CFD General Notation System Steering Committee Charter

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1 Background

1.1 History

In the early 1980s, the PLOT3D data format gained acceptance as a de *facto* standard to enable the storage and exchange of CFD data within analysis processes, and among collaborating organizations. This initial CFD data standard today continues to be the most common storage and exchange standard for CFD data, based on structured grids.

However, by the early 1990s several limitations in the PLOT3D standard had become apparent. Individual organizations were overcoming these limitations by defining extensions to the PLOT3D standard to meet their needs. These extensions were not coordinated among different organizations, and therefore data stored in these extended formats generally could not be utilized outside the originating organization. Further, the PLOT3D standard had not anticipated several key trends in CFD technology, such as unstructured grids, turbulence models based on solutions of partial differential equations, and the need to include chemical species concentrations as part of a CFD solution. Also, the PLOT3D format, which was originally developed simply to expedite post-processing (visualization) did not include self-documenting features. Therefore, it was necessary to rely on file-naming conventions or external notes to maintain awareness of the flow conditions and analyzed geometry of each PLOT3D data file.

The CGNS Data Standard was initially conceived in 1994 by NASA, Boeing, and then-McDonnell Douglas teams working under the Integrated Wing Design element of NASA's Advanced Subsonic Technology Program. The objective of this work was to greatly reduce the time required to design a transport wing. Implicit in this goal was increased extensive use of Computational Fluid Dynamics (CFD) and the possibility of collaborative analyses by many organizations.

To achieve this vision, it was necessary to establish a common data format suitable to meet the needs of production CFD tools in the mid- to late-1990s. This format would be used to enable interchange of data among different CFD-related tools and different computing platforms, and to provide a mechanism for archive and retrieval of CFD data. The chief tools that were taken into consideration for this goal were two structured-grid multi-block codes, OVERFLOW and TLNS3D. The available data standard, the PLOT3D format, was increasingly proving to be inadequate for this purpose. Some of these shortcomings included:

- Requirement to read the entire file to retrieve any data.

- No provision for multi-block connectivity data.

- Requirement to convert to ASCII format to transfer data between dissimilar computing platforms.

- Lack of self-documentation; descriptive information must be separately maintained outside the data file.

Several database options were considered by the NASA / Boeing / McDonnell Douglas team during the period December 1994 to March 1995. In March 1995, a decision was taken to build a new data standard called CGNS (Complex Geometry Navier Stokes). This standard was a "clean sheet" development, but it was heavily influenced by the McDonnell Douglas Common File Format (CFF) standard, which had been established and deployed in 1989 and significantly revised in 1992.

It should be noted that the CGNS data standard consists of two major elements:

Data Content and Format	The definition of the intellectual content of the data to be represented in this standard, and the format of the representation in the standard-conforming data file.
Implementing Software	Software packages developed to ease the process of establishing CGNS-compliant database references within an applications code.

In accepted standards contexts such as ISO / STEP, the "standard" consists only of the first item, a definition of the data content and format. In this regard, the CGNS development team went beyond the traditional role in setting standards, by also developing software to easily implement the standard in a code. The implementing software, in turn, was developed in two layers:

- Low-level routines to perform elementary operations on the database, known as the *ADF (Advanced Data Format) Library*. This low-level ADF library performs basic direct I/O operations on the file. It does not have any built-in knowledge of the data structure or the content of the data. The user must provide this knowledge; thus, a user who writes ADF calls must have a complete understanding of the CGNS data structures and content.

- Higher-level routines to perform common operations required by a CFD code, known as the *CGNS Mid-Level Library*. The CGNS Mid-Level Library is an Application Programming Interface (API) that allows the use of CGNS data files without any knowledge of the underlying data structures and file format. The person who writes code using this mid-level library needs only to have a general understanding of the standard data structure and content. The purpose of the mid-level library is to shield the user from the complexity of the basic ADF calls, and to ensure that the data are written in the proper structure to create a CGNS-compliant file. With the release of CGNS Version 2.4, the Mid-Level Library may be built using either ADF or HDF5 as the underlying database.

The data standards are controlled by two documents, which are available at the CGNS Documentation Home Page, at http://www.grc.nasa.gov/WWW/cgns/. These key control documents are:

- *Standard Interface Data Structures (SIDS)*
- *SIDS-to-ADF File Mapping Manual*, or *SIDS-to-HDF File Mapping Manual*

The ADF library was developed during 1995, and the first large-scale deployment was made by (then) McDonnell Douglas - St. Louis in November 1995, as part of an upgrade to the Common File Format system. During 1995-97, the NASA - Boeing - McDonnell Douglas team focused on adding content to the control documents, and laying out the requirements of the mid-level library.

