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Analytic Patch Configuration (APC) Gateway Version 1.0 User's Guide

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Preface

This document describes the Analytic Patch Configuration (APC) Gateway, release 1.0. It is intended to serve as a "cookbook" reference for all users. New users are directed to read the introductory section, then study the sample sessions presented in appendix A. Readers not familiar with the APC format are referred to appendix B of this document, or to the CSC (Langley Operation) Internal Reference Document titled "Analytic Patch Configuration (APC) File Description."

This software was developed by Computer Sciences Corporation, Applied Technology Division, under contract to the National Aeronautics and Space Administration's Langley Research Center, during the Autumn of 1989. CSC supports this package only at Langley Research Center.

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Introduction

General Description and Purpose

The Analytic Patch Configuration (APC) Gateway is a software tool for converting analytic geometry data from one format to another via the APC format. For example, the Gateway can be used to convert files among the four accepted APC formats, or to convert a Patran 2.x neutral file to an Integrated Aerodynamic Analysis System (IAAS) General Geometry (GG) file.

Features

The major features offered by the Gateway are:

Dialogue Driven - Because the Gateway asks all the necessary questions, and accepts a variety of plain English answers, even new or occasional users can effectively transform their data files.

Automatic Formatting - When it opens an incoming data file, the Gateway automatically determines its format. This feature is particularly handy when receiving unfamiliar data files from unknown or foreign sources.

Consolidation - An attempt has been made to include most analytic geometry formats used at Langley into this software package. This allows Langley's researchers to use this single "geometry gateway" for their geometry transformations.

Error Messages - All error messages are written in plain English, and every effort has been made to describe the problem as clearly as possible. A complete list of all error messages, including a further explanation and suggested remedies, is presented in appendix B.

Portability - Perhaps the Gateway's most enduring feature is its ability to execute on a variety of operating systems. Developed under UNIX, it also executes under VMS and NOS.

Limits

The Gateway reads and writes entire geometry files, not file fragments. Consequently, there is an upper limit on the total number of raw data cells it can accommodate. The capacity of the Gateway is 1,000 components and 10,000 surfaces. However, these capacities may change as the Gateway is installed on different hosts. Both limits are set once in a central part of the Gateway and are easily modified. If and when a data file exceeds either limit a clear error message is written.

Associated Products

Three companion packages, the Analytic-to-Wireframe Geometry Translator, the Wireframe-to-Analytic Geometry Translator, and the LaWGS Octopus, allow additional geometry data manipulations. All three packages are available and supported at NASA Langley Research Center.

Files

The user is responsible for ensuring that all incoming geometry files are available to the Gateway. This normally requires that "read" permission be granted to the user, the default on most systems.

The exception is NOS, where the file can only be made available ("local") by using the command

GET,*filename*

where *filename* is the name of the permanent file to be made local. In addition, the files created can only be retained ("saved") by using the command

SAVE,*filename*

or

REPLACE,*filename*

where *filename* is the name of the local file to be made permanent. (Remember the NOS command SAVE makes a local file permanent only when a permanent file by that name doesn't already exist; the REPLACE command always makes the local file permanent, whether a permanent file by that name already exists or not.)

Execution

How the Gateway is executed depends upon the host computer system. However, most installations require only that

apcgw

be entered to begin execution. Again the exception is NOS, where the commands

GET,APCGW/UN=NTFLIB
APCGW

are required. The following welcome banner then appears:

```
------------------------------

    A P C   G a t e w a y

  Release 1.0   November 1989

------------------------------
```

The release number and date will change as new versions of the Gateway are installed.

Incoming Geometry File

The first question is:

```
What is the name of the incoming file ?
```

A file name must be provided - the Gateway cannot assume a file name. The file name must be valid for the host operating system (e.g., most operating systems do not allow a file name to begin with a number). Also, the file must exist, and it must not be in use (or "locked") by another user or another process. Finally, the file cannot be empty. If any of these conditions are not met the Gateway writes an error message and repeats the question. (For more information regarding a specific error message, please refer to Appendix C - Warnings and Error Messages.)

The Gateway may be stopped here by entering **quit**, **qui**, or **q**.

After the file is opened, the Gateway attempts to match its contents to a recognized geometry file format. This process is invisible to the user. Once a match is made, the Gateway writes the message

```
This file uses APC format 89f.
```

in the case of an APC 89f file. Other formats generate a similar message.

