AUSTRALIAN STANDARDS FOR SPATIAL DATA TRANSFER

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ABSTRACT

The current Australian Standard for spatial data transfer, AS 2482 'Interchange of Feature-Coded Digital Mapping Data', is now ten years old and is unsuitable for modern spatial database and geographic information system applications. Standards Australia proposes to clone the U.S. 'Spatial Data Transfer Standard', with appropriate modifications for Australia, to supersede AS 2482.

INTRODUCTION

The Need for a Standard

One of the key economic benefits of GIS technology arises from the ability it provides to share spatial data among users. Data sharing reduces costs by avoiding duplication of data capture and maintenance. However, realisation of this benefit is dependent on the wide availability of an efficient and effective method for transferring spatial data between agencies and systems with different GIS hardware and software.

The Australian spatial data community is comprised of government, private and academic sectors. The government sector includes numerous agencies which utilise GIS in the Commonwealth Government, numerous agencies in each of the eight state and territory governments, and the larger of the nearly 500 local governments. The diversity and growth of the Australian spatial data community makes data transfer a critical issue.

The history and problems of the current Australian Standard for spatial data transfer, AS 2482, are described in this Chapter. The rationale and implications of the Standards Australia proposal to adapt the U.S. Spatial Data Transfer Standard as a new Australian Standard are also outlined.

Standards Australia

Standards Australia (formerly the Standards Association of Australia) is the national organisation for the promotion of standardization in Australia. It is an independent non-profit organisation administered by a Council comprising representatives from government, industry, professional groups and the community. Standards Australia is the Australian member of the International Organisation for Standards (ISO).

Standards Australia has published over 4000 Australian Standards on a diverse range of topics, and has about 1600 technical committees which prepare draft standards. Each committee is formed on a national basis with a balanced representation from all interested sectors of the relevant industry. New standards are initiated by authoritative sources external to Standards Australia, such as industry associations and professional societies. Technical committees either draft a new standard or adapt the work of the external body to the required format. Drafts are circulated for public comment and consensus must be reached within a committee before a Standard can be published. Australian Standards are not compulsory per se, but they are frequently referenced in statutory regulations and contracts making their use mandatory in specified situations.

The Committee relevant to spatial data is Information Technology Committee Number Four (IT/4), Geographical Information Systems. IT/4 has representatives from government agencies, academia, industry associations, professional societies and research bodies involved in surveying, mapping and land information. Development of spatial data transfer standards is the responsibility of Subcommittee IT/4/2, Geographic Data Exchange Formats.

AUSTRALIAN STANDARD 2482

Development

The development of the current Australian Standard for spatial data transfer, AS 2482, is summarised in the following chronology of events.

<u>1974:</u> The National Mapping Council (NMC) formed a Working Party to develop a standard for the exchange of digital topographic information. A key factor was the increasing use of private sector consultants to produce digital mapping data for government mapping authorities. The resulting 'NMC Standard on Exchange of Topographic Information on Magnetic Tape' was completed in 1978.

1979: The NMC submitted its Standard to the Standards Association of Australia (SAA, now called Standards Australia) for consideration as an Australian Standard. SAA constituted a more broadly-based committee to develop an Australian Standard based on the NMC work.

1981: The SAA published AS 2482-1981 'Interchange of Feature Coded Digital Mapping Data'. The Australian Standard was substantially different to the 1979 NMC Standard.

1982: A NMC Working Party developed a subset of AS 2482 'Recommended Procedures for the Interchange of Digital Mapping and Charting Data on Magnetic Tape'. The subset defined preferred options in places where the Standard allowed for alternatives.

1984: The SAA published a revised version of the Standard AS 2482-1984. This was an extension of the 1981 Standard, adding more feature codes and improving the scope and content of various record types.

1985: The NMC revised its recommended procedures document to reflect AS 2482-1984 and the experience of members in the use of the Standard. The NMC document was titled 'Recommended Procedures for the Interchange of Small and Medium Scale Digital Vector Topographic Mapping Data' to reflect the NMC view of the narrow scope of AS 2482.

1987: The SAA formed Committee IT/4, Geographical Information Systems. This was partly in response to a request from the NMC to change the title of AS 2482 to reflect its narrow application. Key outcomes from the initial meeting of IT/4 were to produce a third version of AS 2482 by incorporating the NMC subset, and to assess the U.S. Draft Standard for Digital Cartographic Data with a view to adopting it as a basis for development of a new Australian Standard to supersede AS 2482. Subcommittee IT/4/2, Geographic Data Exchange Formats, was formed to undertake these tasks.

1989: Standards Australia published AS 2482-1989 (Standards Australia 1989). AS 2482-1989 is compatible with AS 2482-1984 and includes an Appendix based on the 1985 NMC subset. The description of the scope was changed and other minor changes were made to reflect developments relating to the Australian Geodetic System and to enable identification of versions of AS 2482.

