

# NACGIS V.2.0 Help Index

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## File menu commands

The File menu offers the following commands:

<u>New</u>	Creates a new document.
<u>Open</u>	Opens an existing document.
<u>Import</u>	Imports a NACGIS document, or a text file for polylines, polygons or text objects.
<u>Export</u>	Export a text file of all polylines, polygons or text objects of the current document
<u>Close</u>	Closes an opened document.
<u>Save</u>	Saves an opened document using the same file name.
<u>Save As</u>	Saves an opened document to a specified file name.
<u>Print</u>	Prints a document.
<u>Print</u>	Displays the document on the screen as it would appear printed.
<u>Preview</u>	
<u>Print Setup</u>	Selects a printer and printer connection.
<u>Recover</u>	Recovers the last edited document which was periodically backed up during the time it was opened in the software
<u>File</u>	
<u>File 1, 2,3</u>	Lists the last opened files for you to click to open directly.
<u>Exit</u>	Exits NACGIS V.2.0.

## Edit menu commands

The Edit menu offers the following commands:

<u>Edit Graphics</u>	Use this command to activate the graphics editing tools. This function protects the graphics from accidentally changes.
<u>Cut</u>	Deletes an object from the document and moves it to the clipboard.
<u>Copy</u>	Copies an object from the document to the clipboard.
<u>Paste</u>	Pastes the object from the clipboard into the document.
<u>Undo</u>	Recovers the last deleted objects or cleared document.
<u>Delete</u>	Deletes an object from the document
<u>Clear All</u>	Clears all the objects and settings of the document
<u>Select</u>	Selects a group of objects for manipulation
<u>Objects</u>	
<u>Group</u>	Turns the selected objects into a permanent group
<u>Objects</u>	
<u>Align Objects</u>	Aligns the selected objects to the left, center, right, or to the bottom, middle or top
<u>Search</u>	Search an object by its UGID or some key word

## Draw menu commands

The Draw menu offers drawing tools as listed in the following:

<u>Polyline</u>	Draws a polyline or a curve.
<u>Polygon</u>	Draws a polygon or an area with a curved side.
<u>Rectangle</u>	Draws a rectangle, ellipse, star etc.
<u>Picture</u>	Inserts a complex picture from the art gallery.
<u>Text</u>	Creates a text object
<u>Bitmap</u>	Inserts a bitmap into the document
<u>Distribution</u>	Creates or displays a distribution
<u>NAC Grid</u>	Add the NAC grid to the map

## Setting menu commands

The Setting menu offers the following commands:

<u>Pen Properties</u>	Sets the default pen properties.
<u>Brush Properties</u>	Sets the default brush properties.
<u>Font properties</u>	Sets the default font properties.
<u>Coordinate System</u>	Sets up the coordinate system
<u>Window Properties</u>	Sets the window properties.

## View menu commands

The View menu offers the following commands:

<u>Select Layers</u>	Selects the visible theme layers
<u>Zoom In</u>	Zoom in the map
<u>Zoom Out</u>	Zoom out from the previous Zoom In
<u>Selection Dialog</u>	Shows or hides the selection dialog box
<u>Manipulation Dialog</u>	Shows or hides the manipulation dialog box
<u>Toolbar</u>	Shows or hides the toolbar.
<u>Status Bar</u>	Shows or hides the status bar.

## Window menu commands

The Window menu offers the following commands, which enable you to arrange multiple views of multiple documents in the application window:

<u>New Window</u>	Creates a new window that views the same document.
<u>Cascade</u>	Arranges windows in an overlapped fashion.
<u>Tile</u>	Arranges windows in non-overlapped tiles.
<u>Arrange Icons</u>	Arranges icons of closed windows.
<u>Split</u>	Split the active window into panes.
<u>Window 1,</u> <u>2, ...</u>	Goes to specified window.

## Help menu commands

The Help menu offers the following commands, which provide you assistance with this application:

<u>Help Topics</u>	Offers you an index to topics on which you can get help.
<u>About NAC</u>	Describes the concept of the Natural Area Coding System
<u>About NACGIS</u>	Displays the version number of this application.

## **New command (File menu)**

Use this command to create a new document in NACGIS V.2.0.

You can open an existing document with the Open command.

### **Shortcuts**

Keys:      CTRL+N




## **Open command (File menu)**

Use this command to open an existing document in a new window. You can open multiple documents at once. Use the Window menu to switch among the multiple open documents. See Window 1, 2, ... command.

You can create new documents with the New command.

### **Shortcuts**

Toolbar:   
Keys: CTRL+O

## **File Open dialog box**

The following options allow you to specify which file to open:

### **File Name**

Type or select the filename you want to open. This box lists files with the extension you select in the List Files of Type box.

### **List Files of Type**

Select the type of file you want to open:  
NACGIS V.2.0 Document (\*.nac)

### **Drives**

Select the drive in which NACGIS V.2.0 stores the file that you want to open.

### **Directories**


Select the directory in which NACGIS V.2.0 stores the file that you want to open.

## **Import command (File menu)**

Use this command to open the File Import dialog box which allows you to import a file into the current document . You can import a NACGIS document, a polylines file, a polygons file, a text objects file, a DXF file, etc. The Import command will insert the geographic objects into the current document but not change the current document set-up. When you import polylines, polygons or text objects, they will be given the default pen, brush or font.

You can create new documents with the New command.  
You can open an existing document with the Open command.

### **Shortcuts**

Toolbar:   
Keys: CTRL+I

## **File Import dialog box**

The following options allow you to specify which file to import:

### **File Name**

Type or select the filename you want to import. This box lists files with the extension you select in the List Files of Type box.

### **List Files of Type**

Select the type of file you want to import:

NACGIS files (\*.nac)

Polylines files (\*.Ins)

Polygons files (\*.gns)

Text objects files (\*.txs)

DXF files (\*.dxf)

All files (\*.\*)

### **Drives**

Select the drive which stores the file that you want to import.

### **Directories**

Select the directory which stores the file that you want to open.

## **Export command (File menu)**

Use this command to open the File Export dialog box which allows you to export a text file for all the polylines, polygons or text objects of the current document

### **Shortcuts**

Keys:      CTRL+E

## **File Export dialog box**

The following options allow you to specify filename to export a text file:

### **File Name**

Type or select the filename you want to export. This box lists files with the extension you select in the List Files of Type box.

### **List Files of Type**

Select the type of file you want to export:

- Polylines files (\*.lns)
- Polygons files (\*.gns)
- Text objects files (\*.txs)
- DXF files (\*.dxf)
- All files (\*.\*)

### **Drives**

Select the drive which will store the file that you want to export.

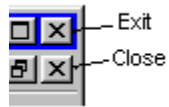
### **Directories**

Select the directory which stores the file that you want to export.

## **Close command (File menu)**

Use this command to close all windows containing the active document. NACGIS V.2.0 suggests that you save changes to your document before you close it. If you close a document without saving, you lose all changes made since the last time you saved it. Before closing an untitled document, NACGIS V.2.0 displays the Save As dialog box and suggests that you name and save the document.


You can also close a document by using the Close icon on the document's window, as shown below:



## **Save command (File menu)**

Use this command to save the active document to its current name and directory. When you save a document for the first time, NACGIS V.2.0 displays the Save As dialog box so you can name your document. If you want to change the name and directory of an existing document before you save it, choose the Save As command.

### **Shortcuts**

Toolbar:   
Keys: CTRL+S



## **Save As command (File menu)**

Use this command to save and name the active document. NACGIS V.2.0 displays the Save As dialog box so you can name your document.

To save a document with its existing name and directory, use the Save command.

## **File Save As dialog box**

The following options allow you to specify the name and location of the file you're about to save:

### **File Name**

Type a new filename to save a document with a different name. NACGIS V.2.0 adds the extension you specify in the Save File As Type box.

### **Drives**

Select the drive in which you want to store the document.


### **Directories**

Select the directory in which you want to store the document.

## **Print command (File menu)**

Use this command to print a document. This command presents a Print dialog box, where you may specify the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.

### **Shortcuts**

Toolbar:   
Keys: CTRL+P

## **Print dialog box**

The following options allow you to specify how the document should be printed:

### **Printer**

This is the active printer and printer connection. Choose the Setup option to change the printer and printer connection.

### **Setup**

Displays a Print Setup dialog box, so you can select a printer and printer connection.

### **Print Range**

Specify the pages you want to print:

**All** Prints the entire document.

**Selectio** Prints the currently selected text.

**n**

**Pages** Prints the range of pages you specify in the From and To boxes.

### **Copies**

Specify the number of copies you want to print for the above page range.

### **Collate Copies**

Prints copies in page number order, instead of separated multiple copies of each page.

### **Print Quality**

Select the quality of the printing. Generally, lower quality printing takes less time to produce.

## **Print Progress Dialog**

The Printing dialog box is shown during the time that NACGIS V.2.0 is sending output to the printer. The page number indicates the progress of the printing.

To abort printing, choose Cancel.

## **Print Preview command (File menu)**

Use this command to display the active document as it would appear when printed. When you choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The print preview toolbar offers you options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate a print job.

## **Print Preview toolbar**

The print preview toolbar offers you the following options:

### **Print**

Bring up the print dialog box, to start a print job.

### **Next Page**

Preview the next printed page.

### **Prev Page**

Preview the previous printed page.

### **One Page / Two Page**

Preview one or two printed pages at a time.

### **Zoom In**

Take a closer look at the printed page.

### **Zoom Out**

Take a larger look at the printed page.

### **Close**

Return from print preview to the editing window.

## **Print Setup command (File menu)**

Use this command to select a printer and a printer connection. This command presents a Print Setup dialog box, where you specify the printer and its connection.



## **Print Setup dialog box**

The following options allow you to select the destination printer and its connection.

### **Printer**

Select the printer you want to use. Choose the Default Printer; or choose the Specific Printer option and select one of the current installed printers shown in the box. You install printers and configure ports using the Windows Control Panel.

### **Orientation**

Choose Portrait or Landscape.

### **Paper Size**

Select the size of paper that the document is to be printed on.

### **Paper Source**

Some printers offer multiple trays for different paper sources. Specify the tray here.

### **Options**

Displays a dialog box where you can make additional choices about printing, specific to the type of printer you have selected.

### **Network...**

Choose this button to connect to a network location, assigning it a new drive letter.

## **Recover File command (File menu)**

Use this command to recover the last edited file which was not saved during your last editing of the file. The software backs up the document every ten minutes. Therefore, you will not lose more than ten minutes work.

## **1, 2, 3, 4 command (File menu)**

Use the numbers and filenames listed at the bottom of the File menu to open the last four documents you closed. Choose the number that corresponds with the document you want to open.

## **Exit command (File menu)**

Use this command to end your NACGIS V.2.0 session. You can also use the Close command on the application Control menu. NACGIS V.2.0 prompts you to save documents with unsaved changes.

### **Shortcuts**

Mouse: Click the application's Control menu button.  
Keys: ALT+F4



## **Edit Graphics command (Edit menu)**

Use this command to activate the graphics editing state. This is a protection of graphics from accidental changes.

### **Shortcuts**


Toolbar:   
Keys: CTRL+G

## **Cut command (Edit menu)**

Use this command to remove the currently selected data from the document and put it on the clipboard. This command is unavailable if there is no data currently selected.

Cutting data to the clipboard replaces the contents previously stored there.

### **Shortcuts**


Toolbar:   
Keys: CTRL+X

## Copy command (Edit menu)

Use this command to copy selected data onto the clipboard. This command is unavailable if there is no data currently selected.

Copying data to the clipboard replaces the contents previously stored there.


### **Shortcuts**

Toolbar:   
Keys: CTRL+C

## **Paste command (Edit menu)**

Use this command to insert a copy of the clipboard contents at its original location. This command is unavailable if the clipboard is empty.

### **Shortcuts**

Toolbar:   
Keys: CTRL+V



## **Undo command (Edit menu)**

Use this command to recover the last deleted objects or the last cleared document.


### **Shortcuts**

Keys: CTRL+Z or  
ALT-BACKSPACE

## **Delete command (Edit menu)**

Use this command to delete the current selected objects.


### **Shortcuts**

Toolbar:   
Keys: CTRL+D

## Clear All command (Edit menu)

Use this command to clear the current document.

### **Shortcuts**

Toolbar:   
Keys: CTRL+A

## Select Objects command (Edit menu)

Use this command to select multiple objects (a single object can be selected by clicking the mouse when the cursor is on the object). Once you click this command, the Theme layer selection dialog box appears, which allows you to select the theme layer on which you want to select multiple objects. Once the layer is selected, you can use the mouse to select the objects: move the cursor to the location where you want to put the top left corner of the selection rectangle, then click down the left button of the mouse and move the cursor to the location where you want to put the bottom right corner of the selection rectangle, then release the left button of the mouse.

Having done these steps, you will see all the objects of the selected layer in the selection rectangle will be bounded by their own bounding rectangles which let you know which objects have been selected. The individual object's bounding rectangle will disappear once you have manipulated the group. The whole group of the selected objects will be bounded by its own bounding rectangle. The appearance of bounding rectangles indicates that the selection is successful. The group is then in the selecting state. You can exit the selecting state and remove the bounding rectangles if you move the cursor out of the group bounding rectangle and click the mouse's left button.

During the selecting state, the group of selected objects can be deleted, cut., copied and pasted, by clicking the corresponding menu commands or toolbar buttons, if you want. You can also open the Alignment dialog box by the Align Objects command to align the objects to the left, center or right, and/or to the bottom, middle or top, and use the Group Objects command to turn the selected objects to a permanent group, and, if you like, add it to the Art Gallery database.

In the selecting state, if you move the cursor to the edge of the group bounding rectangle and click the left button of the mouse, the group will be bounded by a resize-move rectangle, which indicates that the group is in the manipulating state. You can exit the manipulating state and back to the selecting state if you move the cursor out of the resize-move rectangle and click the left button of the mouse.

During the manipulating state, you can move the cursor to the different location on the resize-move rectangle to resize or move the group (when the cursor is on the rectangle, it will change the shape to indicate the action you can do: resize in x-direction, in y-direction, in both directions, or move the group to wherever you want). All these actions can be done by clicking down the left button of the mouse, move the cursor and then release the button.

When the selected group enters the manipulating state, it may open the Manipulation dialog box. If you don't need it, you can click the toolbar button with M to hide the dialog box. The manipulation dialog box is a more powerful tool to manipulate the selected objects. It allows you to input exact data to move, resize, rotate and/or mirror the selected objects.

### Shortcuts

Toolbar:



## **Select layer dialog box**

The select layer dialog box lets you decide which theme layer on which you want to select objects.

### **List box**

The list box lists all the numbers and names of the possible layers of the document. You can use the mouse to select the layer you want. You can select only one layer at a time.

### **OK**

Once you finish the selection of the theme layer, press this button to exit the dialog box.

### **Cancel**

If you don't want to continue the selection, click this button to close the dialog box and exit the selection command.

## **Manipulation dialog box**

The Manipulation dialog box gives you the tools to input exact data to move, resize, rotate and mirror the selected objects.

### **Move the center to x: and y:**

Selecting this option, you can move the center of the selected object or the center of the group of the selected objects into the point specified by the x and y coordinates.

### **Move a distance of dx: and dy:**

Selecting this option, you can move the selected objects a distance as you specified in dx and dy boxes.

### **Stretch in x-direction:**

Input a value larger than one to expand the selected objects in x-direction and input a value smaller than one to compress the selected objects in x-direction.

### **Stretch in y-direction:**

Input a value larger than one to expand the selected objects in y-direction and input a value smaller than one to compress the selected objects in y-direction.

### **Angle:**

Input an angle for the rotation. Anti-Clockwise is positive.

### **Pivot at**

Click the option for the location of the rotation pivot. You can place the pivot at the top left corner, top right corner, center, bottom left corner, bottom right corner of the resize-move rectangle or place the pivot at the location as you specify in the x and y boxes.

### **Mirror in x-direction**

Mark it to mirror the selected objects in x-direction with the symmetric point at the above rotation pivot.

### **Mirror in y-direction**

Mark it to mirror the selected objects in y-direction with the symmetric point at the above rotation pivot.

### **Apply**

All the above inputs will be applied to the selected objects after you press this button.

### **Close**

Push this button to close the dialog box and exit the manipulating state.

## **Group Objects command (Edit menu)**

When a group of objects have been in the selecting state, you can use this command to turn the selected objects to a permanent group picture with a unique name you specify. This command will pop up the Set up a group dialog box which lets you name the new group. Click OK to add the group to the document and remove the individual objects of the group from the document. If you select the option Add to the Art Gallery, the group picture will be saved in the Art Gallery database (you can see the picture on the Insert a complex picture dialog box by the Draw Picture command). If the name of the current group has been used in the art gallery, there will pop up the Choice dialog box which ask you to choose whether not adding the current group, adding the current group in a different name or replacing the group in the art gallery with the current group. The current selection then becomes an insertion and the Insertion dialog box will open. An insertion is just a copied image of the group picture. It saves only the name of the group, the size, the center location and the orientation angle. Therefore, one complex picture can be inserted to many places of the map but the document needs to save the data of only one picture, which can save memory. If you want, you can turn an insertion back to the individual objects without losing any information by simply pushing the button Convert to parts on the Insertion dialog box.

## Set up a group dialog box

This dialog box let you input the name you want to call the newly created group picture.

**Group name:**

Give the name of the group

**Add to the art gallery**

Mark it to add the picture to the Art Gallery database.

**OK**

Press it to input the data and exit the dialog box

**Cancel**

Press it to exit the dialog box and cancel the grouping action.



## **Choice for adding a picture to the art gallery dialog box**

This dialog box asks you to select one of the possible choices for adding a group picture to the art gallery when the name of the current group has been used in the art gallery database.