Outgoing Geometry File

The next question is:

```
What name should be given to the new file being created ?
```

A file name must be provided - the Gateway cannot assume a file name. The file name must be valid for the host operating system. If the file already exists, the user must have "write" permission on it, and it cannot be in use ("locked") by another user or another process. If the file does not already exist, it is created in the active directory.

The Gateway may be stopped here by entering **quit**, **qui**, or **q**.

Outgoing Geometry File Format

The next question is:

```
What format should be used for the new file ?
```

The Gateway attempts to match the format name provided with an internal list of formats supported. For example, **89f** is accepted as a request for an APC 89f file. The other formats have comparable aliases. For a complete list of the available formats, and their aliases, answer this question with **help** or **?**.

The Gateway may be stopped here by entering **quit**, **qui**, or **q**.

Recycle Dialogue

The final question is:

```
Do you wish to convert another file ?
```

If another file is to be translated, enter **yes** or **y**. This starts the dialogue cycle again, beginning with the incoming geometry file question. Even if the cycle is restarted by mistake, the Gateway stops when any questions are answered with a **quit**, **qui**, or **q**.

If no other file is to be translated, enter **no**, **n**, **quit**, **qui**, or **q**.

In Case of Problems...

General

No software is above design and development errors. If you uncover an error, or notice some strange behavior, please follow the steps described below. One minute of your time may save hours or even days of effort.

Langley Users - All Systems

If possible, assemble the following information:

1. Your host computer's manufacturer, model, operating system, and location.
2. The incoming data file name.
3. The desired outgoing data format.

Then call Bradford Bingel ("Bing") at Computer Sciences Corporation, (804) 865-1725. Every attempt will be made to correct the problem, when possible, within a few minutes.

Non-Langley Users - All Systems

Computer Sciences Corporation does not support the APC Gateway outside of NASA Langley. All questions and problems concerning this software should be directed to Dr. John E. Lamar, mail stop 361, (804) 864-2851.

All comments are appreciated and welcomed !!!

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Appendix A
Sample Sessions

Sample Session #1

```
% apcgw

        ------------------------------

            A P C   G a t e w a y

          Release 1.0   November 1989

        ------------------------------


        What is the name of the incoming file ?
 > apc89f

        This file uses APC format 89f.

        What name should be given to the new file being created ?
 > q
%
```

This example illustrates how the Gateway's "auto-format" feature may be used to determine the format of an individual geometry file.

Sample Session #2

```
% apcgw

        ------------------------------

            A P C   G a t e w a y

          Release 1.0   November 1989

        ------------------------------


        What is the name of the incoming file ?
> apc89f

        This file uses APC format 89f.

        What name should be given to the new file being created ?
> patnf

        What format should be used for the new file ?
> pat2

        Do you wish to convert another file ?
> y

        ----------


        What is the name of the incoming file ?
> 14

        "14" is an improper file name.

        What is the name of the incoming file ?
> patnf

       "patnf" is a Patran 2.x neutral file.

        What name should be given to the new file being created ?
> f106gg

        "f106gg" is being rewritten.

        What format should be used for the new file ?
> help
```

```
        The available formats are:

             Format              Aliases

             APC format 89f      89f
             APC format 89fd     89fd
             APC format 89u      89u
             APC format 89ud     89ud
             Patran 2.x          patran2  pat2
             IAAS GG             gg

        What format should be used for the new file ?
 > gg

        Do you wish to convert another file ?
 > x

        Please answer with a YES or a NO.
 > n

        Normal session.

 %
```

This example illustrates a complete Gateway dialogue, including an assortment of error conditions and their corresponding messages.

Appendix B
The APC File Format

Analytic Bicubic Parametric Patches

Imagine two independent parametric variables, C_1 and C_2, which vary over the interval [0,1], and three continuous functions, F_x, F_y, and F_z, which use C_1 and C_2:

$$x = F_x(C_1, C_2)$$
$$y = F_y(C_1, C_2)$$
$$z = F_z(C_1, C_2)$$

These three functions are combined to create an (x,y,z) location in three-dimensional space:

$$(x,y,z) = (F_x,F_y,F_z) = (F_x(C_1, C_2), F_y(C_1, C_2), F_z(C_1, C_2))$$

Since F_x, F_y, F_z, C_1, and C_2 are all continuous over the interval [0,1], the set of points (F_x,F_y,F_z) define a continuous surface in three-dimensional space, a bicubic parametric patch.