AS 2482 has been a moderately successful Standard. It is widely used by government mapping agencies who acquire data from the private sector, and who distribute data to users.

Concepts

AS 2482 specifies a file and record structure for the interchange of point and vector digital mapping data. It is not intended to be used for the transfer of polygon, raster or topologically structured spatial data, nor for attribute data which may be associated with the spatial data. It is designed for interchange on magnetic tape and makes use of existing national and international standards for tape labelling and encoding. A hierarchical system of four-digit feature codes defines about 750 cultural, hydrographic, relief and vegetation features. Users may also define four-digit feature modifiers to further specify map features.

The general structure of an AS 2482 map data file, in accordance with the NMC subset, is as follows:

Tape Label: Fixed length header with tape identification information.

File Headers: Two fixed length headers containing basic file identification, the creation date, and format information.

Essential Information Record: Fixed length record defining coordinate systems, scale factors and offsets.

(Basic) Descriptive Information Records: Six fixed length records defining: the map number, name, scale and theme; the owner, agency and contact person; the source, source scale and source date; the date digitized and date last revised; the estimated root mean square error in X, Y and Z; and the camera focal length and flying height (for digital photogrammetric data).

(Other) Descriptive Information Records: Fixed length records containing other descriptive information, if required, such as non-standard feature codes, feature modifiers, or donor-defined coordinate systems.

Feature Records: Variable length records for each feature. Each record has two or three segments: Header Segment, defining the record length, nature of feature (point or line), feature code and modifier, and number of axes (Z, XY, or XYZ); Detail Segment for Line, Point or Text Data, containing the feature coordinate values; and if required a Detail Segment for Identification/Name, containing textual data such as the feature name.

End of File: Two fixed length labels defining the end of the file.

Problems

AS 2482 represents the state-of-the-art in the late 1970s for computer-assisted map production. The technology then comprised data acquisition through digital photogrammetry or table digitizing, followed by production of map reproduction material on precision vector plotters.

Initial criticisms of AS 2482 were that the options provided in various parts of the Standard made it difficult for users to write comprehensive and robust transfer software, and that the specified feature codes did not satisfy large-scale mapping applications. The NMC subset partially addressed these criticisms. However, with the development of large spatial databases and analytical applications of spatial data, based on GIS technology, AS 2482 was also seen to have some serious conceptual problems. These include:

- o does not support polygon, grid or raster data types;
- o does not support topologically structured data;
- o has minimal provision for data quality information;
- o has minimal provision for attribute data.

These problems merely reflect the original purpose of the Standard, which was to facilitate data transfer for digital topographic map production. It is therefore not a criticism of those involved with its development to say that it is not suitable for use as a general-purpose spatial data transfer standard for GIS and related applications.

U.S. SPATIAL DATA TRANSFER STANDARD

The U.S. Spatial Data Transfer Standard (SDTS) is described in the U.S. chapter of this monograph. Only a brief summary is provided in this chapter.

Development

The development of the U.S. SDTS commenced in 1980, with the final draft being submitted to the U.S. National Institute of Standards and Technology (NIST) in 1990. A feature of the development process has been the extensive consultation and testing.

After approval by NIST for the SDTS to become a Federal Information Processing Standard (FIPS) it will be submitted to the American National Standards Institute for promotion as an ANSI Standard.

Concepts

The three parts of the SDTS are outlined below.

Model, Specification and Quality: Part 1 provides a general model for spatial data, a transfer specification, and a specification for data quality reporting. The data model comprises entities, attributes and objects and is based on the concepts of phenomenon, classification, aggregation, generalization and association. The transferspecification provides modules for global information, for attribute data, for vector, raster and composite objects, for graphic representations and for data quality information. The quality specification utilises a 'truth in labelling' approach, requiring users to report what is known about the lineage, positional accuracy, attribute accuracy, logical consistency and completeness of the data.

Cartographic Features: Part 2 provides a non-hierarchical and extendible model for a spatial data dictionary, comprising entity, attribute and attribute value definitions. Some initial definitions are given (for topographic and hydrographic features) and more will be developed by the maintenance authority. Users may supply their own entity and attribute definitions within the transfer set.

Transfer Mechanism: Part 3 defines the transfer mechanism, which is implemented in an existing general-purpose interchange standard ISO 8211 'Information Processing Specification for a Data Descriptive File for Information Interchange'.

A NEW AUSTRALIAN STANDARD

Proposal

Two approaches were available to Standards Australia for the development of a new standard to supersede AS 2482: either start from scratch and write a new standard in consultation with the Australian spatial data community, or adapt an existing standard to suit the Australian requirements. The first approach would involve many years of effort by many people and could only be justified if no suitable existing or proposed standards could be identified.