There are three choices on the dialog box. If you choose the first one, you will not add the current group to the art gallery. If you choose the second one, you must specify another name for the current group and the current group will be added in the newly specified name into the art gallery. If you choose the last one, then the existing group in the art gallery will be replaced by the current group.

## **Align Objects command (Edit menu)**

When a group of objects is in selecting state, the Align Objects command can be used to align the selected objects: align the objects to the left, center, right or top, middle, bottom of the bounding rectangle of the group of the selected objects. Once you click the command, the Align objects dialog box will open. You can click the option you want and then click OK, the selected objects will be aligned according to your willing.

## Align objects dialog box

The Align objects dialog box helps you align the selected objects. There are two groups of options: vertical alignment and horizontal alignment. In each group you can mark 0 or 1 option.

### **Align the top**

Mark it to align the selected objects to the top of the bounding rectangle of the group.

### **Align the middle**

Mark it to align the selected objects to the middle of the bounding rectangle of the group.

### **Align the bottom**

Mark it to align the selected objects to the bottom of the bounding rectangle of the group.

### **Align the left**

Mark it to align the selected objects to the left of the bounding rectangle of the group.

### **Align the center**

Mark it to align the selected objects to the center of the bounding rectangle of the group.

### **Align the right**

Mark it to align the selected objects to the right of the bounding rectangle of the group.

### **OK**

Click OK to apply the alignment and exit the dialog box.

### **Cancel**

Click Cancel to exit the dialog without any alignments.

## **Search command (Draw menu)**

Use this command to search an object by its UGID or some key word. The found object will be set in its selecting state. Then you can edit the object or open its attached document. This command will open the [Search Dialog Box](#).

## **Search dialog box**

The search dialog box allow you find a graphic object and its associated document by its UGID or key words (the key word search is not supported in NACGIS Version 2.0). If the software is in editing state, the selected object will be placed in the selecting state. If it is not in editing state, the attached document of the object will be open.

## **Polyline command (Draw menu)**

### Introduction

Use this command to draw a polyline or a curve using either the mouse to directly draw on the screen or keyboard to input exact coordinates with a specified line style, color, width, transparency. You can assign the layer number for the theme layer of the polyline. If you want to convert the polyline into a polygon, you can simply click a button on the dialog box. If you want to attach a document to the polyline, you can push the Edit Document button which will open the attached document in the NACGIS Document editor. You can edit or read the document. The attached document is named by the Universal Geographic Identity (UGID) of the polyline. The UGID of a polyline is a ten-character Natural Area Code (NAC) of the middle point of the first two nodes of the polyline. The UGID can be used to universally identify a geographic object no matter its size (it can be a continent or an individual tree) anywhere in the world and can be used to calculate its exact location.

### Creating by the mouse

Once you click the menu command, the software enters the polyline creating state and waits for your input. You can move the cursor to the location where you want to put the first node of the polyline and click the left button of the mouse, which creates the first node of the polyline. In the same way, you can create the other nodes but the last node must be created by clicking the right button of the mouse, which will exit the creating state and start the selecting state. In the selecting state, the polyline will be drawn with its bounding rectangle.

### Editing by the mouse

During the selecting state, you can edit the polyline. If you want to adjust some node of the polyline, you can move the cursor to the node and click down the left button of the mouse. If the node is successfully selected, the tiny node selecting rectangle will change the color and then you can move the mouse to adjust the location of the node and release the button to end the adjustment. At this moment, the polyline is drawn by the default pen. If you accept all the aspects of the polyline, you can move the cursor out of the bounding rectangle of the polyline and click the left button of the mouse to exit the selecting state.


### Creating and editing by the Polyline set-up dialog box

If you click the View: Selection Dialog command during the creating or selecting state, you will get the Polyline set-up dialog box which will display all the parameters of the polyline: nodes coordinates, pen parameters, UGID, layer number, etc. If you don't want it, you can click the toolbar button with S to hide it. If you like to use it, you can input the exact nodes coordinates, specify pen parameters, determine whether it is a smooth curve or real polyline, or open and edit its attached document. You can use both the mouse drawing and keyboard inputting together. They are interacting simultaneously. If you select the node of the drawing, the dialog box will highlight its coordinates listing and place them on the edit boxes. You can see its order number and coordinates. You can edit the coordinates by the keyboard inputting. If you select the coordinates listing of a node, the drawing will highlight the node and you can see where the node locates.

### Resizing and moving

Once the polyline has been created and is in the selecting state, you can move the cursor to the edge of the bounding rectangle and click the left button of the mouse to turn the polyline to the manipulating state. In the manipulating state, the polyline can be moved, resized, rotated and mirrored (see the Mannipulation dialog box).

### **Shortcuts**

Toolbar: 



## **Polyline set-up dialog box**

The polyline set-up dialog box provides more powerful tools for you to create and edit a polyline object.

### **Layer #**

Type a number between 0 and 120 as the polyline's layer number. A graphic object with a larger layer number will be displayed on the top of another graphic object with a smaller layer number if both of them are displayed.

### **UGID**

This displays the Universal Geographic Identity of the polyline, which will be automatically calculated based on the coordinates of the first two nodes of the polyline.

### **Polyline**

Check this box to create a real polyline (its nodes are connected by straight lines).

### **Curve**

Check this box to create a smooth curve (its nodes are connected by smooth curves).

### **Transparency**

Check this box to create a transparent polyline or curve, i.e., all graphic objects under the line can be seen in a mixed color.

### **Point #**

Type in the order number of a node on the polyline to highlight the node on both the graphic drawing and the coordinates listing, and to place the coordinates in the coordinates editing boxes. Note: This box does not allow to be empty before inputting a new number, so you have to highlight the old number before inputting a new number instead of deleting the old number first.

### **X:**

Edit the coordinate in the X-direction.

### **Y:**

Edit the coordinate in the Y-direction.

### **Enter data**

Replace the X-Y coordinates in the coordinates listing with the values in the X: and Y: editing boxes.

### **Insert point**

Click to insert a new node to the polyline after the current selected node and shift the highlight to itself.

### **Delete point**

Delete the current selected node of the polyline and move the highlight to the previous node.

### **Point listing box**

The point listing box lists all the coordinates of the nodes of the polyline. Click on a line to select the node on both the drawing and the listing.

### **Pen width**

This box displays the current pen width of the pen to draw the polyline.

### **Pen type**

This box displays the current pen type of the pen to draw the polyline.

### **Pen color**

This box displays the current pen color of the pen to draw the polyline.

### **Set pen**

Push this button to open the pen dialog on which you can select the width, type and color of the pen to draw the polyline.

### **Edit document**

Push this button to create, edit or read the attached document of the polyline in the NACGIS Document Editor.

### **Close**

Push this button to close the editing of the polyline.



**Convert to polygon**

Push this button to convert the current polyline into a polygon with the filling of the default brush and close the polyline editing dialog and open the polygon editing dialog.

**Abandon polyline**

Abandon the polyline, i.e., delete the current polyline. If you want, you can recover the last deleted polyline by Edit: Undo command.

## Polygon command (Draw menu)

### Introduction

Use this command to draw a polygon with a polyline side or a smoothly curved side using either the mouse to directly draw on the screen or keyboard to input exact coordinates with a specified line style, color, width, filling color and pattern, and transparency to create the polygon. You can assign the layer number for the theme layer of the polygon. If you want to convert the polygon into a polyline, you can simply click a button on the dialog box. If you want to attach a document to the polygon, you can push the **Edit Document** button which will open the attached document in the NACGIS Document editor. You can edit or read the document. The attached document is named by the Universal Geographic Identity (UGID) of the polygon. The UGID of a polygon is a ten-character Natural Area Code (NAC) of the geometric center of the polygon. The UGID can be used to universally identify a geographic object no matter its size (it can be a continent or an individual tree) anywhere in the world and can be used to calculate its exact location.

### Creating by the mouse

Once you click the menu command, the software enters the creating state and waits for your input. You can move the cursor to the location where you want to put the first vertex of the polygon and click the left button of the mouse to create the first vertex of the polygon. In the same way, you can create the other vertices but the last vertex must be created by clicking the right button of the mouse, which will exit the creating state and start the selecting state. The picture is then bounded by its bounding rectangle.

### Editing by the mouse

During the selecting state, you can edit the polygon. If you want to adjust some vertex of the polygon, you can move the cursor to the vertex and click down the left button of the mouse to select it. If the vertex is successfully selected, its tiny selecting rectangle will change the color and then you can move the mouse to adjust the location of the vertex and release the button to end the adjustment. At this moment, the polygon is drawn by the default pen and default brush. If you accept all the aspects of the polygon, you can move the cursor out of the bounding rectangle of the polygon and click the left button of the mouse to exit the selecting state.

### Creating and editing by the Polygon set-up dialog box


If you click the View: Selection Dialog command during the creating or selecting state, you will see the Polygon set-up dialog box which will display all the parameters of the polygon: vertices coordinates, pen parameters, brush parameters, UGID, layer number, etc. If you don't want it, you can click the toolbar button with **S** to hide it. Using this dialog box, you can input the exact coordinates for the vertices, specify pen and brush parameters, determine whether it has a smoothly curved side or a real polyline side, determine whether the polygon is transparent, open and edit its attached document. You can use both the direct mouse drawing and keyboard inputting together. They are interacting simultaneously. If you select a vertex of the drawing, the set-up dialog box will highlight its coordinates listing and place them on the edit boxes. You can adjust the coordinates of the existing vertices, delete vertices or insert new vertices. Therefore, you can use the dialog to create a new polygon or edit an existing polygon. The dialog box directly linked with the drawing. If you select the coordinates listing of a vertex, the drawing will highlight the vertex and you can see where the vertex locates. If you select a vertex on the drawing, you will see the coordinates of the vertex are highlighted in the dialog box.

### Resizing and moving

Once the polygon has been created and is in the selecting state, you can move the cursor to the edge of the bounding rectangle and click the left button of the mouse to enter the

polygon's manipulating state. In the manipulating state, the polygon can be moved, resized, rotated and mirrored (see the [Manipulation Dialog box](#)).

### **Shortcuts**

Toolbar: 

## **Draw Polygon set-up dialog box**

The polygon set-up dialog box provides more powerful tools for you to create and edit a polygon object.

### **Layer #**

Type a number between 0 and 120 as the polygon's layer number. A graphic object with a larger layer number will be displayed on the top of another graphic object with a smaller layer number if both of them are displayed.

### **UGID**

This displays the Universal Geographic Identity of the polygon, which will be automatically calculated from the coordinates of the geometric center of the polygon.

### **Polyline**

Check this box to create a polygon with real polyline side(its vertices are connected by straight lines).

### **Curve**

Check this box to create a polygon with a smoothly curved side (its vertices are connected by smooth curves).

### **Transparency**

Check this box to create a transparent polygon, i.e., all graphic objects under the polygon can be seen in a mixed color.

### **Point #**

Type in the order number of a vertex of the polygon to highlight the vertex on both the graphic drawing and the coordinates listing, and to place the coordinates in the coordinates editing boxes. Note: This box does not allow to be empty before inputting a new number, so you have to highlight the old number before inputting a new number instead of deleting the old number first.

### **X:**

Edit the coordinate in the X-direction.

### **Y:**

Edit the coordinate in the Y-direction.

### **Enter data**

Replace the X-Y coordinates in the coordinates listing with the values in the X: and Y: editing boxes and update the layer number if you have changed it.

### **Insert point**

Click to insert a new vertex to the polygon after the current selected vertex and shift the highlight to itself.

### **Delete point**

Delete the current selected vertex of the polygon.

### **Point listing box**

The point listing box lists all the coordinates of the vertices of the polygon. Click on a line to select the vertex on both the drawing and the listing.

### **Pen width**

This box displays the current pen width of the pen to draw the side of the polygon.

### **Pen type**

This box displays the current pen type of the pen to draw the side of the polygon.

### **Pen color**

This box displays the current pen color of the pen to draw the side of the polygon.

### **Set pen**

Push this button to open the pen dialog on which you can select the width, type and color of the pen to draw the side of the polygon.

### **Brush pattern and color**

This box displays the current brush pattern and color which will be used to fill the inside area of the polygon.

### **Set brush**

Push this button to open the brush set-up dialog on which you can select the pattern and color of the brush which will be used to fill the inside area of the polygon.

**Edit document**

Push this button to create, edit or read the attached document of the polygon in the NACGIS Document Editor.

**Close**

Push this button to close the Polygon set-up dialog box and exit the selecting state.

**Convert to polyline**

Push this button to convert the current polygon into a polyline (disconnecting the first vertex and the last vertex and removing the filling) and close the Polygon set-up dialog box and open the Polyline set-up dialog box.

**Abandon polygon**

Abandon the polygon, i.e., delete the current polygon. If you want, you can recover the last deleted polygon by Edit: Undo command.

## Rectangle command (Draw menu)

### Introduction

Use this command to draw a rectangle-based graphic object (or picture) using the mouse to specify the location and size or the keyboard to input exact location and size with your specified pen and brush, transparency to create the object. You can assign the layer number for the theme layer of the object. If you want to convert the object into a polyline or a polygon, you can simply click a button on the dialog box. If you want to attach a document to the object, you can push the **Edit Document** button which will open the attached document in the NACGIS Document editor. You can edit or read the document. The attached document is named by the Universal Geographic Identity (UGID) of this object. The UGID of a rectangle-based object is a ten-character Natural Area Code (NAC) of the geometric center of the bounding rectangle of the picture. The UGID can be used to universally identify a geographic object no matter its size (it can be a continent or an individual tree) anywhere in the world and can be used to calculate its exact location.

### Creating by the mouse

Once you click the menu command, the software enters the picture's creating state and waits for your input. You can move the cursor to the location where you want to put the top left corner of the object's bounding rectangle, click down the left button of the mouse, drag the cursor to the location where you want to put the bottom right corner of the object, and then release the button. After these steps, a default rectangle-based picture is created and the software enters the picture's selecting state. If you accept all the aspects of the picture, you can move the cursor out of the bounding rectangle and click the left button of the mouse to exit the selecting state.

### Creating by the dialog box

If you click the View: Selection Dialog command during the creating state or selecting state, you will get the Simple picture set-up dialog box which will display all the parameters of the object: width and height with the unit selection,, center coordinates, picture choice, pen parameters, brush parameters, UGID, layer number, etc. If you don't want it, you can click the toolbar button with **S** to hide it. If you want to use it, you can input the exact data for all the parameters. You can open and edit its attached document.

### Resizing and moving

Once the object has been created and is in the selecting state, you can move the cursor to the edge of the bounding rectangle and click the left button of the mouse to enter the picture's manipulating state. In the manipulating state, the object can be moved and resized but not rotated and mirrored because a simple picture has the memory-saving structure. If you want to rotate or mirror the object, you can convert it into a polygon which can be rotated and mirrored (see the Manipulation Dialog box).

### **Shortcuts**

Toolbar:



## **Draw Rectangle set-up dialog box**

The Rectangle set-up dialog box lets you to create and edit a rectangle-based picture.

### **Layer #**

Type a number between 0 and 120 as the picture's layer number. A graphic object with a larger layer number will be displayed on the top of another graphic object with a smaller layer number if both of them are displayed.

### **UGID**

This displays the Universal Geographic Identity of the picture, which will be automatically calculated based on the coordinates of the geometric center of the picture's bounding rectangle.

### **Width**

Edit the width of the bounding rectangle.

### **Height**

Edit the height of the bounding rectangle.

### **Unit:**

The unit of the width and height can be millimeter (mm) or the current geographic unit. If you select mm, then the picture will have a fixed size no matter the scale of the displayed map. This unit is great for symbols representing a point, the exact location of which can be seen on both a small scale display and a large scale display. If you select geographic unit, then the width and height will be in the current geographic unit of the map (degree, meter or user-defined unit). The width and height of the picture in geographic unit will be scaled in the same way as the map on the screen when you zoom in or zoom out.

### **Center x:**

Edit the x-coordinate of the center of the bounding rectangle.

### **Center y:**

Edit the y-coordinate of the center of the bounding rectangle.

### **Transparency**

Check this box to create a transparent picture, i.e., all graphic objects under the picture can be seen in a mixed color.

### **Corner Width**

When you choose the round-corner rectangle, you will see this edit box which lets you input the width of the corner ellipse bounding rectangle. It has always the unit as the width of the whole picture's bounding rectangle.

### **Corner Height**

When you choose the round-corner rectangle, you will see this edit box which lets you input the height of the corner ellipse bounding rectangle. It has always the unit as the width of the whole picture's bounding rectangle.

### **Starting angle:**

When you choose the pie or chord, you will see this edit box which lets you input the starting angle of the pie or chord. The anti-clockwise angle is positive. The starting angle should be larger than the ending angle.

### **Ending angle:**

When you choose the pie or chord, you will see this edit box which lets you input the ending angle of the pie or chord. The anti-clockwise angle is positive. The starting angle should be larger than the ending angle.

### **Inner Width:**

When you choose a star-like picture, you will see this edit box which lets you input the width of the inner bounding rectangle of the picture. It has always the same unit as the width of the outer bounding rectangle.

### **Inner Height:**

When you choose a star-like picture, you will see this edit box which lets you input the height of the inner bounding rectangle of the picture. It has always the same unit as the

width of the outer bounding rectangle.

**Set pen**

Push this button to open the pen dialog on which you can select the width, type and color of the pen to draw the side of the picture.

**Set brush**

Push this button to open the brush set-up dialog on which you can select the pattern and color of the brush which will be used to fill the inside area of the picture.

**Convert to polyline**

Push this button you will convert the current picture to its side polyline without the connection between the first node and the last node.