At a review in June 1997, the CGNS team (NASA, Boeing, and McDonnell Douglas) determined that additional professional support would be required to produce an adequate mid-level library. Subcontracts were issued to the ICEM CFD Engineering Company, in Berkeley, CA, following this decision. ICEM CFD Engineering in effect became the lead organization for the development of the mid-level library. At this time, the acronym "CGNS" was re-defined to mean "CFD General Notation System", which was more in keeping with the evolved goals of this project.

An initial mid-level software library (version 1.0), which met the original goals of structured multi-block analysis codes, was released in May 1998. At this time, a decision also was taken whereby NASA and Boeing (McDonnell Douglas by this time had been absorbed by Boeing) would relinquish all rights to ICEM CFD Engineering. Concurrently, NASA and the informal CGNS

committee determined that there was no need for export authority, so the CGNS standard, the ADF and mid-level library, and all supporting documentation could be distributed worldwide as freeware. Appropriate legal reviews and approvals were obtained at both NASA and Boeing to validate this decision.

At meetings in March, May, and October 1998, the mid-level library was extended to support a wide range of unstructured grid types. The SIDS document defining the standard was modified, and extended versions of the mid-level library were released at intervals in late 1998 and early 1999. By May 1999, the extension to unstructured grids was released.

1.2   Management

Up to this time, all activities related to the development of the standard, the implementing software, and the related documentation had been coordinated and largely funded by NASA under the Advanced Subsonic Technology Program. In 1998, NASA took a decision that the Advanced Subsonic Technology program would end on September 30, 1999, which was approximately one year earlier than their original plan. Further, NASA indicated that they would not be able to manage the development of a standard or a software system such as CGNS, once it ceased to be the focus of an ongoing NASA program.

At this time, a number of U.S. and international organizations had established plans to use the CGNS standard and the ADF and mid-level library, and in several cases they had begun implementation. These organizations had a clear interest in the existence of an organization to coordinate future use and extensions of the CGNS standard and its supporting software and documentation. Also during this same period (1998-99), The Boeing Company launched an initiative to establish an ISO standard for aerodynamic data, to be based on the CGNS standard. However, in a best-case scenario CGNS will not become an ISO standard until roughly 2005–2006, and acceptance of CGNS as an ISO standard is not a certainty. It became clear that CGNS needed to find an organizational home, to coordinate its extension and utilization.

The organizations interested in the CGNS standard met in Hampton, VA, on May 20, 1999 to discuss options for a CGNS management organization. Out of this meeting, the CGNS Steering Committee was established. This Steering Committee is a voluntary organization to coordinate the further development and dissemination of the CGNS standard and its supporting software and documentation. In January 2000, the CGNS Steering Committee became an official subcommittee under the purview of the American Institute of Aeronautics and Astronautics (AIAA) Committee on Standards. The AIAA also distributes the CGNS SIDS document as an AIAA Recommended Practice. However, this AIAA affiliation does not preclude the CGNS committee from public dissemination of the SIDS and other CGNS documentation.

The following sections of this document present the vision of how the CGNS Steering Committee will operate.

2 Mission/Vision/Responsibilities

The mission of the CGNS Steering Committee is to ensure the continuation of the CFD General Notation System. The survival of a standard depends entirely on its level of use. Therefore the CGNS Steering Committee must aim at providing a standard that is widely accepted by the CFD community.

Several elements must be satisfied to ensure the acceptance of the CGNS standard. The most obvious asset is that CGNS must be useful. Not only must it answer the current needs for the recording of fluid dynamics data, but it must also follow the changes in requirements as CFD progresses. A second important element is that CGNS must be easy to implement. The CGNS Mid-Level Library (or Application Programming Interface, API) must be user-friendly and well documented, and online support must be available for all users at all times. The standard must also be easily accessible, meaning that all the sources, binaries, documents and any other pertinent information must be available to anyone without restrictions. Finally, it is of utmost importance that CGNS retains its public nature, encouraging contributions from all users.

