitude binary as a upper digit, with 24 bit longitude binary as lower. →47bit.
4. Use 0-9,A-Z,and "=", total 37 characters, express 47 bit binary value by 37^{th} radix notation. Code is 9-digit length.

Sony proposes that make this code length into 10-digit length, by adding one more letter as an error-correcting code. Sony's code looks random to human, so error correction code is a good idea to detect human error that may cause trouble.

Sample Code

SJ=E8JN32 (Standard)

SJ=E8JN32E(With Check Digit)

World Meteorological Organization squares

http://en.wikipedia.org/wiki/World_Meteorological_Organization_squares

According to Wikipedia article, It divide World area into areas of 10° latitude by 10° longitude. Each area has a unique, 4-digit numeric identifier (refer chart at NODC World Ocean Database 2005 page) . Each area is allocated a number between 1000 and 7817.

WMO squares are used as the basis for the c-squares spatial indexing system, which further divides 10°x10° WMO squares into smaller units of 5°x5°, 1°x1°, 0.5°x0.5°, 0.1°x0.1°, and so on.

Yahoo! Where On Earth ID (WOEID)

http://developer.yahoo.com/geo/geoplanet/data/

Introduced by Yahoo! Corporation on “where 2.0” held in San Jose , May, 2009.

WOEID is an 32-bit integer ID for locations, such as station, airport, landmarks, etc. assigned by Yahoo! Corporation in an arbitrary manner.

There is no way to encode from latitude and longitude.

9. About an Author

Name: Naoki Ueda

An Inventor of LocaPoint™ GEO-coding system, and LP-Address(LocaPoint2) GEO-coding system.

CEO of Locazing Inc.

Born in 1970, Osaka Japan. After eight years of being software engineer, take one year off for childcare. Invent LocaPoint coding system and launch Locazing Inc.

1995 BA of Electronics Engineering, Doshisha University, Japan

2003 MBA, Bond University, Australia

10. References

[i] United States Patent and Trademark Office. http://patft.uspto.gov/

[ii] NAC Geographic Products Inc.—Press Release, "Does Microsoft Infringe the Natural Area Coding System," Geoplace.com Printed from Internet on Jul. 28, 2005., pp. 1-5.

http://www.patentstorm.us/patents/7302343/description.html

[iii] Image is copied from WikiPedia, http://en.wikipedia.org/wiki/Georef

[iv] WikiPeda, http://en.wikipedia.org/wiki/Maidenhead_Locator_System