**Convert to polygon**

Push this button you will convert the current picture to a polygon with exactly the same appearance. The only difference is their internal storing structure. The picture saves only the parameters shown on its dialog box, but its corresponding polygon saves the vertices coordinates. The picture created by this dialog box can't be mirrored or rotated, but its corresponding polygon can. Therefore, if you want the picture capable of rotating, you can use this dialog to create the exact picture you want and then convert it to a polygon.

**Enter data**

Replace the parameters of the picture with the values in the editing boxes and update the drawing.

**Edit document**

Push this button to create, edit or read the attached document of the picture in the NACGIS Document Editor.

**Close**

Push this button to close the picture set-up dialog box and exit the selecting state.

**Abandon picture**


Abandon the picture, i.e., delete the current picture. If you want, you can recover the last deleted picture by Edit: Undo command.



## Picture command (Draw menu)

Use this command to select a complex picture from the art gallery and insert it into the current document. This command will pop up the Art Gallery dialog box for you to select a picture. You can select one of the pictures shown on the dialog box and then click OK which will close the art gallery dialog box and pop up the Insertion dialog box. Then you can move the cursor to the location for the top left corner of the picture, click down the left button of the mouse, drag the cursor to the location for the bottom right corner of the picture and release the left button. Then, the picture will be shown on the screen with its bounding rectangle. If you accept the picture, you can move the cursor out of the bounding rectangle and click the left button of the mouse to close the dialog box and exit the selecting state. If you want to rotate the picture, you can input the angle of the orientation in the dialog box. If you want to edit the picture such as change the pen or brush, you can click the button **Convert to parts**, the picture will become individual parts which you can use other edit tools to edit these parts.

### Shortcuts

Toolbar: 

## **Art Gallery dialog box**

This dialog box shows you all the pictures in the art gallery database. You can select one that you like to insert to the current document.

### **Group name**

This combo box shows the name of the current selected picture. You can open its list box to change the selection. Once the selection is changed, both the edit box of the combo box and the picture gallery will show the selection immediately. The list box lists the names of all the pictures available in the art gallery database.

### **Delete the picture**

Click this box to remove the selected picture from the art gallery database.

### **Picture gallery**

The picture gallery shows 14 pictures at a time. You can click the **Page Down** or **Page Up** button to change the page of pictures. You can use the mouse to select a picture for your insertion. The selected picture will have a gray background in the picture gallery and its name will be shown on the Group name edit box.

### **OK**

Click this picture to close the dialog box and enter the creating state of the insertion.

### **Cancel**

Click this button to close the dialog box and cancel the insertion.

## **Insertion dialog box**

This dialog box lets you specify the parameters for the insertion

### **Layer #**

This box is for you to specify the theme layer (an integer between 0 and 120) for the insertion.

### **UGID**

This box displays the Universal Geographic Identity of the insertion, which is calculated based on the center coordinates of the insertion bounding rectangle.

### **Group name**

This box displays the name of the inserted group picture.

### **Width**

This box lets you input the width for the inserted picture. Its unit is always the current geographic unit of the document.

### **Height**

This box lets you input the height for the inserted picture. Its unit is always the current geographic unit of the document.

### **Orientation**

This box lets you input the orientation angle of the inserted picture, which is positive in the anti-clockwise direction and has the unit of degree.

### **Center x**

This box lets you input the x-coordinate of the center of the inserted picture. Its unit is always the current geographic unit of the document.

### **Center y**

This box lets you input the y-coordinate of the center of the inserted picture. Its unit is always the current geographic unit of the document.

### **Transparent check box**

This box lets you decide whether the inserted picture is transparent or not.

### **Enter data**

Replace the parameters of the picture with the values in the dialog boxes and update the drawing.

### **Edit document**

Push this button to create, edit or read the attached document of the inserted picture in the NACGIS Document Editor.

### **Close**

Push this button to close the Insertion dialog box and exit the selecting state.

### **Convert to parts**

Push this button to convert the Inserted picture into individual parts.

### **Abandon insert**

Abandon the inserted picture, i.e., delete the current insertion. If you want, you can recover the last deleted insertion by Edit: Undo command.

## Text command (Draw menu)

### Introduction

Use this command to create a text object with or without the help of the Text set-up dialog box. You can create a text string with your specified layer number, location, font, size, color, and escapement angle, etc. If you want to attach a document to the text, you can push the **Edit Document** button which will open the attached document in the NACGIS Document editor. You can edit or read the document. The attached document is named by the Universal Geographic Identity (UGID) of the text object. The UGID of a text object is a ten-character Natural Area Code (NAC) of the reference point of the text object. The UGID can be used to universally identify a geographic object no matter its size (it can be a continent or an individual tree) anywhere in the world and can be used to calculate its exact location.

### Creating

Once you click the menu command, the software enters the text creating state and waits for your input. You can move the mouse to the point where you want to place the text reference point and click the left button of the mouse. The software will draw the text bounding rectangle and the caret there which indicates that an empty text object has been created and the text creating state has been replaced by the selecting state which is ready for you to edit the text.

### Editing

During the selecting state, you can input whatever you want and the screen will update your input and the bounding rectangle. You can use the mouse or arrows to move the insertion caret. You can use Back Space key to delete the left character of the caret and Delete key to delete the right character of the caret. When you have input the whole text and you accept the default font, size and color as well as the escapement, you can move the cursor out of the bounding rectangle and click the left button of the mouse to exit the selecting state.

### Creating and editing by the Text set-up dialog box

If you click the View: Selecting Dialog command during the creating or selecting state, you will get the Text set-up dialog box which will display all the parameters of the text object: the layer number, reference point coordinates, reference point relative location in the text box, escapement angle, transparent option, etc. If you don't want dialog box, you can click the toolbar button with **S** to hide it. If you like to use it, you can input the exact parameters for the text, select the font and edit its attached document. Once you have finished the editing, click **Close** button to exit the selecting state.

### Resizing and moving

Once the text object has been created and is in the selecting state, you can move the cursor to the edge of the bounding rectangle and click the left button of the mouse to turn the text object to the manipulating state. In the manipulating state, the text can be moved, resized, rotated and mirrored (see the Manipulation Dialog box).

### **Shortcuts**

Toolbar:



## **Draw Text set-up dialog box**

The text set-up dialog box provides helpful tools for you to create and edit a text object.

### **Layer #**

Type a number between 0 and 120 as the text object's layer number. A graphic object with a larger layer number will be displayed on the top of another graphic object with a smaller layer number if both of them are displayed.

### **UGID**

This displays the Universal Geographic Identity of the text object, which will be automatically calculated based on the coordinates of the reference point of the text object.

### **Reference point**

The reference coordinates edit boxes allows you to input the exact coordinates for the point.

### **Reference point relative location in the text box**

Click the option you want the reference point locates in the box.

### **Select font**

Push this button to open the font dialog box on which you can select the font name, style, size, color, etc. If the font name in the list box is marked by **T**, it means the font is a true-type font which can have any size and can be rotated.

### **Text escapement angle**

This box allows you to specify an angle between the text baseline and the x-direction. Note that not all fonts support the escapement. Only the fonts marked by **T** in the font names list box support the escapement.

### **Font height/width ratio**

This box allows you to specify the exact ratio of the font height to the width.

### **Transparent**

Check this box to remove the font background color.

### **Font size is fixed**

Check this box, you will make the text remain no changes in size when you zoom in or zoom out the map.

### **Font size change with scale**

Check this box, you will make the text change size with the map scale when you zoom in or zoom out.

### **Enter data**

Replace the parameters of the text object with the values in the editing boxes and update the drawing.

### **Edit document**

Push this button to create, edit or read the attached document of the text object in the NACGIS Document Editor.

### **Close**

Push this button to close the text set-up dialog box and exit the selecting state.

### **Abandon text**

Abandon the text object, i.e., delete the current text object. If you want, you can recover the last deleted text object by Edit: Undo command.

## **Bitmap command (Draw menu)**

### Introduction

Use this command to create a bitmap object with or without the help of the Bitmap set-up dialog box. You can create a bitmap object with your specified layer number, location, size, bitmap file, etc. If you want to attach a document to the bitmap, you can push the **Edit Document** button which will open the attached document in the NACGIS Document editor. You can edit or read the document. The attached document is named by the Universal Geographic Identity (UGID) of the bitmap object. The UGID of a bitmap object is a ten-character Natural Area Code (NAC) of the center of the bitmap object. The UGID can be used to universally identify a geographic object no matter its size (it can be a continent or an individual tree) anywhere in the world and can be used to calculate its exact location.

### Creating

Once you click the menu command, the software enters the bitmap object's creating state and waits for your input. You can move the cursor to the point where you want to place the top left corner of the bitmap object, click down the left button of the mouse and drag the cursor to the location for the bottom right corner of the bitmap object and release the button. Then the default bitmap will be created and drawn with its bounding rectangle. The software exits the creating state and enters the bitmap's selecting state.

### Creating and editing by the Bitmap set-up dialog box

If you click the View: Selecting Dialog command during the creating or selecting state, you will get the Bitmap set-up dialog box which will display all the parameters of the bitmap object: the layer number, center point coordinates, width, height, unit option, transparent option, bitmap file name, etc. If you don't want it, you can click the toolbar button with **S** to hide it. If you like to use it, you can input the exact parameters for the bitmap, select the bitmap file, and edit its attached document. Once you have finished the editing, click **Close** to exit the selecting state.

### Resizing and moving

Once the bitmap object has been created and is in the selecting state, you can move the cursor to the edge of the bounding rectangle and click the left button of the mouse to enter the bitmap object's manipulating state. In the manipulating state, the bitmap can be moved and resized but not rotated and mirrored at the current version.

### **Shortcuts**

Toolbar:



## **Draw Bitmap set-up dialog box**

The bitmap set-up dialog box provides helpful tools for you to create and edit a bitmap object.

### **Layer #**

Type a number between 0 and 120 as the bitmap object's layer number. A graphic object with a larger layer number will be displayed on the top of another graphic object with a smaller layer number if both of them are displayed.

### **UGID**

This displays the Universal Geographic Identity of the bitmap object, which will be automatically calculated based on the coordinates of the center point of the bitmap object.

### **Center point**

The center point coordinates edit boxes allows you to input the exact coordinates for the point.

### **Width**

Input the exact width for the bitmap object in either millimeter or the current geographic unit..

### **Height**

Input the exact height for the bitmap object in either millimeter or the current geographic unit..

### **Unit option**

If you check mm, you will get a bitmap which will not change size when you zoom in or zoom out the map. If you check Geographic units, you will get a bitmap which will be scaled along with the map.

### **Transparent**

This option has not been activated in the current version.

### **Bitmap file**

This box displays or lets you specify the path and name of the bitmap file. You can also use the **Select bitmap file** push button to select the bitmap file.

### **Select bitmap file**

Push this button to open the file-open dialog box which will allows you to go to the directory of your interesting bitmap file and select it. Push the **OK** button, the selected file name will be placed in the bitmap file name edit box.

### **Enter data**

Press this button to replace the parameters of the bitmap object with the values in the editing boxes and update the drawing.

### **Edit document**

Push this button to create, edit or read the attached document of the bitmap object in the NACGIS Document Editor.

### **Close**

Push this button to close the bitmap set-up dialog box and exit the selecting state.

### **Abandon bitmap**

Abandon the bitmap object, i.e., delete the current bitmap object. If you want, you can recover the last deleted bitmap object by Edit: Undo command.

**Draw Distribution command (Draw menu)**

This command will be activated in the future version of the NACGIS.



## **Draw NAC Grid command (View menu)**

This command lets you add the NAC grid to the current map. It automatically adjusts the grid, so as to display the appropriate grid level. The NAC grid is the 60th theme layer, that means, all the theme layers with layer numbers larger than 60 will be displayed on top of the grid, while the layers with layer numbers smaller than 60 will be displayed beneath the NAC grid.

### **Shortcuts**

Toolbar:



## **Pen Properties command (Setting menu)**

Use this command to set up the default pen properties. The default pen is the initial pen used in all the drawing tools. If you want to draw many graphic objects with the same pen, you can set up the pen using this command and you don't need to set up the pen individually. For example, if you want import a polylines file which simply lists the nodes coordinates of polylines representing the same kind of lines, you just set the default pen by this command and all the imported polylines will be drawn by this pen.

Once you click on the command, the Pen Properties dialog box will open, on which you can specify the exact pen width, pen type and color.

### **Shortcuts**

Toolbar:



## **Pen Properties dialog box**

This dialog box lets you set up the width, type and color for the default pen which will be used as the initial pen for all graphic objects to be created later on.

### **Pen Width**

In this edit box, you can input a positive real number as the pen width in millimeters. The pen width should be between 0 and 20 mm.

### **Pen Type**

In this combo box, you can select the pen style from 6 possible styles as listed in its list box.

### **Pen Color**

The pen color can be composed from three basic colors: red, green and blue. You can input a number between 0 and 255 for each basic color edit box. The final composed color will be shown on the left large square box as you input the data. Each basic color will be shown on the small rectangle box at the right side of each basic color edit box. There are 27 existing colors shown on the small rectangles under the edit boxes. You can select a color from these boxes by simply clicking the box you want. The basic components will be shown immediately in the basic color edit boxes and their right side boxes and the mixed color will be shown on the larger square box.

### **OK**

Click this button, you will save the current settings for the default pen and close the pen properties dialog box.

### **Cancel**

Click this button, you will abandon the current settings for the default pen and close the pen properties dialog box.

### **Default**

Click this button, you will get a solid pen style and gray color and 0.2 mm pen width.

## **Brush Properties command (Setting menu)**

Use this command to set up the default brush properties. The default brush is the initial brush used in all the later drawing. If you want to draw many graphic objects with the same brush, you can set up the default brush using this command and then you don't need to set up the brush individually. For example, if you want import a polygons file which simply lists the vertices coordinates of polygons representing the same kind of geographic entities, you set the default brush using this command and all the imported polygons will be filled by this brush.

Once you click on the command, the Brush Properties dialog box will open, on which you can specify the exact brush pattern and color.

### **Shortcuts**

Toolbar:



## **Brush Properties dialog box (Setting menu)**

This dialog lets you set up the pattern and color for the default brush which will be used as the initial brush for all graphic objects to be created later on.

### **Brush Pattern**

There are eight different brush patterns available. You can use either the combo box or direct mouse clicking on the pattern display boxes. The combo box lists the name of the pattern and the display boxes show you the actual patterns.

### **Brush Color**

The brush color can be composed from three basic colors: red, green and blue. You can input a number between 0 and 255 for each basic color edit box. The final composed color will be shown on the left large square box as you input the data. Each basic color will be shown on the small rectangle box at the right side of each basic color edit box. There are 27 existing colors shown on the small rectangles under the edit boxes. You can select a color from these boxes by simply clicking the box, if you accept one of them. The basic components will be shown immediately in the basic color edit boxes in digital form and their right side boxes in visual form. The mixed color will be shown on the larger square box.

### **OK**

Click this button, you will save the current settings for the default brush and close the brush properties dialog box.

### **Cancel**

Click this button, you will abandon the current settings for the default brush and close the brush properties dialog box.

### **Default**

Click this button, you will get a solid pattern and gray color for the brush.

## **Font Properties command (Setting menu)**

Use this command to set up the default font properties. The default font is the initial font used in all the later text drawings. If you want to draw many text objects in the same font, you can set up the default font using this command and then you don't need to set the individual font for each later text object. For example, if you want import a texts file which simply lists the text strings with the starting point coordinates, you can set the default font using this command and all the imported text objects will be in this font.

### **Shortcuts**

Toolbar:



## **Coordinate system command (Setting menu)**

Use this command to set up the coordinate system. There are three coordinate systems: Longitude/Latitude system, Universal Transverse Mercator System and User-defined system. The first two systems can be converted to each other if the document range is within one UTM zone. But there are no conversions between User-defined system and Longitude/Latitude (or UTM) system. When the document is empty, you can set up the coordinate system as you like without limits. However, if the document has already had objects, you can shift the coordinates between Longitude/Latitude, and UTM but not the User-defined system. If the document is in User-defined system, you can't shift from this system to any other system.

## **Window Properties command (Setting menu)**


Use this command to set up the scroll window size and background color. The scroll window can have a size larger than the actual screen. The pictures can be scrolled by the window scroll bars. The largest size depends on your computer's hardware. The background color is shown on the screen where the document pictures have not covered.



## Select Layer command

The command lets you select the visible theme layers of the map. Unselected theme layers will not be shown on the screen. You can use this command to arrange the theme layers which will give you the best picture you want. This command will pop up the Select theme layers dialog box on which you can click the layer to select or deselect. The current clicked layer's name is shown on the edit box in which you can input or edit the theme layer name.

### Shortcuts

Toolbar: 

## **Select theme layer dialog box**

This dialog box displays 120 theme layers in a list box. You can select the theme layers you want to display the map.

### **List box**

The list box lists all the possible 120 theme layers that the NACGIS V2 can support. You can select the layers you want the map display. Layer 30 is the default layer which is assigned to all graphic objects at the first time of creation. Layer 60 is the grid layer which decides whether the grid is on or off. The selected layers are highlighted. If you click on a layer without highlighting, the layer will be selected. If you click on a highlighted layer, the layer will be deselected. The selected layer's name has been put in the edit box which allows you to edit the name for the layer.

### **Edit box**

This box lets you input or edit the layer name you last clicked.

### **OK**

Click this button to close the dialog box and enter the selection creating state.

### **Cancel**

Click this button to close the dialog box and exit the selection command.

## **Zoom In (View menu)**

This command lets you select a rectangle on the screen and expand the image in the rectangle to the whole window area. Once you click the command, the cursor changes to the cross-cursor which indicates that you can start the selection now. Move the cursor to the top left corner of your selection rectangle, click down the left button of the mouse, drag the cursor to the bottom right corner of the rectangle, and release the button. Then the expanded image will be drawn on the screen.