Each of the bicubic parametric functions F_x, F_y, and F_z has the form:

$$\begin{aligned} F_{x,y,z} = {} & a_0 + a_1C_1 + a_2C_1^2 + a_3C_1^3 + \\ & a_4C_2 + a_5C_1C_2 + a_6C_1^2C_2 + a_7C_1^3C_2 + \\ & a_8C_2^2 + a_9C_1C_2^2 + a_{10}C_1^2C_2^2 + a_{11}C_1^3C_2^2 + \\ & a_{12}C_2^3 + a_{13}C_1C_2^3 + a_{14}C_1^2C_2^3 + a_{15}C_1^3C_2^3 \end{aligned}$$

where the coefficients a_0 through a_{15} are independent for each function F_x, F_y, and F_z. In other words, each surface is defined by 48 (3 sets of 16) coefficients. This patch description is often called the "alpha" or "algebraic" definition of a surface.

Components

A geometric *configuration* is usually made up of many patches, often grouped into *components*. For example, an aircraft configuration's wing may be defined as a separate component containing the set of patches which, collectively, describe the wing. Other portions of the configuration, such as the fuselage or vertical tail, may also be defined as separate components.

The patches contained in each component are not necessarily mutually exclusive. That is, a patch which belongs to a component may also belong to other components. For example, a common technique is to break the configuration up into components, but retain all patches in the component "ALL". Another common technique is to have *nested* components. For example, the wing may be broken up into a root section, one or more mid-sections, and a tip section. Each of these components may be further divided into an upper surface, a lower surface, and a leading edge. Under this example, a single patch on the wing's leading edge would belong to at least three components.

The APC File

The Analytic Patch Configuration (APC) file is sequential and unformatted. It contains three groups of records: header, component, and coefficient.

Every APC file begins with exactly three 80-character header records:

Analytic Patch Configuration File
Format 89u
descriptive title

The first two records must contain the text strings shown. The third record may contain any descriptive text string, so long as it does not exceed 80 characters. The corresponding FORTRAN fragments are:

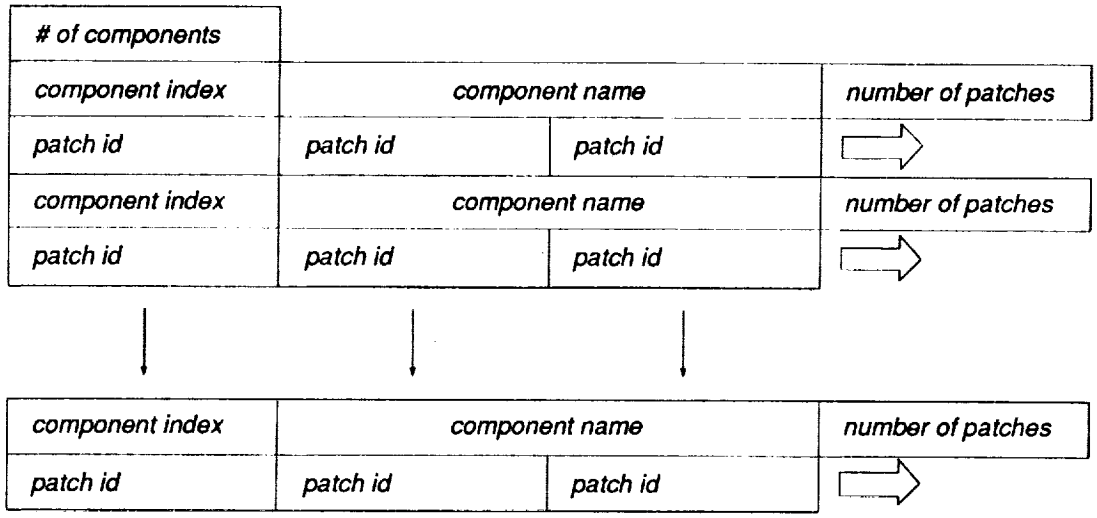
Reading

```
CHARACTER*80   TEXT80, TITLE
.
READ (iounit) TEXT80
IF (TEXT80.NE.'Analytic Patch Configuration File')  --> error
READ (iounit) TEXT80
IF (TEXT80.NE.'Format 89u')  --> error
READ (iounit) TITLE
```