The Steering Committee has the responsibility to oversee that the CGNS standard remains useful, accessible, easy to use, and preserves its public nature. This implies multiple activities, which can be subdivided in the following groups:

2.1 Ensure the maintenance of the existing software, documentation and web site

The CGNS Steering Committee is responsible for appointing a prime source, and overseeing the prime source activities. The Steering Committee must ensure that the prime source maintains the existing software, documentation and web site. This includes, but is not limited to:

- correcting/updating the documentation if necessary
- fixing any reported software bug
- collecting a list of CGNS users via the web site
- keeping the web site up to date with the latest versions of the documentation and software
- informing the user base of new releases and major software problems
- posting proposals for new features or modifications to the CGNS standard on the web site and collect comments from the user base
- maintaining a distribution site for contributed software utilities which utilize the CGNS standard

2.2 Provide mechanisms for the evolution of the standard

The CGNS Steering Committee has the responsibility to support and even encourage the evolution of the standard in order for CGNS to remain useful. Therefore, the committee must solicit technical support and "in-kind" contributions. In addition, the Steering Committee must follow the policies described in Section 4.2 of this document regarding the collection and evaluation of technical proposals.

2.3 Promote the acceptance of CGNS

The CGNS Steering Committee has the responsibility to promote the acceptance of CGNS throughout the CFD community. This can be achieved through various means, including word of mouth, advertising, business articles, and presentations at conferences and technical meetings.

2.4 Provide mechanism for answering questions and exchanging ideas

Electronic mail constitutes the main point of contact between CGNS users and CGNS developers. Therefore, the CGNS Steering Committee must maintain an electronic mail forum, to which users can post questions, answer questions, and exchange ideas. Members of the CGNS Steering Committee and/or appointed qualified persons will respond to the posted questions on the forum.

2.5 Determine the means by which the CGNS activities are supported

The CGNS Steering Committee has the obligation to determine the means by which all CGNS activities are supported. The Committee is also responsible for identifying and obtaining sources of funding, if appropriate. Finally the CGNS Steering Committee has the responsibility to distribute the tasks and funds to the most appropriate candidate, in the best interests of CGNS.

3 Organization/Bylaws

The CGNS Steering Committee is a voluntary organization that will determine its own policies and internal structure, and will govern by consensus whenever possible. In the absence of consensus, a two-thirds majority of the Committee members will be required to adopt changes to the standard, alter this Charter, or take other official actions.

The CGNS Steering Committee will meet at a minimum of one time per year. The time and location will be determined by consensus of the Committee, and all members of the Committee will be notified in advance.

The members of the CGNS Steering Committee will appoint a Chairperson whose responsibilities will include coordinating activities, facilitating meetings and serving as a focal point for the Committee. The Chairperson will be a member of the Committee, be elected by consensus, and serve for a two-year term. There is no limit on how many terms the Chairperson can be elected. At the discretion of the Chairperson, a Vice-Chairperson may be appointed by consensus of the Committee, to assist the Chairperson with his or her duties. The Vice-Chairperson will also be a member of the Committee. The appointment of a secretary to maintain records will be at the discretion of the Chairperson.

The CGNS Steering Committee may decide to suggest appropriate contributions from its members. The Steering Committee is not prohibited from charging membership fees; the decision whether to do so, and the amount of the fees, lies within the purview of the Steering Committee.

All parties are welcome to bring forward issues and participate in development of the CGNS Standard, whether or not they are members of the Steering Committee.

The decision whether to support the migration of the CGNS standard to ISO/STEP, or any other organization, lies within the purview of the Steering Committee.

3.1 Representation

The CGNS Steering Committee will be made up of representatives from specific institutions, rather than individuals. Changes or additions to Steering Committee membership will be based on potential contribution to the standard. Membership on the Steering Committee will be limited to 30 institutions that actively participate in the development, maintenance, distribution and use of the CGNS Standard. No more than 5 institutions may be related, i.e., have the same parent organization. Changes to the Membership (including the limit on the number of institutions) will be determined by consensus, or if required, a two-thirds majority of the existing Membership.

To help satisfy the duties of the Steering Committee as a whole, as described in Section 2, the minimal responsibilities of each individual Steering Committee member are to:

- Attend as many telecons/meetings as possible, but not less than one per year
- Read and send comments on proposals or other issues when asked to do so
- Vote when asked to do so

More active participation — including support, software development, and actively working to improve and promote CGNS — is encouraged.

3.2   Standing Committees

The CGNS Steering Committee may constitute Standing Committees, in an ongoing or temporary basis, to which it may delegate various responsibilities. The Standing Committees will report and make recommendations to the Steering Committee who will retain the authority to act and make final decisions.

3.3   Software and Documentation Support Team

The CGNS Steering Committee will be responsible for selecting one or more organizations to maintain and distribute existing documentation and software, to develop and distribute new software resulting from extensions to the standard, and to post or distribute meeting minutes and other new documentation.