This command changes the coordinates of the top left corner of the window and the scale of the coordinate system. If you want to change back, you can use the Zoom Out command to change back to the last settings. The software saves up to ten settings, i.e., if you zoom in the map ten times, you can still zoom out to the original setting.

If the Zoom In command is used in the split windows, you can zoom in one window and the software will display two maps with two different scales in two split windows. This will be useful when you want to see both the overall map and its local detail map.

### **Shortcuts**

Toolbar:



## **Zoom Out (View menu)**

This command lets you go back from the last Zoom In command. Once you click the command, the original image before your last Zoom In command will be displayed. You can zoom out to the original image before the first of the last ten Zoom In commands.

### **Shortcuts**

Toolbar:



## **Selection Dialog (View menu)**

Click this command to show or hide the selection dialog box of the object in the current creating or selecting state. If you don't need the selection dialog box and use only the mouse to draft a picture, you can use this command to hide the selection dialog box. If you want to draw a picture with exact parameters as you specified, you can use this command to show the selection dialog box which will give you all the tools to draw an accurate picture as you want. A check mark appears next to the menu item when the command is in the show state.

### **Shortcuts**

Toolbar:



## **Manipulation Dialog (View menu)**

Click this command to show or hide the Manipulation dialog box during an object manipulating state (move-resize state). If you don't need the manipulation dialog box and use only the mouse or arrow keys to move or resize a picture, you can use this command to hide the manipulation dialog box. If you want to move, resize, mirror or rotate a picture with exact parameters as you specified, you can use this command to show the manipulation dialog box which will give you all the tools to perform these actions exactly as you specify in the dialog box. A check mark appears next to the menu item when the command is in the show state.

### **Shortcuts**

Toolbar:



## **Toolbar command (View menu)**

Use this command to show or hide the Toolbar, which includes buttons for some of the most common commands in NACGIS V.2.0, such as File Open. A check mark appears next to the menu item when the Toolbar is displayed.

See [Toolbar](#) for help on using the toolbar.

## Toolbar



The toolbar is displayed across the top of the application window, below the menu bar. The toolbar provides quick mouse access to many tools used in NACGIS V.2.0. You can use the mouse to move the tool bar to the top, left, right, bottom or wherever you want.

To hide or display the Toolbar, choose Toolbar from the View menu (ALT, V, T).

### Click To

---



Open an existing document. NACGIS V.2.0 displays the Open dialog box, in which you can locate and open the desired file.



Import an existing NACGIS document or a text file of polylines, polygons, text objects or a dxf file. NACGIS V.2.0 displays the Open dialog box for the import, in which you can locate and import the desired file.



Save the active document or template with its current name. If you have not named the document, NACGIS V.2.0 displays the Save As dialog box.



Remove selected data from the document and stores it on the clipboard.



Copy the selection to the clipboard.



Insert the contents of the clipboard at the insertion point.



Remove selected data from the document and stores it in the undo buffer.



Remove all the contents of the current document and stores them in the undo buffer.



Print the active document.



Click this button to enter the context help state during which you can move the cursor to the window item you want to get the help and click the left button of the mouse. You will open the help window which will be displaying the desired help text.



Click this button to start a polyline creating state.



Click this button to start a polygon creating state.





Click this button to start the creating state of a rectangle, ellipse, regular polygon, star or another simple picture.



Click this button to select a complex picture from the art gallery and insert it into the current document.



Click this button to start a text object creating state.



Click this button to insert a bitmap object.



Click this button to show or hide the NAC grid.



Click this button to start a polyline creating state.



Click this button to start the Zoom In command



Click this button to go back from the last Zoom In command.



Click this button to start to select objects.



Click this button to select visible theme layers for the current document.



Click this button to show or hide the selection dialog box.



Click this button to show or hide the manipulation dialog box.



Click this button to set the default pen.



Click this button to set the default brush.



Click this button to set the default font.

## **Status Bar command (View menu)**

Use this command to display and hide the Status Bar. When the cursor is at a window item, the status bar will show the description of the action to be executed. When the cursor is in the view window, it will display the coordinates of the current cursor in longitude/latitude, UTM and NAC. A check mark appears next to the menu item when the Status Bar is displayed.

See [Status Bar](#) for help on using the status bar.

## Status Bar

LON/LAT[-58.72218, 42.23317] UTM[21, 357893, 4677102] NAC: B35T2 Q14Z8

NUM

The status bar is displayed at the bottom of the NACGIS V.2.0 window. To display or hide the status bar, use the Status Bar command in the View menu.

The left area of the status bar describes actions of menu items as you use the arrow keys to navigate through menus. This area similarly shows messages that describe the actions of toolbar buttons as you depress them, before releasing them. If after viewing the description of the toolbar button command you wish not to execute the command, then release the mouse button while the pointer is off the toolbar button.

The left area of the status bar displays the Longitude/Latitude, UTM and NAC of the current cursor location when the cursor is in the view window. The three forms representing the cursor location has almost the same accuracy (about one meter).

The right areas of the status bar indicate which of the following keys are latched down:

<b>Indicator</b>	<b>Description</b>
CAP	The Caps Lock key is latched down.
NUM	The Num Lock key is latched down.
SCRL	The Scroll Lock key is latched down.

## **New command (Window menu)**

Use this command to open a new window with the same contents as the active window. You can open multiple document windows to display different parts or views of a document at the same time. If you change the contents in one window, all other windows containing the same document reflect those changes. When you open a new window, it becomes the active window and is displayed on top of all other open windows.

## **Cascade command (Window menu)**

Use this command to arrange multiple opened windows in an overlapped fashion.

## **Tile command (Window menu)**

Use this command to arrange multiple opened windows in a non-overlapped fashion.

## **Tile Horizontal command (Window menu)**

Use this command to vertically arrange multiple opened windows in a non-overlapped fashion.

## **Tile Vertical command (Window menu)**

Use this command to arrange multiple opened windows side by side.



## **Window Arrange Icons Command**

Use this command to arrange the icons for minimized windows at the bottom of the main window. If there is an open document window at the bottom of the main window, then some or all of the icons may not be visible because they will be underneath this document window.

## **Split Command (Window menu)**

Use this command to split the active window into panes. You may then use the mouse or the keyboard arrows to move the splitter bars. When you are finished, press the mouse button or enter to leave the splitter bars in their new location. Pressing escape keeps the splitter bars in their original location.

## **1, 2, ... command (Window menu)**

NACGIS V.2.0 displays a list of currently open document windows at the bottom of the Window menu. A check mark appears in front of the document name of the active window. Choose a document from this list to make its window active.

## **Index command (Help menu)**

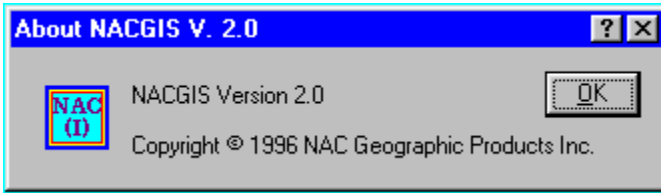
Use this command to display the opening screen of Help. From the opening screen, you can jump to step-by-step instructions for using NACGIS V.2.0 and various types of reference information.

Once you open Help, you can click the Contents button whenever you want to return to the opening screen.

## **Using Help command (Help menu)**

Use this command for instructions about using Help.

## About command (Help menu)



## Context Help command

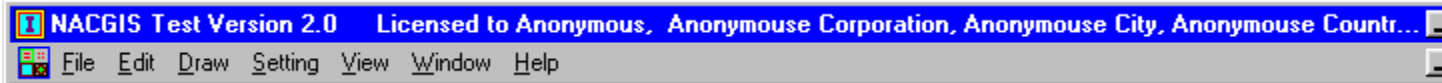


Use the Context Help command to obtain help on some portion of NACGIS V.2.0. When you choose the Toolbar's Context Help button, the mouse pointer will change to an arrow and question mark. Then click somewhere in the NACGIS V.2.0 window, such as another Toolbar button. The Help topic will be shown for the item you clicked.

### **Shortcut**

Keys:      SHIFT+F1










## Title Bar



The title bar is located along the top of a window. It contains the name of the application, license information.

To move the window, drag the title bar. Note: You can also move dialog boxes by dragging their title bars.

A title bar may contain the following elements:

- Application icon
- Name of the application
-  License information
-  Frame window maximize button
-  Frame window minimize button
-  Application exit button
-  Document icon
-  Menu
-  Document view window maximize button
-  Document view window minimize button
-  Document view window exit button



## **Scroll bars**

Displayed at the right and bottom edges of the document window. The scroll boxes inside the scroll bars indicate your vertical and horizontal location in the document. You can use the mouse to scroll to other parts of the document.

## **Size command (System menu)**

Use this command to display a four-headed arrow so you can size the active window with the arrow keys.



After the pointer changes to the four-headed arrow:

1. Press one of the DIRECTION keys (left, right, up, or down arrow key) to move the pointer to the border you want to move.
2. Press a DIRECTION key to move the border.
3. Press ENTER when the window is the size you want.

Note: This command is unavailable if you maximize the window.

### **Shortcut**

Mouse: Drag the size bars at the corners or edges of the window.

## **Move command (Control menu)**

Use this command to display a four-headed arrow so you can move the active window or dialog box with the arrow keys.



Note: This command is unavailable if you maximize the window.


### **Shortcut**

Keys: CTRL+F7

## **Minimize command (application Control menu)**

Use this command to reduce the NACGIS V.2.0 window to an icon.

### **Shortcut**

Mouse: Click the minimize icon  on the title bar.  
Keys: ALT+F9

## **Maximize command (System menu)**

Use this command to enlarge the active window to fill the available space.

### **Shortcut**

Mouse: Click the maximize icon  on the title bar; or double-click the title bar.

Keys: CTRL+F10 enlarges a document window.

## **Next Window command (document Control menu)**

Use this command to switch to the next open document window. NACGIS V.2.0 determines which window is next according to the order in which you opened the windows.

### **Shortcut**

Keys: CTRL+F6

## **Previous Window command (document Control menu)**

Use this command to switch to the previous open document window. NACGIS V.2.0 determines which window is previous according to the order in which you opened the windows.

### **Shortcut**

Keys: SHIFT+CTRL+F6

## **Close command (Control menus)**

Use this command to close the active window or dialog box.

Double-clicking a Control-menu box is the same as choosing the Close command.



Note: If you have multiple windows open for a single document, the Close command on the document Control menu closes only one window at a time. You can close all windows at once with the Close command on the File menu.

### **Shortcuts**

Keys:      CTRL+F4 closes a document window  
              ALT+F4 closes the NACGIS window or dialog box



## **Restore command (Control menu)**

Use this command to return the active window to its size and position before you chose the Maximize or Minimize command.

## **Switch to command (application Control menu)**

Use this command to display a list of all open applications. Use this "Task List" to switch to or close an application on the list.

### **Shortcut**

Keys: CTRL+ESC

### **Dialog Box Options**

When you choose the Switch To command, you will be presented with a dialog box with the following options:

#### **Task List**

Select the application you want to switch to or close.

#### **Switch To**

Makes the selected application active.

#### **End Task**

Closes the selected application.

#### **Cancel**

Closes the Task List box.

#### **Cascade**

Arranges open applications so they overlap and you can see each title bar. This option does not affect applications reduced to icons.

#### **Tile**

Arranges open applications into windows that do not overlap. This option does not affect applications reduced to icons.

#### **Arrange Icons**

Arranges the icons of all minimized applications across the bottom of the screen.

**No Help Available**

No help is available for this area of the window.

## **No Help Available**

No help is available for this message box.

# Tutorial for NACGIS Version 2.0

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## Introduction

The NACGIS Version 2.0 is a powerful geographic information management system with an efficient graphics editor. The software can display multiple maps at the same time, multiple views of one map at the same time. It allows you to display different theme layers of a map as you specify. You can easily open, read and edit the attached document of each graphic object of maps.

The NACGIS Version 2.0 has introduced a revolutionary new concept into geography: the Natural Area Coding System which creates many useful tools for geography and all geography related science and industry. One of its useful applications has been directly implemented in the software: the Universal Geographic Identity (UGID) which is a ten-character Natural Area Code assigned to every geographic object in the world. With the UGID, every geographic object can be uniquely identified and directly located on the map. Its related documents can be efficiently retrieved from a database of any size by either using the mouse to select graphic objects or inputting the UGID in the Search Engine. The geographic object can be as large as a continent and as small as a parking meter.

The graphics editor of NACGIS Version 2.0 allows you to create or edit graphic objects in the most convenient manner compared with all other GIS's or general graphics editors. The graphics editor can create polylines, curves, polygons, areas and pictures with any kind of pens and brushes. It can create text objects with any kind of fonts, colors, sizes, styles and escapement angle. It can import the graphics objects from a NACGIS document, a text file of polylines, polygons, text objects, bitmap and pictures from the art gallery database of the software. You can also add new pictures to the art gallery database to expand the useful database. The graphics editor allows you to use both the mouse to draft a picture and keyboard to input data to create an accurate picture. Therefore, the graphics editor can be used for mapping purposes or general graphics creation purposes.

The software supports the context help and tool tips. When you move the cursor to a window item, you will see a yellow text box which gives you the simple instruction about the item. You will also see a bit more detail information about the item on the status bar. If you want to get a detail help on a command or a dialog, you can move the cursor on it and press F1 which will automatically open the help file about the command or dialog. You can

also click the help toolbar button  and then move the cursor to a menu command, a control button or a dialog and click the left button of the mouse, the help context for the command, button or dialog will pop up.

The software can automatically print a large color map to pieces of small size paper. You can connect them to make the large map.

### What does a complete NACGIS map document consist of?

The NACGIS creates and manages NACGIS documents. A complete NACGIS map document usually includes a file with the extension “.nac” called the map file, a series of attached files created by NACGIS Document Editor, a series of bitmap files and a series distribution data files. Therefore, you have to copy all these files to make the document complete. The map file contains the data of all graphic objects of a NACGIS document. The attached files contain the information related to the graphic objects. The bitmap files contain all the bitmaps data for the bitmap insertions in the map file. The distribution data files are the files for distributions, such as temperature distribution, wind velocity vectors field, population distribution, forest distribution, etc.

It is suggested that you make a directory with the same name as the map file of a NACGIS map document and save the file and other text files with “.lns”, “.gns” and “.txs” in the newly created directory. You then make subdirectories: Document, Bitmap and Distribution. You save attached files in the Document directory, bitmap files in the Bitmap directory and distribution data files in the Distribution directory. When you save or copy the complete document to a floppy disk, you have to save or copy the whole directory.

## View a NACGIS map document

If you have a complete NACGIS map document, you can first make a directory (or folder) with the same name as the file of “.nac” extension, copy the file of “.nac” extension to the directory. Then make other three subdirectories under the above created directory, called them “Document”, “Bitmap” and “Distribution” respectively. Finally copy the NACGIS Document Editor’s files to the “Document” directory, copy the bitmap files to the “Bitmap” directory and copy the distribution data files to the “Distribution” directory.

Once you finish these steps, you can launch the NACGIS Version 2.0 and use the File Open command to open the file of “.nac” extension. Then all the graphic objects of the map document will be loaded to the computer and some of them will be displayed on the screen. You can change the scale, window top left corner coordinates and scroll window size to adjust the view. You can also use the View Select Layer command to select or deselect visible theme layers.

If you want to see some details of the map, you can use the View Zoom In command to zoom in the map and use the View Zoom Out to go back to the original setting. The software can remember ten settings, which allows you continuously zoom in ten times and zoom out ten times. If you want to see both the original map and a Zoomed-In map, you can use the small bar at the scroll bar’s left end or top end to split the window, then apply the Zoom In command in one window pane, then the two window panes will show two maps of different scales.

If you want to read the attached document of a graphic object, you can click the graphic object on the screen to enter the object’s selecting state. If the View Selection Dialog command is checked, the graphic object’s set-up dialog box will open and you can click the button **Edit document to open** its attached document in the NACGIS Document Editor.



## [Edit the NACGIS map document](#)

If you have followed the steps in the [View a NACGIS map document](#), then you can immediately enter the objects selecting state by click an object or use the [Edit Select Objects](#) command to select multiple objects. Once the objects are in the selecting state, they can be [aligned](#), [cut](#), [copied](#) and [deleted](#). You can also use the selected objects to [make a permanent group picture](#) and turn the current picture to an insertion of the group picture. You can [insert the picture](#) to many other places with different sizes and orientations and the document saves only the data of one picture. If you like the picture very much, you can add the picture to the [art gallery database](#). If you want to move, resize, mirror or rotate the objects, you can click the edge of the bounding rectangle to enter the manipulating state. During the manipulating state, you can use either the mouse or the [Manipulation dialog box](#) to perform the manipulations you want. If you want to change the parameters of an object, you can use its set-up dialog box to input your data (To edit a polyline object, see the [Polyline set-up dialog box](#); to edit a polygon object, see the [Polygon set-up dialog box](#); to edit a simple picture such as a rectangle, ellipse, regular polygon, star, etc, see the [Simple picture set-up dialog box](#); to edit a text object, see the [Text set-up dialog box](#); to edit a bitmap insertion, see the [Bitmap set-up dialog box](#); to edit a complex insertion object, see the [Insertion set-up dialog box](#)).

## Create graphic objects for a NACGIS map document

If you want to create a new map document, click the File New command. Once the new document is created, default coordinate system (longitude/latitude coordinate system), scale (14 degrees/cm) and top left corner coordinates have been assigned. If you want to change the setting, you can use the Setting Coordinate System command to reset them as you want. You can also use the Setting Window Properties command to set the view window's size and background color.