Writing

```
CHARACTER*80   TEXT80, TITLE
.
TEXT80 = 'Analytic Patch Configuration File'
WRITE (iounit) TEXT80
TEXT80 = 'Format 89u'
WRITE (iounit) TEXT80
WRITE (iounit) TITLE
```

The component records define the configuration's component structure. The records have the format:



Notice that if the first record contains a zero (indicating no components exist), the subsequent component definition records should not be processed. The corresponding FORTRAN fragments are:

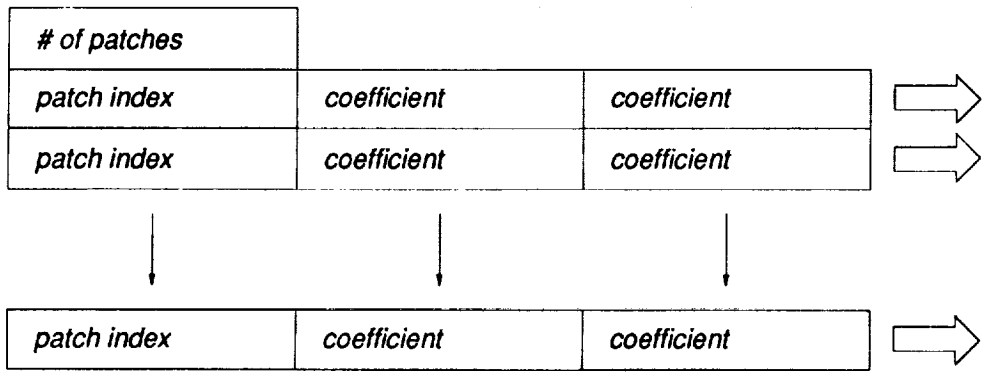
Reading

```
CHARACTER*40    CNAME(component_capacity)
INTEGER         CINDEX(component_capacity)
INTEGER         START(component_capacity), STOP(component_capacity)
INTEGER         PLIST(patch_list_capacity)
.
READ (iounit) NCOMPS
IF (NCOMPS.GT.0)  THEN
   IF (NCOMPS.GT.component_capacity)  --> error
   IBASE = 0
   DO  ICOMP = 1, NCOMPS
      READ (iounit) CINDEX(ICOMP),CNAME(ICOMP),NUMBER
      START(ICOMP) = IBASE + 1
      STOP(ICOMP) = IBASE + NUMBER
      IF (STOP(ICOMP).GT.patch_list_capacity)  --> error
      IF (NUMBER.GT.0)
+        READ (iounit) (PLIST(K),K=START(ICOMP),STOP(ICOMP))
      IBASE = IBASE + NUMBER
   END DO
END IF
```

Writing

```
CHARACTER*40    CNAME(component_capacity)
INTEGER         CINDEX(component_capacity)
INTEGER         START(component_capacity), STOP(component_capacity)
INTEGER         PLIST(patch_list_capacity)
.
WRITE (iounit) NCOMPS
IF (NCOMPS.GT.0)  THEN
   DO  ICOMP = 1, NCOMPS
      NUMBER = STOP(ICOMP) - START(ICOMP) + 1
      WRITE (iounit) CINDEX(ICOMP),CNAME(ICOMP),NUMBER
      IF (NUMBER.GT.0)
+        WRITE (iounit) (PLIST(K),K=START(ICOMP),STOP(ICOMP))
   END DO
END IF
```

The coefficient records define each patch in the configuration. The records have the format:



The corresponding FORTRAN fragments are:

Reading

```
INTEGER          PINDEX(patch_capacity)
REAL             COEF(48,patch_capacity)
INTEGER          NSURFS
.
READ (iounit) NSURFS
IF (NSURFS.GT.0)  THEN
   IF (NSURFS.GT.patch_capacity)  --> error
   DO  IPATCH = 1, NSURFS
      READ (iounit) PINDEX(IPATCH),(COEF(K,IPATCH),K=1,48)
   END DO
END IF
```

Writing

```
INTEGER          PINDEX(patch_capacity)
REAL             COEF(48,patch_capacity)
INTEGER          NSURFS
.
WRITE (iounit) NSURFS
IF (NSURFS.GT.0)  THEN
   DO  IPATCH = 1, NSURFS
      WRITE (iounit) PINDEX(IPATCH),(COEF(K,IPATCH),K=1,48)
   END DO
END IF
```

Eliminating Host Dependencies

APC files were designed to be unformatted in order to minimize their relatively large storage size and significantly improved I/O response. Unfortunately, this same feature also prevents them from being transferred across communications networks to other host computers.