The organization(s) selected to maintain CGNS software will determine the form of newly developed software and maintain compatibility with the existing ADF Core and CGNS API.

The organization(s) selected to maintain CGNS Documentation will be responsible for posting and maintaining on the web the Steering Committee meeting minutes, Charter, and archive information.

4 Standard and Software Governing Principles

4.1 Distribution

This section describes the policy governing the distribution of the CGNS standard and software to the engineering and scientific community at large. By definition, the CGNS *standard* refers to the Standard Interface Data Structures (SIDS) definitions, the SIDS to ADF and SIDS to HDF File Mappings, and the CGNS Mid-Level Library structure (API), as well as all documentation. The CGNS *software* refers to the ADF Core source code and the CGNS Library source code. The CGNS *software* may also include sample programs demonstrating the application and use of the CGNS and ADF libraries, as well as some utility programs to assist with the implementation and analysis of CGNS-based files and systems.

Implementation and maintenance of the CGNS distribution policy is the responsibility of the CGNS Steering Committee. The distribution policy dictates that both the CGNS standard and the CGNS software are publicly available, and that the standard and software itself are free of charge. The CGNS software may be used for any purpose, including commercial applications, and may be altered and redistributed, subject to the restrictions described in the CGNS License (see the Appendix).

It is the responsibility of the CGNS Steering Committee to enable distribution mechanisms that comply with the following principles:

- The CGNS standard (documentation and definitions) will be publicly available at no more than the cost of distribution.

- The CGNS software (ADF core and CGNS Library), including source code, will also be available at no more than the cost of distribution.

- The CGNS API (Mid-Level Library), including source code will be similarly available.

- Development, sale, and licensing of proprietary packages based on CGNS that perform substantive operations on the data, beyond the I/O performed by the API, are encouraged. Such packages must abide by the restrictions described in the CGNS License.

- The sale of services designed to assist in the conversion of existing software to the CGNS standard is acceptable.

- The voluntary contribution of software that performs operations on CGNS data is encouraged.

- The CGNS Steering Committee will provide mechanisms for the accumulation and distribution of contributed software, but will not be responsible for the function of contributed software.

- Contributed software does not become part of the CGNS Standard, that is, either the SIDS or the API, without the approval of the CGNS Steering Committee.

- The Steering Committee may agree to support or endorse additional utility software.

- The Steering Committee will *not* endorse third party software.

4.2 Changes or Additions to the Standard

CGNS is a standard that has been developed with the key concepts of flexibility and extendibility in mind. The standard can accommodate the majority of CFD data quantities in practical usage

today; however, some additional capabilities are still being implemented. It is also understood that in the future other additional capabilities will need to be implemented as well. For these reasons, a process for adding to or modifying the existing CGNS standard is necessary.

To address a particular need or deficiency in CGNS, a proposal for a potential change to the standard first must be made. A Technical Team will prepare all proposals. A Technical Team may voluntarily submit the proposal, or a Technical Team may be specifically appointed by the Steering Committee to author the proposal.

A primary requirement of all proposals for modifications will be to support and maintain code compatibility. No additions or changes to the CGNS standard will be adopted which invalidate existing software or data.

Prior to adoption, the Technical Team must present all proposals in an open and public forum. Included with the proposal, a draft of the necessary changes to the SIDS and File Mapping must be provided by the team introducing the modifications. The open forum will then review the proposal, identify any possible shortcomings, and suggest alternatives or improvements.

After the proposal has been presented and deliberated upon, only the Steering Committee has final authority of approval and may elect to do one of three things. First, the Steering Committee may vote by consensus (or a two-thirds majority if necessary) to accept the proposal as is, and thus the changes are approved for implementation. If such approval does not occur, the Steering Committee may still feel there is merit to the proposal, and may choose to defer acceptance of the proposal under the provision that specific changes be made. Finally, the Steering Committee may deem there is little merit in the proposed changes to CGNS, and reserves the right to reject the proposal outright. Whatever the disposition of the proposal, individual organizations may implement `UserDefined` functions, provided that they adhere to the conventions and standards as defined in the SIDS.

A   CGNS License

The distribution and use of the CGNS software is covered by the following license:

This software is provided "as-is", without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.

Permission is granted to anyone to use this software for any purpose, including commercial applications, and to alter it and redistribute it freely, subject to the following restrictions:

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For details on the policy governing the distribution of the CGNS standard and software see Section 4.