When the above steps have been done, you are ready to create graphic objects. If you have many graphic objects to draw in the same pen, brush or font, it is an efficient way to set the default pen, brush and font. These default tools will be automatically given to all the new objects created later on. Only the objects you want to use different pen, brush or font need to be reset these tools in their own pen, brush or font setting dialog boxes.

If you want to create a new polyline, polygon, text object, simple picture, complex picture or a new bitmap object, you can use the Draw Polyline command, Draw Polygon command, Draw Text command, Draw Rectangle command, Draw Picture, or Draw Bitmap command respectively.

### Import objects to a NACGIS map document

The NACGIS Version 2.0 supports several types of files for importing objects. You can import objects from another NACGIS map document, a polylines file, a polygons file, a text objects file, etc. An importing action can be performed by the File Import command.

## [Export objects from a NACGIS map document](#)

The NACGIS Version 2.0 supports several types of files for exporting objects. You can export objects to a polylines file, a polygons file, a text objects file, etc. An exporting action can be performed by the File Export command.

## [Recover a NACGIS map document](#)

The NACGIS Version 2.0 backs up the current active document every ten minutes. If you lose the document due to various causes such as a system crash, having not saved the document, etc., You can recover the document later on and will not lose more than ten-minute work. Details about the file recovery can be found in the [File Recover File](#) command.

[View or edit files](#)

The NACGIS Version 2.0 provides you a powerful document editing tool: NACGIS Document Editor, which can be opened by the graphic object selecting and finding tools or launched by itself independently. This document editor is an OLE container which can include all kinds of objects created by OLE servers (Paint brush, MS Word, Excel, are just some of OLE server examples). Therefore, if you are a real estate manager, you can save both the picture and text of a house in the document. More detail about the NACGIS Document Editor can be found in its own help file.

## [Sample files](#)

The set-up package has included a sample NACGIS map file: coast.nac and three text files: test.lns, test.gns and test.txs. You can open coast.nac to make your tests. You can import the three text files to the software. The text files show you the format for these files, so that you can easily prepare your own text files for importing.

## Technical Support

NAC Geographic Products Inc. provides full support to NACGIS users for various questions. If you have questions, first look at the help file. If that can't help, you can Email to: [nac@io.org](mailto:nac@io.org) or mail to:

NAC Geographic Products Inc.  
509-50 Stephanie Street  
Toronto, ON M5T 1B3  
Canada  
NAC: 8CHK Q87P

all your questions.



# ReadMe File

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## **Introduction**

NAC Geographic Products Inc. has developed a geographic information system called NACGIS Version 2.0 for Windows 95 and Windows NT, which has implemented the great invention: the Natural Area Coding System. Based on the Natural Area Coding System, NACGIS has introduced a ten-character Universal Geographic Identity for every geographic object in the world. No matter what size it is. Every geographic object in the world from a continent to a parking meter can be statistically uniquely identified by its Universal Geographic Identity (UGID).

## Major features:

1. Automatic assignment of UGID's to all geographic objects.
2. Automatic links between a graphic object in the map file and its associated document in the document database. You can use both text searching and mouse clicking on the graphic object to retrieve the document for reading and editing.
- 3 Supports transparency which allows you draw transparent graphic objects with all pictures underneath shown in a mixed color.

### 4. Graphics editor's features:

#### a) Drawing tools:

NACGIS Version 2.0 provides two sets of drawing tools:

- i) Mouse direct drafting on the screen with your specified default line color, line type, line thickness, brush color, brush pattern, font type, font size, font color, layer number, etc.
- ii) Graphic object set-up dialog boxes to create accurate pictures. The dialog boxes allow you input exact coordinates for polyline nodes and polygon vertices and layer number, text escapement angle, layer number, specify whether it is a polyline or smooth curve and a polygon or an area, whether it is transparent, and set up pen, brush and font parameters. You can insert or delete nodes or vertices at any location of a polyline or a polygon. A polyline, polygon, simple picture or a group picture can be converted to each other by simply clicking a button on the dialog boxes.

NACGIS Version 2.0 can draw polylines, curves, polygons, areas, simple pictures (rectangle, circle, ellipse, regular polygons, stars, etc.), text objects, bitmap objects and group pictures (from an art gallery database).

#### b) Manipulation tools:

NACGIS Version 2.0 provides the following graphic objects manipulation tools:

- i) Mouse and arrow keys direct dragging and resizing
- ii) Manipulation dialog box which allows you move an graphic object or a group of graphic objects a specified distance or to a specified location, exactly stretch it in x- and/or y-directions, rotate it a specified angle around a specified pivot, and mirror it in x- and/or y-directions with a specified symmetric center.
- iii) Alignment dialog box which allows you align a group of graphic objects to the left, center, right, top, middle, bottom.
- iv) Group objects tool which allows you to create group pictures (only

one set of a group picture's data will be stored in the memory but can be shown in as many places as you want, which will greatly simplify your drawing and save memory). Once the group picture is created, you can also add it to the art gallery database of the software for later use.

- v) Delete, Erase All, Undo, Cut, Copy and Paste tools
- vi) Grid generator which can automatically generate the appropriate level of the NAC grids.

#### 5. Map viewing tools

NACGIS Version 2.0 provides the following map viewing tools:

- i) Theme layers dialog box allows you select the visible layers for the current map. It can store 120 different theme layers.
- ii) Zoom In and Zoom Out tools allows you zoom in as many time as you want and zoom back to the original picture.
- iii) Split panes of a window, multiple windows of a document and multiple windows of multiple documents. NACGIS Version 2.0 allows you to view different parts of a map in different panes or windows, view different scales in different panes, and compare different maps in different windows.
- iv) Display of the cursor's coordinates in Longitude/Latitude, UTM and NAC simultaneously on the status bar of the frame window.
- v) Coordinate systems  
NACGIS Version 2.0 supports three types of coordinate systems: Longitude/Latitude system, UTM system and user-defined system. You can import a map file in one coordinate system and export it in another system (Longitude/Latitude <=> UTM).
- vi) Window setting  
You can set the scroll window size, window background color, the coordinates of the top left corner of the window and suitable scale to create the best view for the map.

#### 6. Document editor's features

NACGIS Version 2.0 also provides a powerful document editor which allows you to read and edit the attached document of a graphic object. The attached document is named by the UGID of a geographic object, which can contain text contents with all kinds of fonts, font styles, sizes and colors, bitmaps, and all other objects created by OLE servers such as Excel Charts and Worksheets.

#### 7. Help file

NACGIS Version 2.0 provides a powerful help system which has the following features:

- i) Context help  
Whenever you need help for a dialog or a menu command, you can get the help topic immediately by pressing F1. You can also press the

button with an arrow and a question mark on the toolbar and then move the cursor to the item which you need help and click the left button of the mouse to get the help topic.

ii) Tooltips

NACGIS Version 2.0 provides tooltips for all menu commands and buttons. When you move the cursor to a toolbar button, you will see a yellow box with simple help text beside the cursor and a bit more detail help text on the status bar of the frame window.

iii) Topics, index and word search

NACGIS Version 2.0 allows you to search help content by topics, index and simply a word.

8. Print, print preview and printer set-up

NACGIS Version 2.0 provides you all the useful features for print, print preview and printer set-up. It allows you print black/white or color map, and a large map into small pieces which can be connected together to get a large map. You can also print any part of a map as you select.

9. Support of file types

NACGIS Version 2.0 mainly support its own map document files with the extension ".nac". However, it can import and export three types of text files: lists of polyline nodes coordinates, lists of polygon vertices coordinates and lists of text objects (text contents, insert point coordinates and escapement angle). In the future versions, we will add dxf files. NAC Geographic Products Inc. also provides you various map documents at good prices.

## **System requirement:**

Operating system: Windows 95 or Windows NT  
Memory size: Larger than 4 MB  
Hard disk space: Larger than 4 MB

## Discount information

NAC Geographic Products Inc. would like to offer you a special discounted price for the license of using NACGIS Version 2.0. The standard price for the license for a single person using NACGIS Version 2.0 in one computer is US\$999. If you are using the software at home for non-business purposes, you can get 50% discount. Once you have bought one license of the software, you will get a 80% discount for the license for a future version of the same software. There is a special discount price now. If you buy the license before November 20, 1996, you need to pay only US\$39 + US\$5 shipping fee ( + 7% GST if you are in Canada). After then, the price will rise everyday (about US\$5.3 a day) until it reaches US\$999.

## Ordering information

You can order the license by sending us the international money order (or a check if you are in Canada) or tell us the information of the VISA credit card (Credit card number, holder's name, expiration date and issuing bank name). The price is determined by the date you send out your order. If you use credit card, you can also order it through Email, fax or phone. Please include the exact name, company, address, phone, fax, email for each licensee because the name and address will be embedded into the software.

Our address is

NAC Geographic Products Inc.  
509-50 Stephanie Street  
Toronto, ON M5T 1B3  
Canada  
NAC: 8CHK Q87P

Phone and fax: (416) 979 9306  
Email: [nac@io.org](mailto:nac@io.org)  
Web: <http://www.io.org>

If you are doing land planning, NACGIS will be your great assistant!

If you are working on transportation, NACGIS will be your first assistant!

If you are managing natural resources, NACGIS will provide you the convenience!

If you are working on environment protection, NACGIS will be your powerful tool!

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If you like fishing, NACGIS will help you record the best fishing spots!

If you are a bird watcher, NACGIS will tell you where birds live and move to!

If you are learning geography, NACGIS will be your helpful teaching assistant!





# **The Natural Area Coding System**

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## ABSTRACT

The Natural Area Coding System is a new revolutionary geodetic system. Its major characteristics and applications are:

- It integrates both geodetic datum and coordinate systems into one system.
- It unifies the concepts of points, areas on the earth and 3-D regions in the universe.
- It introduces a unified representation called Natural Area Code (NAC) for all geographic points, areas on the earth and 3-D regions in the universe.
- The NAC of a point requires only half of the number of characters of the longitude/latitude coordinates for the same point.
- The NAC of an area or a 3-D region requires very few characters but includes the information as to both where and what exact size it is, which always requires a paragraph of words to describe in traditional geographic coordinate systems.
- NAC's can be used as the universal names to represent all areas on the earth and 3-D regions in the universe no matter what size they are in all dimensions.
- NAC's as the universal names of areas are easy for both the general public and professionals to understand, remember and use.
- NAC's have a natural alphabetical order and level structure corresponding to the actual areas or 3-D regions they represent, which can help establish an efficient geographic database.
- The Natural Area Coding System is also a universal map grid system which can be directly applied to any kind of map of any scale.
- The system leads directly to a geographic information management system which requires minimal data storing space and provides the most efficient way to retrieve, record and process geographic data.
- The system provides an efficient navigation system which not only improves all air and naval navigation but greatly helps the general public locate addresses in daily life.
- The system provides a global postal code system which can replace all current domestic postal code systems, automatically sort all mail from world level to final addresses, and optimize all mail transporting routes.
- The system provides an emergency address dispatching and locating system which will significantly reduce both the response time and the cost of emergency services.
- The system provides Universal Property Identity Codes to all properties in the world.
- The system provides Universal Telecommunication Address Codes to all telecommunication units in the world to allow all tree-structured networks to be converted into real net-structured networks to increase efficiency and capacity.
- The system can perform all the functions of current geographic, geologic and geospatial coordinate and grid systems and adds many more previously unavailable advantages, and therefore, can be used as the Universal Geodetic Reference System.

# INTRODUCTION

## Geographic Coordinate Systems

Currently there are many different geographic coordinate systems such as the Longitude/Latitude system and the Universal Transverse Mercator system. There are also many different geodetic datum systems such as the World Geodetic System - 84 and the North American Datum 27 and 83. This variety of systems has created a great deal of inconvenience for people when interpreting, relating and comparing the geographic information represented in different systems. These differences were created over a long period of time. They were not serious problems when surveying technology was poor and the global integration process had not emerged. However, as the survey technology is now able to measure the earth's radius to a resolution of submeters, and the Internet can deliver geographic data anywhere in the world in seconds, the demand for a universal geodetic reference system has been created and is rapidly increasing. People are getting less and less patient with the unnecessary work of converting data between different systems. At the same time, due to the inefficiency of all these geographic coordinate systems in representing geographic points, areas and 3-D spatial regions, people have not been able to directly make use of these systems in daily life for such functions as locating addresses and representing randomly picked areas. Unsystematic names and codes are continuously created for different areas and for different purposes. These different names and codes for single purposes block the communications between their users. Remembering, using and managing all these names and codes is getting more and more difficult for both average users and professionals. In spite of so many systems having been created, most areas on the earth and three-dimensional regions in the earth and in space have not been named or coded efficiently.

## Map Grid Systems

Currently, many maps do not have grids or if they do, these grids are their own artificial grids. People always have difficulty relating the information obtained from different maps. The grid coordinates of a map are used only as temporary intermediate links between a street name and a map location, which are obtained from an alphabetical name list and abandoned after the street is found on the map. These coordinates usually make sense only on one map and do not stand as an independent name or an alternative to a traditional name of an area or a location. Every time people locate an address on such a map, they have to go through all these steps: looking up the alphabetic street name list to find the grid coordinates for the street, using the grid coordinates to locate the street on the map, and then estimating the location of the street number. Therefore, locating an address on such a map is a time consuming process.

Moreover, due to the inconsistencies of current map grid systems, the grids do not help to connect maps of neighboring areas and all the connections between maps of neighboring areas can be done only after many common topographic features of the maps are found.

It would be very convenient if all topographic maps and other maps which need to cover a whole area like the world, a country or a province were represented by a series of simple, ordered and level-structured names. But current geographic coordinate or grid systems do not provide such powerful name systems, and all these maps are still named by a set of indirect and locally defined indexes, which causes great inconvenience for those shelving these maps and for users. It is also difficult for researchers to relate geographic information across borders.

### Geographic Information Systems

Although computerized Geographic Information Systems (GIS) have greatly improved the efficiency of using maps and geographic databases, real efficiency and power in these systems have not been liberated yet due to the lack of an efficient language to systematically describe geodetic points, areas on the earth and three-dimensional regions. The coordinates of a geodetic point in all current geodetic systems are always unnecessarily long character strings. The description of a randomly picked area in conventional coordinate systems always needs a paragraph of words. This inefficient description systems wastes a lot of storing space in GIS databases and results in databases with poor structures. Users of these GIS's have to type in long descriptions when they want to retrieve maps of randomly picked areas.

### Navigation Systems

Navigation systems have been greatly improved since the launching of navigation satellites. Now a hand-held Global Positioning System (GPS) unit can tell the coordinates of its location accurate to meters. The continuous drop in prices and the continuous reduction of the weight and size of GPS units have been greatly increasing the civil applications of GPS units. However, there are serious limitations in using these units. Since a current GPS unit can only tell the inefficient geographic coordinates of locations, it is difficult to relate these coordinates to actual area names. Consequently, the geographic coordinates of addresses have not been able to be used directly for daily life, which seriously blocks the use of GPS units for average people in the whole world, even though people waste a lot of time and money in locating addresses and places everyday.

### Postal Services

Many countries presently utilize postal codes for simplifying mail sorting processes and increasing efficiency. However, these codes have many disadvantages. Since each country has created its own postal code system which differs from that of other countries, international mail can not be sorted and transported in the most efficient manner. Based on the distribution structure of postal corporations, these postal codes have to change frequently as postal corporations adapt to continually increased urbanization. These resulting changes have inconvenienced both the public and postal corporations. For example, the public has to remember new postal codes, to inform their friends of changes, and some of their mail is lost or delayed. Postal corporations have to cancel and assign codes, to inform all people within the area of changes, to convert old codes on mail to new codes, and to compensate for the loss of mail. Due to the frequent changes, postal corporations have had to update postal code databases, to revise and publish postal code books and postal zone atlases periodically. Many marketing companies have had to buy these books and atlases to update their mailing lists, or risk losing their customers, letters and parcels due to postal code changes.

Created based on delivery network structures, current postal codes - tree-structured route codes - come back to prevent the delivery networks from changes. Due to this property, all mail is sent and delivered in fixed routes no matter what amount of mail is delivered in each route and whether there are more economic or efficient routes for the delivery.

The rapid increase in the amount of mail has also forced postal corporations to introduce longer

postal codes to expand the capacity of the postal code systems. These long meaningless and single-use codes have become more and more difficult for the public to manage.

### Emergency Services

Current emergency services use common addresses to find their locations. Since all the names of countries, provinces, cities, streets and street numbers are not developed systematically but historically, using common addresses to find their locations is always inefficient. Many emergency address dispatching centers in many developed countries have introduced powerful computers and large address-geocode databases for the dispatching of addresses, which has really increased the address dispatching efficiency. But this is still far from the maximum efficiency these systems should have. Currently, these systems have to search a street name in a street name list and find out two intersections between which the street number is located. The location of the address will be interpolated from the coordinates of these two intersections using the street number. Since the street numbers are not uniformly distributed, the interpolation has a poor accuracy. If the street is new and not included in the database, the dispatching will fail. Since the database is so large, mistakes are inevitable. Sometimes the results may be completely wrong.

Once the correct geographic coordinates of an address have been obtained in the address dispatching center, it is still difficult to tell local emergency stations the long character strings of the coordinates on the phone. Even if the coordinates have been correctly recorded in local stations, it is still difficult to use them due to inefficient grids. Thus, all emergency vehicles always have to be guided by the address dispatching center and a lot of communication has to be carried out, which wastes much precious time. Therefore, these systems are not as efficient and reliable as they should be, but cost really a lot of money.