APC files have a formatted counterpart. They contain the exact same information, but use FORTRAN list-directed READ's and WRITE's. The only difference is "89f" replaces "89u" in the second header record. Once an APC file is converted from unformatted to formatted, it can be transferred to a different host computer, then converted from formatted back into unformatted, with little or no loss in accuracy. This technique allows users to freely transfer APC files between different hosts.

The APC file design also accommodates double precision files. The REAL coefficients become DOUBLE PRECISION and "89ud" replaces "89u" in the second header record. Its formatted equivalent follows the pattern described above, and "89fd" replaces "89ud" in the second header record.

Finally, APC applications software running under an operating system which doesn't support the ASCII character set (such as CDC/NOS) may write APC header records using all uppercase letters. So that APC files may be freely transferred between different host computers, all APC applications software should be able to read and accept APC files with all uppercase header records.

Appendix C
Warnings and Error Messages

The APC Gateway generates few error messages. Each was designed to be self-explanatory, but occasionally they may be misinterpreted. The purpose of this appendix is to clarify the situation creating the error, and, where appropriate, suggest techniques which may help to avoid similar problems in the future.

All error messages are listed in alphabetical order.

"*filename*" appears to be empty.

The file exists, yet contains no information. On most operating systems this is possible when some previous I/O operation created a new file without transferring any data.

"*filename*" does not exist.

The requested file does not exist, or the file exists but "read" permission is denied. Note that file names are case sensitive on UNIX installations (i.e., file "GEOM1" is unique from file "geom1").

"*filename*" is already in use.

The requested file exists, but another user (or another process) has it "locked," making it inaccessible to the Gateway.

"*filename*" is an improper file name.

The file name provided is not valid on the host operating system. The most common problems are having a number as the first character, or using some special character (!@#$%) anywhere in the name.

"*filename*" is a reserved file name.

The file name provided is reserved for use only by the host operating system. For example, file *stdout* is reserved under UNIX, and *SYS$INPUT* is reserved under VMS.

"*filename*" is being rewritten.

The outgoing file specified already exists. Its original contents will be lost as the Gateway writes the new information in its place.

Capacity limit - Component lists are too long.
Only *number* total elements can be accommodated.

The Gateway cannot dynamically allocate central memory. Consequently, there is a limit placed on the extent of the components' element lists. If the file exceeds this limit, this message appears. When possible, a quick solution is to break up the file into two or more smaller files. However, if this message begins to appear regularly, please follow the steps listed in the section "In Case of Problems . . ." and ask for the Gateway's element list capacity to be increased.

Capacity limit - Too many components.
Only *number* components can be accommodated.

The Gateway cannot dynamically allocate central memory. Consequently, there is a limit placed on the number of components it can handle. If the file exceeds this limit, this message appears. When possible, a quick solution is to break up the file into two or more smaller files. However, if this message begins to appear regularly, please follow the steps listed in the section "In Case of Problems . . ." and ask for the Gateway's component capacity to be increased.

Capacity limit - Too many surfaces.
Only *number* surfaces can be accommodated.

The Gateway cannot dynamically allocate central memory. Consequently, there is a limit placed on the number of surfaces it can handle. If the file exceeds this limit, this message appears. When possible, a quick solution is to break up the file into two or more smaller files. However, if this message begins to appear regularly, please follow the steps listed in the section "In Case of Problems . . ." and ask for the Gateway's surface capacity to be increased.

Format 89u is assumed.

If you only press the *Return* key in response to the question *What format should be used for the new file?*, APC format 89u (the default format) is assumed.

Internal Fatal Error - Ghost File.
Please contact the APC Gateway support team.

Internal fatal errors appear when logic errors occur within the software. Please accept the developer's apologies for any consequential inconvenience, and follow the steps listed in the section "In Case of Problems . . ." to report this message.

