GRAPPLE APPLICATIONS

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ABSTRACT

The Bell-Northern Research Graphical application programming language called Grapple provides a useful tool for computer graphics users involved in a wide variety of application areas. Grapple's full power is realized through interactive programs which can be written with considerable ease, while a subset of Grapple forms an effective graphic interchange language. By interfacing Grapple and external user programs there exists an extremely powerful environment for applications where all of the power of a large scale computer system is required. The success of Grapple is demonstrated by its diverse utilization by a multi disciplined population.

LES APPLICATIONS DU LANGAGE GRAPPLE

RÉSUMÉ

Le langage de programmation graphique des Recherches Bell-Northern, intitulé Grapple, constitue un précieux outil de travail pour les usagers de très nombreuses applications graphiques de l'ordinateur. On tire le plus grand parti possible du Grapple dans les programmes interactifs qui peuvent être écrits avec une grande facilité, tandis que des variantes du Grapple forment un langage efficace d'échange graphique. En utilisant conjointement le Grapple et des programmes externes d'usagers, il est possible de réaliser des applications extrêmement importantes, nécessitant toute la puissance d'un grand système d'informatique. Le succès du Grapple est démontré par la possibilité de son utilisation dans des applications pluridisciplinaires très variées.

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INTRODUCTION

This paper presents several applications of Grapple the Bell-Northern Research graphical application programming language. The applications presented are chosen to illustrate the utility of Grapple in various disciplines and include:

A graphic interchange language

Grapple quick look and editing of integrated circuit masks and printed circuit boards

Urban mapping and information retrieval

Summary of Grapple applications

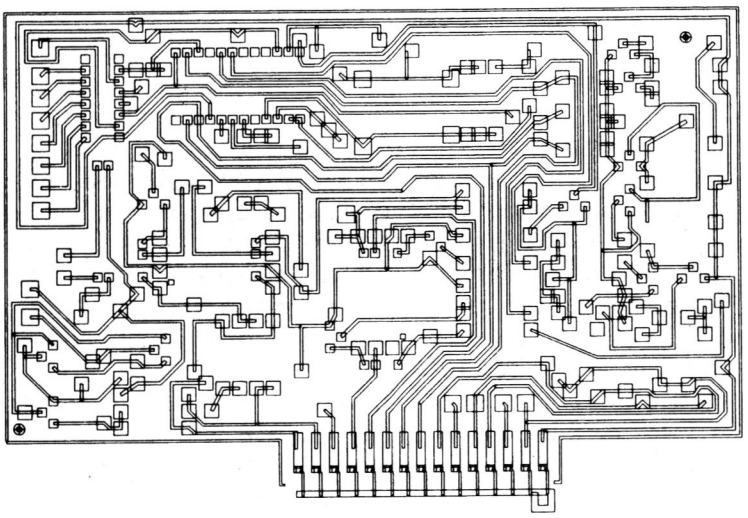
A GRAPHIC INTERCHANGE LANGUAGE

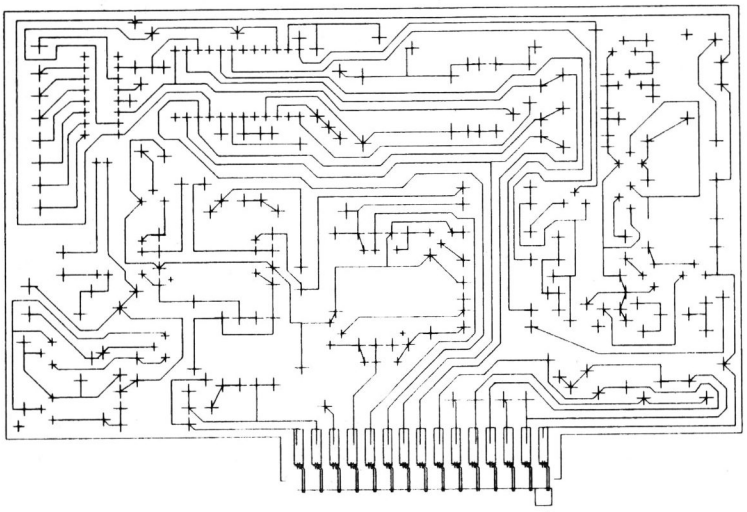
Within Bell-Northern Research, a variety of devices exist for the input and display of graphic information. This equipment includes a Computervision Designer I system, Gradicon digitizers, a Gerber photoplotter, a Calcomp plotter, an Optimat rubylith cutter, an Idiom refresh type CRT as well as Tektronix, Ards and Computek storage tube devices. In order to provide compatibility