Many existing and proposed standards for spatial data transfer are described in other chapters of this publication. While each may have advantages, the proposed U.S. SDTS was considered to be the most appropriate. It overcomes the conceptual problems of AS 2482, it has been developed with extensive user consultation, it will be supported by the major North American GIS vendors who are active in the Australian GIS market, and implementation by Australian GIS vendors will assist those vendors in penetrating the U.S. GIS market. Further, it is considered that the U.S. SDTS is more likely than others to be adopted by Australia's Asian and Pacific neighbours.

Technical benefits of adapting the U.S. standard include:

- It will be applicable to most of the spatial data community, particularly GIS, LIS, remote sensing and computer-assisted cartography users.

- It will enable transfer of all spatial data types (topologically structured and unstructured vector data, raster data) and the associated attribute data.

- It will assist all levels of communication between spatial data users through definition of a general spatial data model.

- It provides a structure for data quality reporting.

- It provides a structure for the development and maintenance of Australian entity and attribute definitions.

Standards Australia therefore proposes to clone the U.S. standard when it is published as a FIPS, with the minimum necessary modifications to make it suitable for Australian use. Public consultation will be on the question of cloning rather than on the detail of the standard.

Adaption

Three areas of modification to adapt the U.S. SDTS to Australia have been identified: referenced standards, coordinate systems, and entity and attribute definitions.

Some of the existing standards referenced in the U.S. SDTS may not be applicable or valid within Australia. Alternative standards may need to be substituted, or the referenced standards may be adopted for Australia or incorporated within the new Australian standard. ISO 8211 has already been cloned as AS 3654-1989.

The Australian version must refer to the Australian Map Grid, the Australian Height Datum and to other relevant coordinate systems. No problems are envisaged with this modification.

The U.S. definitions for topographic and hydrographic features are not generally applicable to Australia. Australian definitions for these and other types of geographic entities and attributes will be required, in accordance with the model structure included in the U.S. SDTS. Subcommittee IT/4/4, Entity and Attribute Definitions, has been formed by Standards Australia to coordinate this work. Working groups are being formed for the following data types:

- topographic and hydrographic;
- geological and geophysical;
- land use;
- natural resources;
- cadastral;
- street addressing;
- utilities.

The existing draft standards and coordinating mechanisms of groups such as the Australian Land Information Council and the Inter-Governmental Advisory Committee on Surveying and Mapping will be utilised in the development of the Australian definitions. The Australian Surveying and Land Information Group has produced a set of test files of topographic, census, remote sensing, cadastral and utilities data to facilitate testing of the standard and validation of transfer software.

Assuming that the U.S. SDTS becomes a FIPS by the end of 1990 and that there is consensus on the question of cloning, the new Australian standard should be available by early 1991. AS 2482-1989 would remain as a valid Australian Standard for an overlap period of some years. Ongoing management of the new standard by Standards Australia will include continuing development and maintenance of entity and attribute definitions, implementation of revisions made by the U.S. maintenance authority, and promotion of the standard to the Australian spatial data community.

Implications

A number of implications arise from the proposal to clone the U.S. SDTS. These include:

- There is a need for Australian testing of the standard, both to validate its applicability to Australian data types and to develop local expertise in its concepts and implementation.

- There may be a need for an Australian support group to validate transfer software and to provide training, documentation and support to users. Such a support group may also take responsibility for maintaining the entity and attribute definitions database. Standards Australia does not have the facilities to offer these services, but would of course cooperate in its operation.

- The spatial data transfer specification within the standard is complex, reflecting the complexity of structured spatial data. Software development by users may not be practicable, so there is a need to encourage local spatial software vendors to support the standard.

- The overheads in creating a conforming set of files may inhibit use of the standard for small data volumes, on-line transfers, and transfers involving primarily attribute data.

- The standard will not be applicable to all agencies and all spatial data types. Defence agencies have international obligations which include support of alternative standards. Some industry sectors may consider that the effort required to conform with a general-purpose spatial data transfer standard exceeds the benefits for their specialist applications.

- Comprehensive entity and attribute definitions must be developed by the user community, within the framework provided by the standard and Subcommittee IT/4/4. This will be a major task but it is essential if the full benefits of standardisation are to be realised.

- Full compliance with the data quality report will be challenging, but should yield benefits for both data producers and users.

- Promotion of the standard will require a concerted effort from Standards Australia, agencies that produce and distribute spatial data, and agencies that receive spatial data.

CONCLUSIONS

Australia was ahead of many countries in the adoption of a national standard for spatial data transfer when AS 2482 was first released in 1981. However, AS 2482 is not suitable for GIS applications and a new general-purpose spatial data transfer standard is urgently required. The Standards Australia proposal to clone the U.S. SDTS offers significant economic and technical benefits. The Australian spatial data community is now addressing the implications of this proposal.

REFERENCES

Standards Australia, 1989, Australian Standard 2482-1989 Geographic Information Systems - Geographic Data - Interchange of Feature-Coded Digital Mapping Data, Sydney.