### Property Identity Codes

All houses, buildings and other properties in the world need identity codes to represent them uniquely and efficiently. These codes are especially useful in the setting up of computer databases of property documents. Regular addresses are not convenient for people to retrieve property documents from a computer database because their formats are not well defined and inputting these addresses into a computer is not efficient. For example, Ontario started a long term project called POLARIS many years ago, the object of which was to assign a unique code called Property Identity Number (PIN) to each property in the province. A PIN comprises nine digits in which the first five digits represent a street block and the remaining four digits represent the property in the block. Since street blocks and properties are not organized systematically, the PIN is usually assigned randomly by computers provided the code is unique. Therefore, a PIN does not have any other meaning except to identify a property. The use of PIN is limited to the province. The resulting property document databases are not easily merged with other databases related to properties or property databases of other provinces or countries. The PIN of a property can not be found without a large database support. The PIN is useless to the general public except real estate lawyers who register properties. The PIN of a house does not help people locate the house when they want to have a look at the house before buying it. Electricity, cable TV and water supply companies still have to create their own codes to represent the house. When people want to correlate all these data, the different codes create much inconvenience. Why should we have so many single-use and irregular codes?

### Telecommunication Address Codes

As computer science develops rapidly, telecommunication is undergoing a revolution. Telephone, fax, cellular phone and Internet communication are entering more and more people's homes. It is an exciting time and people can notice changes everyday. At the same time, everybody may feel the burden to remember and use continually-introduced codes for new communication services as well as codes of continually-increased length for existing services. In fact, all these codes serve the same purpose: to represent an address. Why should we introduce so many single-use codes? Why don't we unify them into one code for all the services? Moreover, the unification of codes could also help the unification of telecommunication networks.

Currently, most telecommunication networks are tree-structured networks which have low capacity and efficiency. Although the tree-structured networks were efficient before the introduction of computers, the tree structure has become a serious problem in expanding capacity and increasing efficiency of the networks in the computerized era. Now the far more efficient net-structured networks with much larger capacity have been considered. However, the real net-structured networks can be practically used only when all destinations have absolute and independent addresses. They must not be the tree-structured route codes like most telephone numbers presently in use. Instead, absolute address codes which are independent of networks have to be introduced to replace the current route codes.

### Summary of the Introduction

The world requires a unified geodetic reference system which performs the uses and functions of all current systems. If the system is able to be used directly for global postal services, emergency services, taxi and delivery services, all telecommunication services, etc., then people would get rid of all inconvenience in managing address codes. If the system unifies all map grid systems, creates efficient geodetic coordinates, represents areas and three-dimensional regions efficiently and links addresses with universal geographic codes, then people could easily locate addresses when traveling anywhere in the world.

The Natural Area Coding System has been invented to meet the needs. In addition to all the functions of existing geographic coordinate systems, the Natural Area Coding System integrates both geographic datum and coordinate systems into one system, unifies the concepts of geographic points, areas and 3-D regions and provides an efficient and unified format of coordinates called Natural Area Codes (NAC's) for all these geographic entities no matter where and what size they are. The NAC's have also a natural alphabetic order and level structure corresponding to the actual areas and 3-D regions they represent, which can greatly simplify all geographic databases and improve their efficiency in retrieving and storing data. The simple name (NAC) of an area can not only identify the area universally, but also tells where it is and what size it has. As a result of so many previously unavailable advantages, the Natural Area Coding System will start a worldwide revolution among geography and all its related applications.

## DEFINITION OF THE NATURAL AREA CODING SYSTEM

The Natural Area Coding System is a new geodetic system which combines the geographic datum standard with a coordinate system. It unifies the concepts of geographic points, areas and 3-D regions and creates a unified representation for all these geographic entities. Thirty characters have been used instead of ten digits to compress the coordinates and make the coordinates into very short universal codes.

The coordinate system places its origin at the earth's gravitation center and has coordinate axes extending to infinity. It employs a character set consisting of digits 0 to 9 and all English capital consonants since these characters are the most popular characters in the world which are used in common languages such as English, French, Spanish, German, Chinese, and all categories of science and engineering. Without vowels, the random combinations of these characters will never become words of any languages so as to avoid codes coincidentally being words of offensive meanings. Each character in the character set represents an integer ranging from 0 to 29 ordered as shown in the following table:

**Table of the NAC character and integer correspondences**

0	0	M	10	S	S0
8	8	T	18	X	S8
Δ	Δ	K	1Δ	M	SΔ
Q	Q	L	1Q	A	SQ
2	2	H	12	L	S2
4	4	G	14	Z	S4
3	3	E	13	B	S3
5	5	D	15	O	S5
1	1	C	11	F	S1
0	0	B	10	H	S0
Character	Integer	Character	Integer	Character	Integer

Since no absolute points exist in the real world, the concept of geographic points is unnecessary. Using points to represent 2-D areas or 3-D regions is inefficient. Therefore, the concept of abstract points has been removed in the Natural Area Coding System. Instead, a relatively small 2-D area or a relatively small 3-D region is used to represent real geographic points. Thus, all 2-D areas, 3-D regions or points defined in the Natural Area Coding System have size (or measurement error ranges). Actually, people have already been using such concepts all the time. For example, on a world map, a city is always plotted as a point, but in the city map, it becomes a real area.

Therefore, a unified format of coordinates is invented to represent any kind of the geographic units: a geographic point with a given error range, an area on the earth or a 3-D region in the universe. A set of these coordinates is called a Natural Area Code (NAC). A Natural Area Code consists of three character strings separated by blank spaces. The first character string represents longitude, the second string represents latitude, and the third string represents altitude.

The Natural Area Coding System divides the whole range of longitude (0 - 360°), latitude (0 - 180°) and altitude (from the earth center to the infinite outer space) into 30 discrete divisions respectively as the first level NAC divisions. Each of these divisions in each dimension is named



by one character picked up from the above character set with the character order corresponding to the order of the divisions. Each division is further divided into 30 subdivisions as the second level NAC divisions. Each of these subdivisions is named by one character in the same manner as the first level NAC divisions are named. The division process can continue to the third, fourth, ... and n-th level NAC divisions.

A set of three divisions corresponding to the three dimensions at the same NAC level forms a 3-D region called a NAC block. A first level NAC block is named by a NAC of three characters separated by blank spaces, each of which is corresponding to the division in longitude, latitude and altitude respectively, for example, NAC: 5 0 B, in which 5 represents the fifth division in longitude at the first NAC level, 0 represents the zeroth division in latitude at the first NAC level and B represents the 11th division in altitude at the first NAC level.

A second level NAC block is named by a NAC of six characters to form three character strings: the first two characters form the longitudinal string, the third and fourth characters form the latitudinal string, and the last two characters form the altitudinal string. A blank space is placed between these strings, for example, NAC: JB KH LN represents a NAC block at the second level, in which the characters J, K and L represent coordinates of a first level NAC block which contains the second level NAC block, and the characters B, H and N are the relative coordinates of the second level NAC block within the first level NAC block. A NAC block at another level is named similarly.

If the third string of a NAC is omitted, the resulting NAC represents an area on the earth surface, which can be on the land or on the top of a mountain or on an ocean surface. A set of two divisions corresponding to the longitude and latitude at the same NAC level forms an area on the earth, which is called a NAC cell.

As stated above, a NAC represents an area or a three-dimensional region, which is totally different from the set of coordinates of other geographic coordinate systems which can only represent a geodetic point. A geodetic point with a given resolution can be expressed by a small area or a 3-D region which has a size equal to the error range of the point.

The NAC of a NAC block that contains a geodetic point expressed by the coordinates of longitude, latitude and altitude in the WGS-84 Datum can be determined by the following algorithm:

$$\begin{aligned}
 LONG &= (Longitude + 180)/360 \\
 x1 &= \text{Integer part of } (LONG*30) \\
 x2 &= \text{Integer part of } ((LONG*30-x1)*30) \\
 x3 &= \text{Integer part of } (((LONG*30-x1)*30-x2)*30) \\
 x4 &= \text{Integer part of } (((LONG*30-x1)*30-x2)*30-x3)*30) \\
 &\dots
 \end{aligned}$$

$$\begin{aligned}
 LAT &= (Latitude + 90)/180 \\
 y1 &= \text{Integer part of } (LAT*30) \\
 y2 &= \text{Integer part of } ((LAT*30-y1)*30)
 \end{aligned}$$

$$y3 = \text{Integer part of } (((LAT*30-y1)*30-y2)*30)$$

$$y4 = \text{Integer part of } (((LAT*30-y1)*30-y2)*30-y3)*30)$$

...

$$ALT = \text{Arctan}((\text{Altitude} + R)/R) / 90$$

$$z1 = \text{Integer part of } (ALT*30)$$

$$z2 = \text{Integer part of } ((ALT*30-z1)*30)$$

$$z3 = \text{Integer part of } (((ALT*30-z1)*30-z2)*30)$$

$$z4 = \text{Integer part of } (((ALT*30-z1)*30-z2)*30-z3)*30)$$

...

where *Longitude* is positive in the eastern hemisphere but negative in the western; *Latitude* is positive in the northern hemisphere but negative in the southern; both *Longitude* and *Latitude* are in degrees plus decimals; *Altitude* is measured along the gravitational force line from the geoid surface of the earth in km; *Altitude* is positive above the geoid surface and negative below the surface; the symbol \* is the multiplication sign;  $x1, x2, x3, x4, \dots, y1, y2, y3, y4, \dots, z1, z2, z3, z4, \dots$  are integers ranging from 0 to 29 here; *Arctan()* is the arctangent function with value in degrees; *R* is in km the distance from the earth center along the gravitational force line to the geoid surface and can be approximated by the earth radius at the location:

$$f = (a - b)/a ; e = 2*f - f^2 ;$$

$$N = a/\text{sqrt}(1 - e^2*\sin^2(\text{Latitude})) ;$$

$$R = N*\text{sqrt}[1 - e^2*(2-e^2)*\sin^2(\text{Latitude})]$$

where *a* is the semi-major earth axis (ellipsoid equatorial radius) equal to 6378.1370 km; *b* is the semi-minor earth axis (ellipsoid polar radius) equal to 6356.7523 km; *sqrt()* is the square root function; *sin()* and *cos()* are trigonometric functions; the symbol / is the division sign.

Once  $x1, x2, x3, x4, \dots, y1, y2, y3, y4, \dots, z1, z2, z3, z4, \dots$  are calculated, the corresponding characters can be found from **Table of the NAC character and integer correspondences**:  $X1, X2, X3, X4, \dots, Y1, Y2, Y3, Y4, \dots, Z1, Z2, Z3, Z4, \dots$ . Then, the Natural Area Code of the region is NAC:  $X1X2X3X4\dots Y1Y2Y3Y4\dots Z1Z2Z3Z4\dots$ . The NAC block including the geodetic point is not unique. It can be a first level, a second level, a third level or a n-th level NAC block.

However, to represent the geodetic point with a given resolution, only one NAC block can be selected which has the size equal to the error range of the point.

If the geodetic point is on the earth's surface, then it can be represented by a NAC cell. The NAC of this cell has only two character strings corresponding to longitude and latitude respectively. For example, NAC: 8KD8 PGGK represents a 25 by 50 meter area in the White House, while NAC: 8KD8 PGGK H000 represents a 3-D region 25 meters wide, 50 meters long and 25 meters high measured from the geoid surface under the White House.

When a NAC is used to represent a geodetic point, it has included the information of both the location and its error range.

Although NAC cells or blocks have already had many different sizes, their sizes do not cover the

whole range in each dimension. Therefore, a group NAC representing a group of NAC cells or blocks is introduced to overcome this limit. Any group of neighboring NAC cells or blocks can be represented by a simple group NAC provided they forms an area or a 3-D region bounded by lines or surfaces of constant longitude and constant latitude and constant altitude. The group of this kind of NAC cells or blocks is called a NAC area or a NAC region respectively.

The group NAC is formed by the NAC's of the corner NAC cells or blocks of the group. Each character string of the group NAC is the corresponding character string of the starting NAC cell or block in that dimension plus character "-", plus the part of the corresponding character string of the ending NAC cell or block in that dimension which is different from the corresponding character string of the starting NAC cell or block. For example, a group of NAC blocks with eight corner blocks as listed in the following:

N000	NAC: 8CHK Q87P N000	NAC: 8CPK Q87P
N008	NAC: 8CHK Q8QJ N000	NAC: 8CHK Q87P
N008	NAC: 8CPK Q8QJ N008	NAC: 8CHK Q8QJ
N000	NAC: 8CPK Q87P N008	NAC: 8CHK Q8QJ

can be represented by NAC: 8CHK-PK Q87P-QJ N000-8. Six NAC cells:

NAC: HJ KL	NAC: HK KL	
NAC: HJ KM	NAC: HK KM	<=>
NAC: HJ-K KL-N		
NAC: HJ KN	NAC: HK KN	

can be expressed by a single group NAC.

Characters "0-Z" at the end of a character string of a group NAC can be dropped off because "0-Z" means all the divisions at its higher level division, but if "0-Z" is the whole string of a character string of a NAC, it is not allowed to drop "0-Z". Therefore, a group NAC can have character strings representing divisions at different levels. For example, NAC: HL K0-Z can be simplified as NAC: HJ K, in which the first string represents a second level NAC division while the second string represents a first level NAC division. In fact this NAC is more like a line section than an area because the side in the latitude is 30 times longer than the side in the longitude. Thus, besides a point, an area and a 3-D region, a NAC can also represent a line section of any length parallel to the longitude or latitude.

Therefore, the NAC of a NAC cell or a NAC block or a group of NAC cells or a group of NAC blocks can be of any size in each dimension. When a NAC represents an area or a 3-D region, the simple NAC not only identifies the area or 3-D region universally but also conveys the information of both where and what size it is.

Using a NAC to represent a geodetic point, an area on the earth or a 3-D region is the most efficient way of all geographic coordinate systems. For example,

NAC: 8CHK Q87P is a geographic point on the earth, equivalent to the following conventional description:

A geographic point on the earth at Longitude West 79°23'32" and Latitude North 43°39'05" in NAD83 datum with resolution to a second.

NAC: 8CHK Q87P represents an area on the earth equivalent to the following conventional description:

An area on the earth with its southwestern corner at Longitude West 79.39244 degrees and Latitude North 43.65156 degrees in NAD83 datum and 35 meters in easting and 25 in northing

NAC: 8CHK Q87P N000 represents a spatial point equivalent to the following conventional description:

A spatial point at Longitude West 79.3924 degrees, Latitude North 43.6513 degrees and 4669048 meters above sea level in NAD83 datum with resolution to 50 meters

The Natural Area Coding System can significantly reduce the storing space of any geographic database and make databases very well structured, which allows people to retrieve and store data efficiently. When people use a NAC-structured geographic information system, they can retrieve the information of any randomly-picked area by simply typing a few characters; for example, simply typing 8CH Q87, people can directly retrieve the map of a 1.05X0.75 km<sup>2</sup> area of Metro Toronto from a world geographic database.

If the NAC of a NAC region is known as NAC: X1X2X3X4... Y1Y2Y3Y4... Z1Z2Z3Z4..., then the longitude, latitude and altitude of its southwestern lower corner can be calculated by the following procedure:

First, convert all characters X1, X2, X3, X4, ... Y1, Y2, Y3, Y4, ... Z1, Z2, Z3, Z4, ... into integers x1, x2, x3, x4, ... y1, y2, y3, y4, ... z1, z2, z3, z4, ... using **Table of the NAC character and integer correspondences**

Then use the following formulae to calculate the coordinates:

$$\text{Longitude} = (x1 / 30 + x2 / 302 + x3 / 303 + x4 / 304 + \dots) * 360 - 180$$

$$\text{Latitude} = (y1 / 30 + y2 / 302 + y3 / 303 + y4 / 304 + \dots) * 180 - 90$$

$$f = (a - b) / a ; \quad e = 2 * f - f^2 ; \quad N = a / \sqrt{1 - e^2 * \sin^2(\text{Latitude})} ;$$

$$R = N * \sqrt{1 - e^2 * (2 - e^2) * \sin^2(\text{Latitude})}$$

$$\text{Altitude} = R * \tan((z1 / 30 + z2 / 302 + z3 / 303 + z4 / 304 + \dots) * 90) - R$$

The northeastern upper corner of the region can be calculated by repeating the same procedure using the same integers except that 1 is added to the integer corresponding to the last character of each string of the NAC. The region can be completely determined by the coordinates of these two geodetic points.

If the NAC's of any two areas on the earth surface have been given as: NAC1 and NAC2, then the earth surface distance between the centers of these two areas can be calculated as follows:

First, calculate the longitude, latitude and the local earth radius of NAC1 and NAC2:  $a_1, b_1, R_1$  and  $a_2, b_2, R_2$  respectively using the above formulae;

Then calculate the distance  $S$  between them as follows:

$$S = R_{av} * \text{Arccos}(\cos b_1 * \cos a_1 * \cos b_2 * \cos a_2 + \cos b_1 * \sin a_1 * \cos b_2 * \sin a_2 + \sin b_1 * \sin b_2)$$

where  $R_{av}$  is the average of the local earth radiuses of the two NAC's.

The natural time difference between these two areas can be calculated with the following equation:

$$DT = (a_1 - a_2) * 24 / 360$$

where the positive value means area of NAC1 has the day starting  $DT$  hours earlier than area of NAC2.