between these devices, several basic features of Grapple were selected and developed into a common coding scheme called the Grapple interchange language. These features embodied in translation programs permit picture information to be created on any of the input devices and transferred to any of the output devices via a central computer system (IBM 360/67). Since the coding scheme is Grapple a quick look at the picture on a CRT terminal is possible before the data is sent to a plotter type output device. This capability is extremely useful in the area of printed circuit board and integrated circuit layout where expedient turnaround is essential and complicated plots could tie up a plotter for several hours. As new equipment is added to the system, it is merely a matter of defining and writing new translation programs based upon the Grapple interchange language in order to provide full compatibility with the system. This important application of Grapple ensures expedient turnaround of results with flexibility of the work environment.

GRAPPLE QUICK LOOK AND EDITING OF INTEGRATED CIRCUIT MASKS AND PRINTED CIRCUIT BOARDS

As a compliment to the interchange language, Grapple editors (or control programs) provide the capability to perform quick look and editing operations at low cost graphics terminals. These editors are structured such that user defined functions in the form of menu items and related Grapple code are invoked on an as required basis through joystick or lightpen detection. In this manner, change, addition or deletion of the picture material is easily achieved. Within Bell-Northern Research, this capability was conceived, written in Grapple and implemented for integrated circuit artwork design; the author of the program was not a professional programmer but an integrated circuit designer. The attributes of Grapple are such that as much or as little detail as required may be chosen through appropriate definition of application related Grapple functions. For example the connectivity pattern on a printed circuit board may be portrayed as wide lines or as thin lines at the users discretion. Figure 1 illustrates typical check plots obtained through Grapple as well as the final artwork produced on the Gerber PC 732 system. The users options are limited only by his imagination.





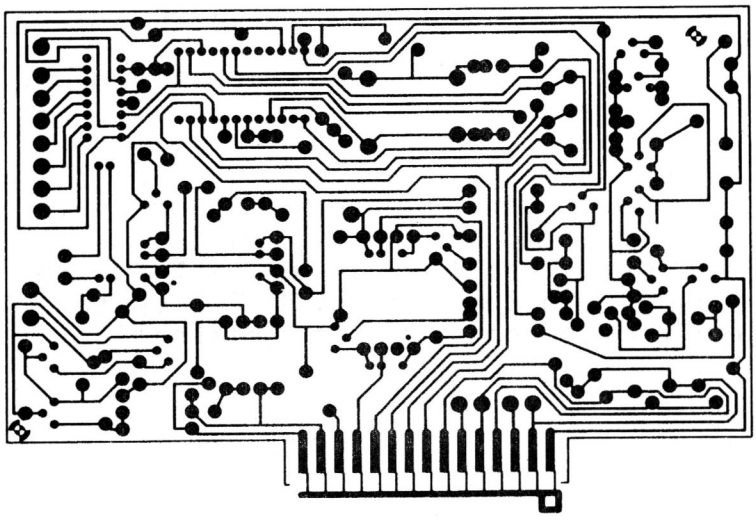


Figure 1

URBAN MAPPING AND INFORMATION RETRIEVAL

Many applications such as geocoded information systems where voluminous amounts of data are related to picture information require an environment where graphics and data management systems merge. To this end, Grapple provides a mechanism for passing control to an external procedure and back to Grapple again. The sequence shown in figure 2 illustrates a technique which can be employed to show greater picture detail as a user zooms into portions of a picture. First, a map of Canada is displayed while subsequent magnification presents the province of Ontario, the Ottawa-Hull region and finally property boundaries and centroids.

The following Grapple application involves the display of property ownership and assessment data related to urban planning. Data for this example was obtained from the National Capital Commission in Ottawa and converted to Grapple. The property ownership data in conjunction with a Grapple editor, an external PL1 procedure and a graphic terminal with joystick provide the media through which the assessment information is retrieved. Specifically, the system is capable of displaying street name and block number identification upon detection of any street boundary line, as well as assessment information upon detection of any property centroid.

The system has three parts:

Property ownership data

Assessment data

Display and retrieval system

PROPERTY OWNERSHIP DATA

The property ownership data exists as a Grapple file as shown and has the following attributes:

Level 1 contains alignment mark information at four specified locations. The alignment marks are in the form of moire patterns with outer radius of 20 and inner radius of 10.

Level 2 contains city block boundary vectors. Block number and street name information is contained in the form of a Grapple comment.