Internal Fatal Error - Improper I/O Unit Passed.
Please contact the APC Gateway support team.

Internal fatal errors appear when logic errors occur within the software. Please accept the developer's apologies for any consequential inconvenience, and follow the steps listed in the section "In Case of Problems . . ." to report this message.

Internal Fatal Error - RGG #1.
Please contact the APC Gateway support team.

Internal fatal errors appear when logic errors occur within the software. Please accept the developer's apologies for any consequential inconvenience, and follow the steps listed in the section "In Case of Problems . . ." to report this message.

Internal Fatal Error - RGG #2.
Please contact the APC Gateway support team.

Internal fatal errors appear when logic errors occur within the software. Please accept the developer's apologies for any consequential inconvenience, and follow the steps listed in the section "In Case of Problems . . ." to report this message.

Internal Fatal Error - Unknown Error Code.
Please contact the APC Gateway support team.

Internal fatal errors appear when logic errors occur within the software. Please accept the developer's apologies for any consequential inconvenience, and follow the steps listed in the section "In Case of Problems . . ." to report this message.

Please answer with a YES or a NO.

The preceding question asked for a simple yes/no response. The Gateway accepts any of the following: **yes, y, no, or n**. In addition, the Gateway stops when any of the following responses are entered: **quit, qui, q**. Any other response appears as an unclear answer.

Sorry, but couldn't understand your answer.
Please try again.

For some unknown reason, the Gateway did not receive your response. This usually occurs after an unsuccessful attempt to alter a response by using a series of control characters.

This doesn't look like an APC file.

This incoming file satisfied the APC quick-screen tests but, upon closer inspection, does not meet all of the APC format requirements. This often occurs with formatted versions (89f and 89fd) after a slight variation was introduced during an editing session.

This doesn't look like an IAAS GG file.

This incoming file satisfied the IAAS GG quick-screen tests but, upon closer inspection, does not meet all of the GG format requirements. This often occurs when the unformatted GG file is improperly retrieved from a remote host.

This doesn't look like a Patran 2.x neutral file.

This incoming file satisfied the Patran neutral file quick-screen tests but, upon closer inspection, does not meet all of Patran's format requirements. This often occurs after a slight variation was introduced during an editing session.

This file appears to be empty.

The file exists, yet contains no information. On most operating systems this is possible when some previous I/O operation created a new file without transferring any data.

This file's format isn't recognized.

The incoming geometry file is not in a recognized format. Those formats which are recognized by the Gateway, along with their abbreviations/aliases, are then listed below the error message. If you would like to see a new format added to the Gateway's vocabulary, or believe that additional aliases are needed for an existing format, please follow the steps listed in the section "In Case of Problems . . ." and ask for the enhancement.

Unable to open this file. Please try another.

For any of a number of reasons, the requested file cannot be accessed. This situation should be somewhat rare, as the more common causes (e.g., the file doesn't exist, or it's locked by another user) are successfully diagnosed to create pinpoint explanations. The underlying cause is usually system-dependent, putting the Gateway in the unenviable position of writing this general error message. The only recommended remedy is to stop the Gateway, reestablish all file connections, and reexecute.

Unclear or unavailable format.

The incoming geometry file is not in a recognized format. Those formats which are recognized by the Gateway, along with their abbreviations/aliases, are then listed below the error message. If you would like to see a new geometry format added to the Gateway's vocabulary, or believe that additional aliases are needed for an existing format, please follow the steps listed in the section "In Case of Problems . . ." and ask for the enhancement.

You must enter a file name . . .

The Gateway cannot assume the incoming or outgoing file's name. After this message appears the question asking for the file name is repeated.

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Langley Technical Monitor: Dr. John E. Lamar

16. Abstract

The Analytic Patch Configuration (APC) Gateway is an interactive software tool which translates aircraft configuration geometry files from one format into another. This initial release of the APC Gateway accommodates six formats: the four accepted APC formats (89f, 89fd, 89u, and 89ud), the PATRAN 2.x phase I neutral file format, and the Integrated Aerodynamic Analysis System (IAAS) General Geometry (GG) format. Written in ANSI FORTRAN 77 and completely self-contained, the APC Gateway is very portable and has already been installed on CDC/NOS, VAX/VMS, SUN, SGI/IRIS, CONVEX, and CRAY hosts.

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