## THE UNIVERSAL MAP GRID SYSTEM

The Natural Area Coding System is also a universal map grid system. Translated into conventional words, the universal map grid system is a set of grids which use specifically selected constant longitude lines and constant latitude lines to form grid cells. The first level grid comprises south-to-north lines of constant longitude equals to Longitude West 180o, 168o, 156o, 144o, 132o, 120o, 108o, 96o, 84o, 72o, 60o, 48o, 36o, 24o, 12o, 0o, and Longitude East 12o, 24o, 36o, 48o, 60o, 72o, 84o, 96o, 108o, 120o, 132o, 144o, 156o, 168o, 180o respectively and west-to-east lines of constant latitude equal to Latitude South 90o, 84o, 78o, 72o, 66o, 60o, 54o, 48o, 42o, 36o, 30o, 24o, 18o, 12o, 6o, 0o, Latitude North 6o, 12o, 18o, 24o, 30o, 36o, 42o, 48o, 54o, 60o, 66o, 72o, 78o, 84o, 90o respectively. Each resulting cell is assigned one character from **Table of the NAC character and integer correspondences** for the west-to-east direction and the south-to-north direction respectively. NAC: 0 0 is the origin of the first level NAC grid which represents the south pole of the earth. The first 0 in the NAC grid coordinates represents its longitude coordinate and the second 0 represents its latitude coordinate.

The second level NAC grid is formed by dividing each cell of a first level grid uniformly into 30 subdivisions in both directions respectively, so is the third or other level NAC grid, which is equivalent to the algorithm in the definition of the Natural Area Coding System.

These grids can be applied to all kinds of maps of any scale such as a world map, a country map, a province map, a city map and a local property data map. The resulting grid coordinates of these maps are the same universal area codes (NAC's) for the same areas. These codes are very short. For example, an eight-character NAC can specify a 25X50m<sup>2</sup> area anywhere in the world, and can be used as a global postal code or a telephone code. The NAC of a house will be an efficient alternative to an address, which can be read from a map and a GPS unit.

Knowing the NAC of an address, people can directly pinpoint the address on any map with the NAC grids whether it is a world map, a city street map or a property data map. Using a NAC-enhanced street map, people no longer need to look up the street from an street name alphabetical list to find the grid coordinates. They can directly use NAC's to find the exact location of an address on the map.

All information obtained from different NAC-enhanced maps can be easily correlated by the NAC's because NAC's are universal. Moreover, the NAC's of two addresses anywhere in the world can be used to calculate the distance and the natural time difference between them and determine their relative locations.

All topographic data, satellite images, elevations, weather information and earthquake distribution can be printed on maps of areas corresponding to NAC cells at different levels. NAC cells have good sizes: a first level NAC cell is about 1200X600 km<sup>2</sup>, a second level NAC cell is about 40X20 km<sup>2</sup>, and a third level NAC cell is about 1.3X0.7 km<sup>2</sup>. Maps of NAC cells at different levels of NAC grids can be named by their simple universal area codes (NAC's), that is, a NAC cell can be universally named by two characters if it is a first level NAC cell, four characters if it is a second level NAC cell, or six characters if it is a third level NAC cell. Since NAC's have the alphabetic order and level structure corresponding to the actual areas (NAC

cells) they represent, maps of NAC cells can be stored in a map library systematically. People can directly access any of these maps without wasting time in index search and can link all neighboring maps efficiently. Maps of NAC cells of different countries can be shelved together to help people to link geographic information across borders between countries.

Tourist maps, city street maps and rural area road maps can be greatly enhanced by the NAC grid. If they include information such as the list of hotels, restaurants, railway stations, airports, tourist information centers, parks, historic sites, shopping malls, and museums with their NAC's to help tourists locate them, they will be even more helpful. The following is an example of a NAC-enhanced world map:



Figure 1. A Map with the NAC grid

## **THE NAC GEOGRAPHIC INFORMATION MANAGEMENT SYSTEM**

The NAC geographic information management system is a computerized geographic database with an efficient user interface. The computerized system is very similar in many aspects to a library of paper maps. As mentioned above, maps of NAC cells can be very efficiently organized and retrieved. This is also true for digital maps in a computerized geographic database. All information associated with areas or regions can be very well organized, stored and retrieved in the NAC geographic information management system.

A NAC-enhanced geographic information database for the whole world can be organized into two main directories. The first main directory is called data directory which contains files of global features such as coastal lines, borders of countries, airline routes, railways, rivers, etc. and directories for first level NAC cells named by their NAC's; for example, the name of the directory for NAC: 8 Q can be called 8Q. The directory for a first level NAC cell contains files of features significant in this cell such as province borders, roads, forests, rivers, etc. and directories for second level NAC cells. The directory for a second level NAC cell can be named by their relative NAC's, for example, the name of the directory for NAC: 8C Q7 can be called C7 because the information of the other characters in the NAC has been represented by the name of its parent directory. The structure of the directory for a second level NAC cell is similar to that of its parent directory. So is the directory for a third level NAC cell or fourth level NAC cell.

All geographic coordinates in the feature files will be saved as the relative NAC's, for example, a geographic point at NAC: 8CHK0 Q87PB in a feature file will be saved as two character strings: K0 and PB if the file is in directory C:\8Q\C8\H7\, which requires only two bytes for each dimension but has resolution to one meter. If a feature file is a distribution such as elevation, temperature, it can be directly saved as a two-dimensional array with its elements corresponding to the NAC cells under the directory. Therefore, these feature files do not need to save any coordinates to represent the locations of the distributing data, which can save more than 60% of the storing space for the files. This arrangement can also make a map be the background of a spreadsheet and people can directly input and display data on the spreadsheet with the map as the background because the NAC grid of the map is the same as the grid of the spreadsheet. Figure 2. is an example of such a spreadsheet.



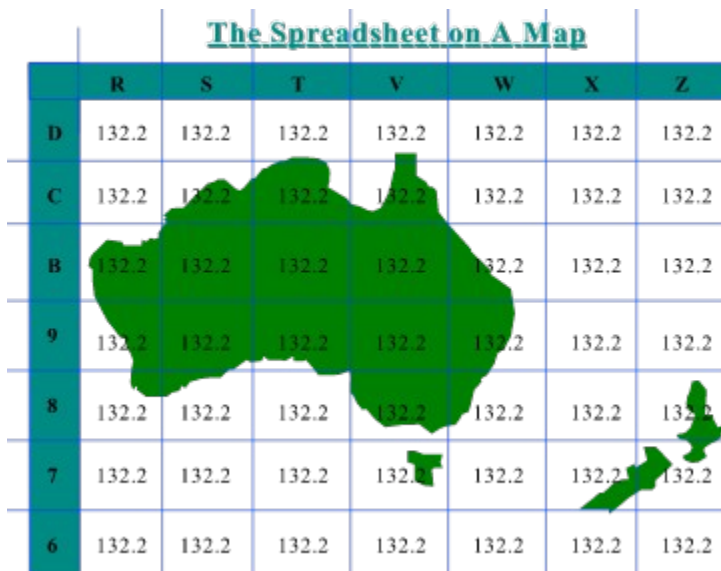


Figure 2. A spreadsheet with the NAC grid and a map background

This arrangement can greatly help users to establish their own databases and get rid of all inconveniences in the conventional databases which require indirect spread sheets to input data and their coordinates.

The second main directory is called the index directory which contains an alphabetic index file of global entities listing the traditional names such as countries, continents, oceans, forests and deserts with their corresponding group NAC's and their reference codes. The index directory also contains directories for all the global geographic entities. The directory for a global geographic entity is named by the reference code of the geographic entity. It contains an index file listing all its sublevel geographic identities such as provinces, states, etc. with their corresponding group NAC's and reference codes, and directories for sublevel geographic identities named by the reference codes of the sublevel identities. The directory for a sublevel geographic entity has the same structure as the directory for a global geographic entity, so does the directory for other level geographic entity.

The above defined NAC structure for a geographic database is illustrated in the following figure:

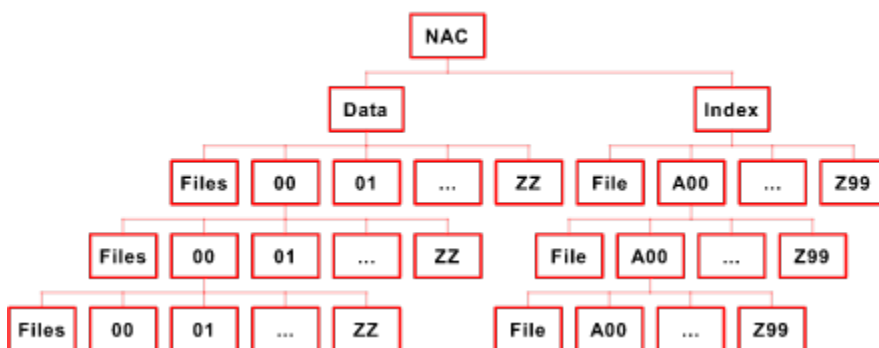


Figure 3. The NAC Structure for GIS Databases

The NAC geographic information management system has a user interface which has a graphics window for displaying maps and a column of tool icons for a user to use the mouse to add or remove some features to maps, and select location of interests to zoom in or out, etc.. The window will also have two text input boxes to allow a user to input the name of a country and the NAC of an interesting area respectively. If a country name is input, the software will go to the index directory to find out the group NAC of an area covering the country from the index file. Using the group NAC of the country, the software can go to the data directory to find out the subdirectories named by the NAC's of the group NAC and display the country boundary on the screen. Then the user can add or remove other features to or from the country map or retrieve a province map by inputting a province name.

If a user inputs a NAC in the text box, then the software will directly go to the data directory to retrieve the map represented by the NAC. It is therefore very convenient for a user to retrieve any randomly picked map because he/she only needs to type in a very short NAC which contains the information for both where and what size the area is, for example, the user only need type in six characters: 8CH Q87 to specify a 1.05X0.75 km<sup>2</sup> area in a world scale geographic database. This function is much more efficient than a mouse driven zooming function and the text input of a political entity name.

A NAC geodetic information management system for a three-dimensional database can be constructed in a way similar to a NAC geographic information management system for the earth's surface using the NAC's of three-dimensional NAC blocks instead of two-dimensional NAC cells as the directory names but not including an index directory. The three-dimensional system will be very useful to geologists, oceanographers, meteorologists, earth and space scientists.

The NAC geographic and geodetic information management system has the following advantages over all current GIS's:

It requires a much smaller storage space to save geographic or geodetic coordinates. In the NAC geographic and geodetic information management system, all geographic or geodetic coordinates are saved in relative NAC's which need much fewer characters than other geographic or geodetic coordinates such as Longitude/Latitude or UTM coordinates. For example, an eight-character NAC represents a geodetic point with the resolution to 1.6 seconds in longitude and 0.8 seconds in latitude which requires at least 15 characters represented by longitude/latitude coordinates. The relative NAC of this point may require only two characters.

It cuts out a great amount of memory by avoiding map overlaps. Current GIS's usually save digital maps according to the political entities. There may be two strategies to save these maps: one is to save political entities without any neighboring areas and the other is to save political entities with certain neighboring areas. Although the first one can avoid map overlaps, it is extremely difficult to link geographic information across the borders of neighboring political entities. The second one is more common than the first one, which can give all the information of the neighboring areas of a political entity, but includes many map overlaps which may require more than 30% extra memory. This problem has been solved in the NAC geographic information

management system since it saves only the maps of the NAC cells and all political entities are represented by a series of NAC cells. The NAC cells are not used for some specific political entities but for all these entities within the NAC cells, so they include all the information of neighboring areas of a political entity, but are never overlapped on each other. Therefore, the NAC geographic information management system can link geographic information between political entities easily by displaying the neighboring areas of a political entity without map overlaps.

It includes an efficient tool for users to retrieve their interesting maps directly from a large geographic database no matter where and what sizes the areas are by simply inputting the NAC's of the areas, since the NAC of an area has included the information for both the universal location and the size of the area. This function greatly improves the efficiency of the system, and users do not need to click the mouse many times and wait for a long time before the system goes to interesting locations with appropriate scales step by step.

The system can also help users to store their own geographic data into the database efficiently. The NAC-enhanced system can include a function to allow users to view and edit the database since the database structure is so systematic that any geographic data can be saved as a feature file under the directory named by the NAC of the area. This can even be done by general text editors because the NAC-enhanced files are always saved in text format which require even less storage space than the binary files of other coordinate systems. Therefore, a NAC geographic information management system is a progressive system which can be updated by users all the time.

With so many superior advantages, the NAC geographic and geospatial information management system stands to be the most economic, efficient and user friendly system.

## THE NAC NAVIGATION SYSTEM

Currently, the GPS unit can show the WGS-84 geodetic coordinates directly by analyzing the signal from a series of satellites. Although GPS technology was originated for military purposes, it has started to be used for civilian purposes now. Many airplanes, ships and trucks have already been equipped with GPS units which can help determine their current locations and measure their moving speeds. Some explorers, hikers and hunters are using GPS units too. The price of a GPS unit has dropped from several thousand dollars to several hundred dollars and its weight and volume have decreased significantly too. A hand held GPS unit may weigh less than one kilogram and is as small as a calculator, but can tell the universal coordinates of a location with an error of less than 100 meters.

However, there are serious limitations to the general public's use of GPS units because the current GPS units display only longitude/latitude or UTM coordinates. The character strings of these coordinates are too long for actual locations and areas such as a house or a fishing spot. It is difficult for people to remember and communicate these coordinates. These codes lack of clear level structure and natural order, which prevents people from recording geographic data efficiently and systematically. It is this inefficiency of current geographic coordinates that prevents the general public from using GPS units for their daily life. For example, if a person takes a taxi equipped with a GPS unit to go to an unfamiliar address, the GPS unit will not give the driver any help in locating the address because the general public can't remember the complicated coordinates of their destinations.

The NAC-enhanced GPS units, which can directly display the NAC of any area in the world, can solve all these problems because the NAC is short and logical and possesses all the functions of any other global geographic coordinates. The NAC can be easily obtained, remembered and used. It is a useful alternative to a common address. Knowing the NAC of an address, people can easily use a GPS unit to navigate to the destination. The GPS units can show the distance from the current location to the destination and its relative orientation. Users can easily mark the destination on a map with the NAC grid if the NAC of the destination is known. They can draw the path on a NAC-enhanced map in advance of a trip, use a NAC-enhanced GPS unit to navigate on the trip and make an analysis in a NAC-enhanced geographic information system after the trip.

A GPS unit with the NAC display has the following advantages:

the display can be greatly simplified, easily remembered and efficiently communicated;

the display is closely related to the common names of locations, streets and houses;

the display itself can be used as the name of an area without a common name;

the display corresponds to grid coordinates of all kinds of NAC-enhanced maps.

When the NAC-enhanced GPS unit is used in air navigation, it can simplify the description of locations and speed the correct communication between airplanes and control stations. When it

is used in naval navigation, it can simplify the collection and processing of geographic data and mark special areas more clearly and efficiently. When it is used in exploration and hiking, it can simplify recording routes, marking interesting sites and describing activities. When it is used in emergency services, it can help to optimize routes, speed locating emergency places and simplify the description of locations. When it is used in taxi and delivery services, it can help drivers find unfamiliar addresses quickly and communicate their current location easily. Moreover, the NAC-enhanced GPS units can be used by the general public for their daily life as easily as they use their watches in such activities as driving, such as driving to unfamiliar places, telling people their current locations, describing events, etc..

## THE GLOBAL POSTAL CODE SYSTEM

The global postal code system has been developed as an important application of the Natural Area Coding System. A standard NAC global postal code is an eight-character Natural Area Code representing a 1.6X0.8 seconds area (less than 50X25 meters) anywhere on the earth. The global postal code for an individual house or an apartment is defined in the following way:

If an eight-character NAC represents an area with only one house and without any postal zone borders, then the global postal code of the house is the same as the NAC, for example, NAC: 7HGG KJ9L.

If the NAC represents an area with several houses, the global postal code of each house in the area is the NAC plus a locally defined third character string which people can define by themselves using a family name, a location name or a name of their choice. The locally defined string should comprise characters from digits or English capital letters without blank spaces, and be unique in the area, for example, NAC: 7HGG KJ9L DAVID.

If the NAC represents a high-rise building with many apartments, the global postal code for each apartment is the NAC of the building entrance plus a locally defined string, for example, NAC: HGJK PLLT APT125.

If an eight-character NAC represents a NAC cell split by a border, and a house is located in the larger part of the cell, then the global postal code of the house is the NAC. If the house is within the smaller part of the cell, then its global postal code should be a nine- or ten-character NAC to specify the main entrance of the house precisely.

Having obtained the global postal code, people can start to include it on a letter as extra information immediately no matter how many post offices have already started sorting mail based on the codes. If some post offices have been sorting mail based on the codes, a letter with a global postal code can be sent faster.

The written convention of the global postal code on a letter is to write the global postal code on an extra line at the bottom of the current address plus domestic postal codes. For example:

Mr. Xinhang Shen  
50 Stephanie Street, Suite 509  
Toronto, ON M5T 1B3  
Canada  
NAC: 8CHK Q87P S509

This writing convention allows post offices to sort mail by either domestic postal codes or global postal codes. The domestic postal code systems will be replaced by the global postal code system gradually. Post offices can use character recognition techniques to read addresses. If the last line of an address starts from "NAC", then the following character strings will be a global postal code. One of the algorithms for computers to sort mail based on the global postal code, which does not require any changes to or in the delivery structure in current postal

services, works in the following way:

Convert the first two character strings of the global postal code into decimal longitude and latitude.

Use the city boundary file to check whether the destination is within the city or not.

If the destination is within the city, then use the boundary files of the local postal areas to find out the area of the destination and to transport the mail to the post office in charge of the area.

If it is not within the city, then use the boundary file of the country to check whether the destination is in the country.

If the destination is in the country, use the boundary files of postal zones at the city level to find out the postal zone containing the destination and to transport the mail to the postal terminal in charge of the postal zone.

If it is outside the country, then use the boundary files of countries to find out the mail destination country and to transport the mail to the country's postal terminal.