Level 3 contains a small square at the centroid of each property on the block as well as the lot number in the form of a comment.

Level 4 contains property delimiting vectors.

```
PROP:

L(1),
S(    0,    0), MOIRE,
S( 1000, 3000), MOIRE,
S( 5000, 3000), MOIRE,
S( 5000,-1000), MOIRE,

L(2),
S( 4258, 3124),V(  594,  -53),  ""    25 ST JEAN BAPTISTE
S( 4852, 3071),V( -140,-1207),  ""    25 RUE LAURIER
S( 4712, 1864),V( -599,   55),  ""    25 RUE PAPINEAU
S( 4113, 1919),V(  145, 1205),  ""    25 RUE NOTRE-DAME

L(3),
S( 4404, 3037), FRECT,          ""10080000
S( 4693, 2978), FRECT,          ""10240000
S( 4663, 2773), FRECT,          ""10230000
S( 4639, 2566), FRECT,          ""10220000
S( 4600, 2383), FRECT,          ""10210000
S( 4572, 2078), FRECT,          ""10200000
S( 4341, 2003), FRECT,          ""   90000
              etc
L(4),
S( 4555, 3096), V( -119,-1007),
S( 4436, 2089), V(  -31,    3),
S( 4405, 2092), V(  -23, -196),
S( 4263, 1905), V(   22,  197),
              etc
MOIRE: $MO(20,10);
FRECT: M(-5,-5),$RECT(10,10);
```

It is significant that certain of the information has been specified as Grapple comments since as such it is ignored by the Grapple compiler but yet is readily retrievable as required by the Grapple command $READ.

ASSESSMENT DATA

A file of assessment data provides detailed information concerning each lot number portrayed in the property ownership data. The assessment data is processed in a conventional manner by a PL1 program employing a pre defined Grapple communication structure.

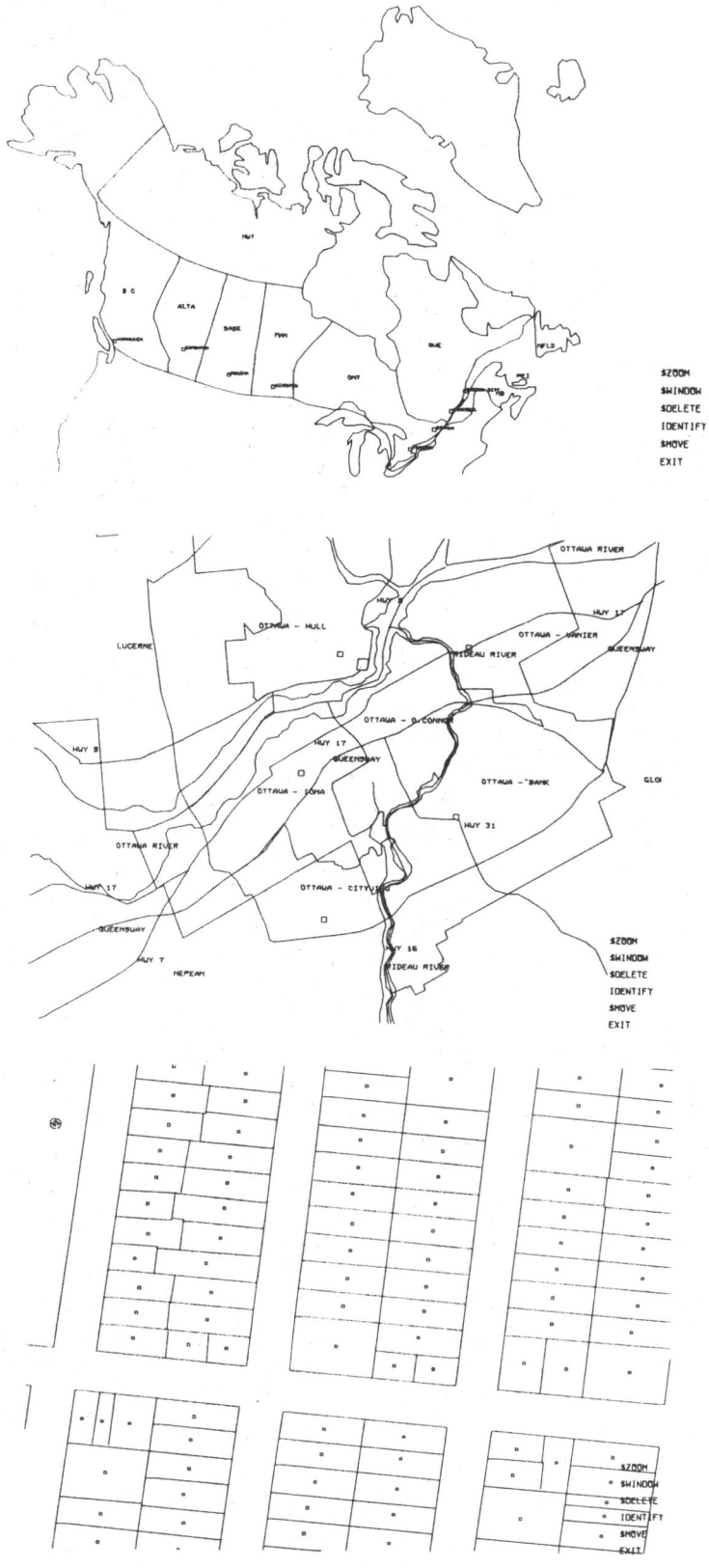

$ZOOM
$WINDOW
$DELETE
IDENTIFY
$MOVE
EXIT
OTTAWA RIVER
HWY 8
HWY 17
OTTAWA - HULL
LUCERNE
OTTAWA - GLOUCESTER
RIDEAU RIVER
QUEENSWAY
OTTAWA - O'CONNOR
HWY 8
HWY 17
QUEENSWAY
OTTAWA - BANK
GLOU
OTTAWA - SOMA
HWY 31
OTTAWA RIVER
HWY 17
OTTAWA - CITY
QUEENSWAY
HWY 16
HWY 7
RIDEAU RIVER
NEPEAN
$ZOOM
$WINDOW
$DELETE
IDENTIFY
$MOVE
EXIT
$ZOOM
$WINDOW
$DELETE
IDENTIFY
$MOVE
EXIT

Figure 2

DISPLAY AND RETRIEVAL

The requirements of the Grapple editor are as follows:

1) To provide a windowing capability.

2) To provide a framing capability.

3) To provide street name and block number identification upon detection of any street boundary line.

4) To provide and display assessment data concerning any lot number upon detection of its centroid.

The Grapple editor which performs the above operations is as follows.

```
EDITN: $ERASE,$OPEN('PROP'),$RUNMENU(!MENUA);

MENUA: <5>(STREET,LOT,$WINDOW,$FRAME,$AGAIN);

LOT:   $NOLEVEL,$LEVEL(3),
       G,&($$X>3500)(MEXIT)(&(I(!$DRAW,$$X,$$Y,50,50))
       ($$C->X1,S($$X+20,$$Y+20),
       $SETKEY(X1),$READ,$SETCOL(32),$ERASE,T($GET(8)),
       S(0,2900),$SETCOL(32),
       $CALLEXT($NUMERIC($GET(8))),
       $LEVELS(1,2,3,4),S(0,0),$DRAW,
       LOT)(S(0,0),T('NO-FIND'),MEXIT));

STREET: $NOLEVEL,$LEVEL(2),
       G,&($$X>3500)(MEXIT)(&(I(!$DRAW,$$X,$$Y,50,50))
       ($$C->X1,S($$X+20,$$Y+20),
       $SETKEY(X1),$READ,$SETCOL(35),T($GET(27)),
       S(0,0),STREET)(S(0,0),T('NO-FIND'),MEXIT));

MEXIT: $LEVELS(1,2,3,4),1;
$MAINFIG: PROP;  X1: 0;
```

GRAPPLE OUTPUT

Typical output from Grapple consists of a picture with superimposed assessment information. The output format and content are at the users discretion and may be altered through revision of either the PL1 program or the Grapple editor or both. More sophisticated applications will utilize data management techniques in place of the PL1 program.

SUMMARY OF GRAPPLE APPLICATIONS

The following list includes Grapple applications which have been developed or are in development at Bell-Northern Research:

- Integrated circuit quick look and editing program
- Printed circuit board quick look and editing program
- Logic extraction from a schematic program
- Logic extraction from integrated circuit mask layout program
- Three dimensional Grapple editor
- Office layout program
- Generalized plotting program
- Geocoded information systems
- Flowcharting programs
- Schematic input and editing program
- Hydro/Telephone line exposure analysis
- Outside plant location records mechanization

CONCLUSION

The current and proposed applications of Grapple within Bell-Northern Research emphasize the versatility of our approach to computer graphics while the broad spectrum of users emphasizes the success.

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