To check whether the destination is within an area, the mail sorting program can first calculate the distance  $R$  between the destination and the reference point of the area, then compare  $R$  with the maximum distance  $R_{max}$  from any point in the area to the reference point. If  $R > R_{max}$ , then the destination is outside the area. If  $R < R_{max}$ , then the program can compare  $R$  with the minimum distance  $R_{min}$  from any boundary point of the area to its reference point. If  $R < R_{min}$ , then the destination is within the area. If  $R > R_{min}$ , the program has to calculate the angle  $\alpha$  of the vector from the reference point to the destination. Assume that each boundary node is represented by the angle and length of the vector from the reference point to the boundary node. Assume that there is only one boundary node corresponding to one angle in the area, while a complex area can be divided into several such simple areas. Therefore, the program can find out two boundary nodes: the vector from the reference point to one of the nodes has a length  $R1$  and angle  $\alpha1$  equal to the maximum angle smaller than  $\alpha$ ; the vector from the reference point to the other node has a length  $R2$  and an angle  $\alpha2$  equal to the minimum angle larger than  $\alpha$ . Then the program will know that the destination is within the area if

$$R1 * R * \sin(\alpha - \alpha1) + R * R2 * \sin(\alpha2 - \alpha) < R1 * R2 * \sin(\alpha2 - \alpha1)$$

otherwise it is outside the area.

The mail sorting software based on this algorithm can work together with the existing delivery structure of post offices and help sort all mail from the international level to final addresses automatically.

If post corporations are willing to adjust their delivery structure, the global postal code system can be a great help. Since the current distribution structure of postal corporations are not optimal, all mail is transported through fixed routes no matter how much mail there is in each route and whether there are more efficient or economic routes. The mail delivery would be greatly improved if the mail were to be grouped and transported through optimal routes depending on the flow of mail corresponding to each destination area and available transport means. This kind of optimization is difficult to carry out in current postal code systems because the current postal codes represent given delivery routes, but can be easily done if the NAC's of

all mail destinations are known. For example, Canada Post Corporation may set up more international postal terminals, then other countries can send mail to a specific Canadian postal terminal when the distance from the mail destination to the terminal is the shortest. This adjustment can prevent some situations such as a letter from Seattle to Vancouver being sent through New York City and Toronto and then to Vancouver - an unnecessarily long trip which wastes both time and money.

In addition, the global postal code system has many other advantages over current domestic postal code systems:

The global postal code is assigned to every mailing address in the world, with a much higher resolution than any other postal codes. With a global postal code, a letter can be sorted from the world level to the final address automatically.

The code is permanently attached to the area and never changes, which prevent both the user and post office from unnecessary inconvenience; a wasting of time and money in postal code changes and losses of mail due to the change.

The code need not be assigned by a post office, which can help people living in newly developed areas to get their postal services immediately.

The code can be used instead of the domestic postal code to save costs in revising and publishing postal code books and postal zone atlases periodically.

The code can be used for all other services related to addresses such as emergency services, taxi and delivery services, and in the future, telephone, fax and Internet services.

The code can be obtained from many methods i.e. read from maps with the NAC grid, measured by GPS units with the NAC display, or derived from the longitude and latitude coordinates obtained from ordinary maps or measured by other methods.

The code can be used to determine the distance and natural time difference between any two addresses and their relative locations in the world.

The code can be directly used in navigation to find addresses or locations by ambulances, trucks, airplanes and pedestrians equipped with GPS units.

The code can help people directly pinpoint an address on all maps of the NAC grid: a world map, a country map, a province map, a city map, and a local property data map.

The code can be easily remembered because of its clear meaning, reasonable length, multiple uses and multiple accesses.

The code has certain self-error-detecting functions. There is a more than 80% chance for a computerized mail sorting program to find out a wrong global postal code since a random NAC may represent an area in oceans where no one lives. This property can avoid most mail with



wrong codes being sent to wrong places.

The global postal codes can also help people understand, interpret, communicate and use geographic, geologic, meteorological, oceanographic, archeological, environmental and astronomic information represented in Natural Area Codes.

The global postal code system is self-motivated. Since the system is ready to use parallel to the current domestic postal code systems, it does not need any international agreements to initiate the system. Any country can start to use the system immediately whenever it wants to enjoy all the benefits of the system.

A possible disadvantage is that a global postal code can only be sorted efficiently by computers but not by human beings due to the handling of postal zone boundary files. However, the continuous decrease in computer prices have made computers cheaper and cheaper, and most post offices in developed countries already have the ability to buy computerized mail sorting equipment.

## **THE NAC EMERGENCY ADDRESS DISPATCHING SYSTEM**

A new efficient, reliable and low-cost emergency address dispatching and locating system has been developed based on the Natural Area Coding System. The principle of the system can be applied to both the map-based address dispatching system and the computerized address dispatching system. Both systems use the Natural Area Codes of addresses to speed up the address dispatching process. The NAC of an address can be told by the caller of an emergency call or forwarded by the telephone company directly. If the NAC is used as a postal code or telephone code, then the NAC will be even easier to obtain.

With the NAC, the address dispatching staff can find the address by using a map with the NAC grid or a digital map in a computer directly. Then they can inform the emergency station closest to the address or, the address and its NAC are forwarded electronically to the computer of the emergency station closest to the address. Equipped with a map of the NAC grid, the driver of an emergency vehicle can use the NAC to find out the exact address on the map immediately and figure out the best route to reach the location. Since the driver knows the address exactly, he/she does not need to check street names and numbers frequently and does not need any dispatching center's guidance. If the driver is equipped with a GPS unit with the NAC display, the process will be even more reliable and efficient, especially for an air ambulance.

The NAC emergency address dispatching system will save significant time in the emergency services and help reduce the loss of life and property from fires, diseases and crimes. This is because the time-wasting process of address-to-geographic-coordinates matching and interpolation has been removed. Due to the simplicity of a NAC, the NAC will become part of an address in the telephone registration form like the domestic postal code. Therefore, the NAC of an address can be directly forwarded to the emergency address dispatching center directly.

The system can also overcome many problems of current map-based and computerized address dispatching systems. In the current map-based address dispatching system, people have to look up the street alphabetic list to find out the artificial grid coordinates, use the grid coordinates to find the street on the map, and then guess the approximate location of the address on the street. This process is slow and not accurate. It is also unreliable because it won't work when the street is new and not listed on the alphabetic list.

In the current computerized address-dispatching system, the telephone company sends the address of the telephone to the address dispatching center electronically. The address dispatching computer will look up the coordinates of the nearest street intersections in a large database, and then use the street number of the address to interpolate the coordinates of the street intersections to calculate the approximate coordinates of the address. Using the coordinates, the computer displays the address on the map on the computer screen and informs the nearest emergency station of the address. Once the emergency address dispatching center knows the emergency place, it is still not easy to let the local emergency station know exactly where the address is except with the street name and street number. Finally locating the address completely relies on the drivers' familiarity with the street address. If they don't know where it is, problems happen. For example, a heart attack patient in Scarborough, Ontario died in November 1994 just because the ambulance could not find the address efficiently, although the emergency station was only

about one kilometer from the address. If the street of an address can not be found in the address-coordinates database, the dispatching process will fail.

All these problems are caused by the lack of an efficient language to describe locations. Except for traditional addresses, people do not have any other methods to describe where they are, but the traditional addresses are always created irregularly and are too inefficient to locate.

The Natural Area Coding System solves this problem. It provides very short and regular names to all locations and addresses anywhere in the world. With these efficient names, people can tell exactly where they are immediately, which will greatly help the emergency services.

The NAC address dispatching system can work efficiently even without computers since the NAC of an address can be very conveniently found on maps of the NAC grid. Equipped with maps of the NAC grid, the emergency address dispatching center and emergency vehicle drivers can dispatch and locate addresses based on the NAC of an address told by the emergency caller or forwarded by the telephone company. This property makes the NAC-enhanced address-dispatching system more reliable, while the current emergency address-dispatching system will fail when the computer is down. This property can also help developing countries to establish efficient and low-cost emergency address dispatching systems.

The NAC address dispatching system will also save all the money invested in the creation and maintenance of address-coordinates databases.

Therefore, The NAC emergency address dispatching system is a more reliable, efficient and inexpensive system.

## **THE UNIVERSAL PROPERTY IDENTITY CODE SYSTEM**

The Universal Property Identity Code (UPIC) is a ten-character NAC which represents the reference spot of a property, such as the main entrance with the street number. The UPIC can identify the property universally and tell the exact location of the entrance of the property. Since NAC's are naturally ordered and possess a well defined level structure, the UPIC's can be grouped systematically and consistently. The UPIC-based databases of property registration documents can be very well organized in the same way as other NAC-enhanced geographic information databases. These property databases will be easily merged into one larger database no matter what provinces or countries they represent. The database can be directly used by the general public in the world by the same universal retrieving method. The database saves all the space for storing the location coordinates of properties because they have been included in their UPIC. Since the property databases have the same structure and user interface as other NAC-enhanced geographic information databases, they will also be easily supported by other NAC-enhanced GIS's.

With the UPIC of a property, anybody can pinpoint the location of the property on a NAC-enhanced map without the need of any databases. This feature of the UPIC can significantly help people who want to buy or sell houses.

## **THE UNIVERSAL TELECOMMUNICATION ADDRESS CODE SYSTEM**

The public is finding it more and more difficult to manage continually-introduced numbers, codes and addresses for various services. They are always meaningless and designed for specific purposes, such as: postal codes, telephone numbers, fax numbers, and many other Internet addresses. In addition, these numbers are also changing frequently and becoming longer and longer. Why should we remember so many codes which really serve the same purpose: to represent an address?

As pointed out above, the postal code systems can be unified by the Natural Area Coding System, so can all the telecommunication address codes.

A Universal Telecommunication Address Code (UTAC) can be constructed in the same way as the NAC global postal code and in most situations the NAC telecommunication code is exactly the same as the global postal code. If in one family or one office there is more than one telecommunication unit, people can assign a unique locally defined third string to distinguish every unit. Generally, a UTAC is an eight-character NAC plus a locally defined third string. But for a cellular phone or other large range valid telecommunication units, the address codes may comprise only one unique user defined string, or a two-, four- or six-character NAC plus a unique user defined third string valid in the corresponding area. The rules for defining a third character string are the same as those for defining the third string in a global postal code. A cellular phone address code having only a user defined string is a globally valid code which can be recognized and used in the whole world. A cellular phone UTAC comprising a NAC plus a user defined string will be valid within the area defined by the NAC, so a shorter NAC plus a user defined third string will be valid in a larger area. Large international companies may use globally valid cellular phone UTAC's for their businesses, while small local companies may take cellular phone UTAC's which are valid within smaller areas.

The universal telecommunication address code system can be used efficiently on a new telephone set on which it has keys of all digits and English letters as well as several function keys such as a space key, a hyphen “-” key, an Enter key and some other function keys. If people want to call a person, they need input the three character strings of the UTAC separated by space keys and then press Enter. If there is no third string in a UTAC, they simply input the two strings separated by a space key and then press Enter.

The NAC telephone set should have a display window to show the codes and an erasing key for correcting wrong characters. There should be another function on the telephone set to display the distance between the caller and the receiver and to show the price of the call before the user presses Enter. Therefore, the caller can make a decision whether to make the call or not before pressing Enter. The keys and their bit codes of a NAC telephone set should be the same as those of a computer keyboard, which may help produce an integrated computer system for phones, faxes, and Internet services in the near future.

Using a current touch tone telephone set to call a UTAC, the user has to use two keys “\*” and “#” as the prefix of each character string and two digits to represent each character

corresponding to **Table of NAC character and integer correspondences**, and press “\*” and “\*” to enter the code. NAC integer 0 - 9 should be replaced by 00 - 09. The English capital vowels are defined as: A = 30, E = 31, I = 32, O = 33, U = 34, Y = 35, “-” = 36. For example, if one wants to call UTAC: 8CHK Q87P SHEN, he/she can press these keys: “\*#08111512\*#22080719\*#24153120\*\*”. If a telephone code has only a user defined string, then the caller only needs to press “\*#”, the corresponding digits and then “\*\*”.

Using a NAC telephone set to call an old telephone number, one has to press “O”, then input the number and press Enter. Therefore, the two systems can work compatibly and the old system is allowed to go out of its service gradually.

With the universal telecommunication address codes, telephone cables, TV cables and Internet cables can be easily integrated into one telecommunication network.

Furthermore, since UTAC is universal and independent of telecommunication networks, it will allow to convert the inefficient and low-capacity tree-structured networks into real net-structured networks with a thousands times increase in capacity and efficiency. The following figures demonstrates the difference between a tree-structured network and a net-structured network:

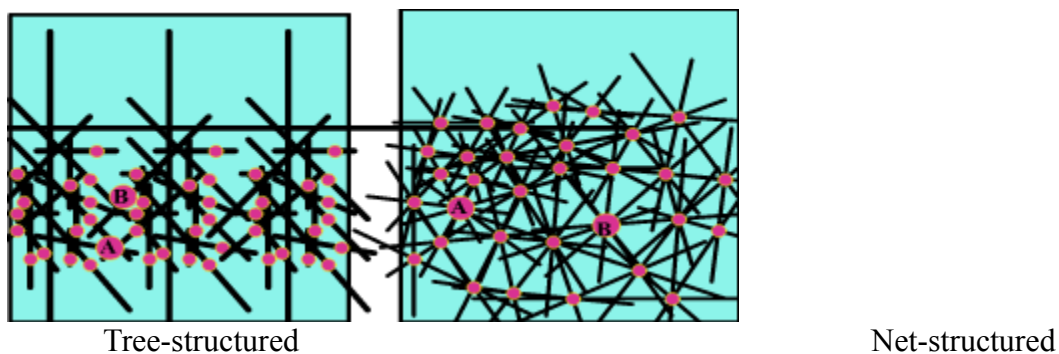


Figure 4. Two types of networks

In the tree-structure network, there is only one way to connect A to B, in which any one section of the route occupied by another phone call will block the communication between A and B. However, in the net-structured network, there are numerous possible routes to connect A and B, and the connection between A and B can be made whenever one of the routes is available. The efficiency and capacity of a net-structured network can be more than a thousands times higher than those of a tree-structured network. Since two route dependent codes like current telephone numbers can be connected through a specified route, they are not able to be used in net-structured networks. But the UTAC's are different. They represent the absolute locations of the communication units, which are independent of connection routes. The intelligent connectors know exactly where they are and how many possible route can connect them. Here is a simple algorithm to realize a net-structured network. The connectors can first try the shortest way to connect two UTAC's based on the information of the UTAC's. If one of the sections of the route is busy, they can try the second shortest route, or the third. There will be little probability that all the possible routes are busy. Therefore, any two UTAC's may always be connected quickly.

Actually, net-structured networks have already been used widely, for example, street networks which allow cars to go from one location to another through many different routes and significantly increase its capacity and efficiency. The prerequisite of using net-structured networks is the addresses are independent of routes and the “vehicles” are intelligent, that is, cars in streets or messages in cables know where their destinations.

## **THE UNIVERSAL GEODETIC REFERENCE SYSTEM**

As stated above, the Natural Area Coding System is a very useful and powerful system which integrates almost all address code systems and makes all address related services more efficient than current systems. People need to know only one location code and to get all their address-related services and purposes. The Natural Area Coding System generates simple universal names for all geodetic points, all areas of any size and any longitudinal and latitudinal spans on the earth surface and all three-dimensional regions of any size and any longitudinal, latitudinal and altitudinal spans. These well ordered and level-structured names can greatly help people record geographic data systematically, retrieve maps efficiently and report events easily.

The Natural Area Coding System performs the functions that all current geodetic and geographic coordinate systems do and combines the geodetic datum with the coordinate system. Once a NAC is given, it tells the exact area on the earth or in the universe without the need to mention which geographic datum it uses. The system introduces many superior advantages over all current geographic systems.

This is a great demand for a universal reference system and the Natural Area Coding System is a natural choice that is to be used as the universal geographic and geodetic reference system. The unification can greatly accelerate the exchange of all information related to the earth and the universe and help not only professional people but also the general public of the world to understand and use the information obtained from the science and engineering related to the physical world, such as geology, geography, meteorology, oceanography, ecology, environmental science, space science, archeology, natural resources, mining and exploration, transportation and statistics.



## **SUMMARY**

The Natural Area Coding System is a standard multi-use geographic and geodetic coordinate system which integrate both the standard of geodetic datum and the geographic coordinate system. It has unified the concepts of geographic points, areas and 3-d regions and created a unified format to represent all points, areas and 3-D regions. The unified coordinates for all points, areas and 3-D regions require very few characters so that they can be used as the names of these geographic entities. All areas on the earth no matter where and what size they are in each dimension have been systematically named by Natural Area Codes. With these names, people can describe any randomly picked areas conveniently for reporting discoveries, pollution, earthquakes, weather changes, forests, animal distributions or traffic accidents.

Furthermore, the Natural Area Code System integrates all address-related services and provides all the address codes for these services, which will greatly reduce the burden for people to use these services and significantly increase the efficiency and capacity of these services and networks. With the Natural Area Coding System, people can easily manage all existing and continually introduced address related services such as postal services, taxi, courier services, emergency services, telecommunication services, etc.. Due to so many superior advantages over other systems, the Natural Area Coding System can be used as the universal reference system for geography, geology, oceanography, meteorology and astronomy to help people to record, retrieve, interpret, understand, present and communicate all spatial information and eliminate all the waste of time and money used in converting data between different reference systems. The world wide application of the system can greatly benefit every individual in the world.

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Many thanks for your interests in the idea. We will be happy to receive your comments and suggestions. Our address is:

The International NAC Society, Inc.  
509-50 Stephanie Street  
Toronto, ON M5T 1B3  
Canada  
NAC: 8CHK Q87P

Phone&Fax: (416)9799306  
Email: [nac@io.org](mailto:nac@io.org)  
<http://www.io.org/~nac/>

