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OVERVIEW OF SDTS PROFILES

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ABSTRACT

The Spatial Data Transfer Standard (SDTS) has many options. These options provide support for all types of geospatial data. The development of a single translator that can accommodate all of the options and models supported by SDTS is not practical. Using a subset, or profile, of SDTS is a way to reduce the number of options. Developing a limited number of complementary profiles that are grouped into families with shared conventions or mechanisms will support more feasible implementations of SDTS in an integrated geographic information system environment. The emerging strategy is for profiles to be differentiated by geospatial data model, with application-specific profiles grouped into families. The types of existing or proposed SDTS profiles include topological vector, raster, transportation network, high-precision point data, CADD, nontopological vector, object or feature, transaction-based, DX-90 hydrographic, GDF or ITS (IVHS) transportation, cadastral, graphic, AUSLIG vector, mining, MCAMLIS/local government, utility, and DIGEST vector. These profiles are in varying states of use, development, and discussion within the geospatial data community.

DISCLAIMER

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INTRODUCTION

The Spatial Data Transfer Standard (SDTS) is a Federal Information Processing Standard (FIPS 173) for the nonproprietary, vendor neutral distribution of geospatial data and for the exchange of geospatial data between dissimilar digital geographic information systems (NIST, 1992). SDTS is one of several standards (e.g., metadata, cadastral data) within the scope of the Federal Geographic Data Committee (FGDC). The organizers and designers of SDTS represent more than just the federal sector and include individuals from academic, commercial, and research organizations. The implementation, acceptance, and use of a common exchange standard such as SDTS is one component of the National Spatial Data Infrastructure.

Parts 1, 2, and 3 of the SDTS document constitute the base specification of SDTS. This base specification provides data standards at conceptual, logical, and physical or format levels. The SDTS base specification is intentionally very flexible so that it can accommodate all models of geospatial data. This flexibility is possible because SDTS has so many options. At the conceptual level there are several dozen types of zero-, one-, two-, and three-dimensional spatial objects to accommodate raster, vector, topological, planar, spaghetti, and other models of geospatial data. There are also options for projections, coordinate systems, datums, quality information, attribute structure, and feature content. At the logical level there are many possibilities for the structuring, naming, and placement of information into modules and fields. At the physical or format level, using ISO 8211, there are options which can be restricted if required.

PURPOSE OF PROFILES

The development of translation software that accommodates all of the possible spatial objects and options in the SDTS base standard would be very difficult. For example, the developers of software to translate or decode from all-encompassing SDTS to a specific planar-vector-topological GIS format would need software that could detect and react to all possible SDTS objects including objects from raster and nontopological vector data models. This "full SDTS to topological GIS" decoder would also need the capability to do raster-to-vector conversions, to enforce planar graph structure, and to derive topological relationships, because the incoming SDTS data could be of any type. The translation software needed to accomplish all this would be very complicated.

To make the development of translation software feasible, SDTS options are grouped into subsets based on specific data models. For example, a raster profile is limited to only elements of a raster model (i.e., pixels or grid cells) and does not allow vector chains or strings or polygons. In general, a profile identifies types of SDTS spatial objects and related SDTS modules that are (1) always required, (2) allowed, and (3) prohibited. A profile can also restrict options by specifying module and file naming and ordering conventions, by specifying ISO 8211 encoding methods, and by specifying feature and attribute content requirements. These restrictions further reduce the complexity of SDTS decoder software.

Additional information on the purpose and development of SDTS profiles is found in articles by Szemraj, Fegeas, and Tolar (1994) and by Szemraj and Tolar (1993).

DEVELOPMENT OF PROFILES

Because of the large variety of options within SDTS, some number of profiles are needed to make the implementation of translators easier. However, a large number of uncoordinated and unrelated SDTS profiles would defeat the goal of having a common exchange standard that improves overall data sharing. The wish to keep the number of SDTS profiles to a minimum must be balanced against the need to accommodate required data characteristics that are not supported in existing profiles.

The development of a potential new profile to SDTS begins with a group of geospatial data producers or users who act as the sponsors or "champions" for the new profile. This group may be one of the FGDC Subcommittees as was the case with the Transportation Network Profile, or it could be a group of agencies such as USGS and Census for the Topological Vector Profile. The FGDC can provide some profile coordination and can put new profile developers in touch with SDTS experts for additional assistance. Typically, the data associated with this group has some characteristics that do not appear to be supported by current profiles. Before this sponsoring group begins the development of a new profile, other SDTS options for supporting the desired data characteristics should be explored.

A group who is seeking to use SDTS and who are considering a new profile should go through the following steps.

(1) Study existing profiles in an effort to find one that will accommodate their requirements.

(2) If no current profiles can be used "as is," then consider modifications, additions, or clarifications to the most similar current profile. Additions may be in the form of an annex which specifies extra options that are allowed in profile. A valid profile data set (called a "transfer") is allowed to accommodate these annex options, but valid profile translators are not required to decode this information. Clarification about the use of a profile may be provided by a product-to-profile mapping document as described later.

(3) If a new profile is indeed required, then the developers of the new profile document should follow the example of the most similar existing profile. This allows similar profiles to be grouped into families that share many common elements and that can lead to easier implementations based on using functions and software designed for earlier profiles.

(4) As a further effort to keep the number of profiles low, developers of a new profile should try to identify and include other groups of data users and producers that may have requirements for a similar new profile.

(5) Ultimate implementation and success of a profile will then include the creation of product mapping documents, the production of lots of data using the profile, the development of translation software by GIS vendors, the approval of the profile to be an FGDC, FIPS, ANSI, ISO, or similar standard, the availability of official tools to test both data and software for compliance to the profile, and the inclusion of the profile as a "Part" of FIPS173.

The development of new SDTS profiles can be justified for several reasons. The primary reasons are a need to support a different spatial data model or variation of a model that is not supported by any current profiles, the need to harmonize with other geospatial data transfer standards, and the need to provide an extension to the SDTS base standard. The Transportation Network Profile was developed in large part because the other vector profiles did not adequately support a nonplanar model needed for the valid representation of highway overpasses. The DIGEST Vector Profile was developed to help the harmonization effort between SDTS and the DIgital Geographic Exchange STandard. The newest version of the Raster Profile includes an extension to the SDTS base standard that accommodates multi-dimensional data necessary for some NASA products.

There are also a number of less valid reasons for new profile development that should be mentioned. Differences in application area or feature content, by themselves, should not justify different profiles. For example, the justification for a railway profile, a pipeline profile, and transmission line profile because of different content is questionable. The Transportation Network Profile is designed for transportation content, but its justification is due to a data model difference and not specific content. The DIGEST Vector Profile does mandate the use of the FACC content specification, but this content requirement by itself does not accomplish harmonization between SDTS and DIGEST and would not justify a separate profile. The transfer of specific content is not primarily an issue for profiles, but should be addressed through possible volumes of SDTS Part 2, a feature register, or master data dictionaries related to thematic areas and guided by the Thematic Subcommittees of the Federal Geographic Data Committee.

Differences in data products and GIS formats is also not a good reason to develop new profiles. For example, the need for a DLG-3 profile, a TIGER profile, an Arc/INFO profile, an MGE profile, a GDS profile, a SmallWorld profile, a MapInfo profile, a wetland profile, an elevation profile, an EPA River Reach profile, a GDT profile, and an ETAK profile is doubtful. This type of profile proliferation defeats the goal of SDTS to make data exchange easier, and should be avoided.

FAMILIES OF PROFILES

The grouping of profiles into families is one way to help organize and emphasize the relationships between profiles. Once a new profile is justified, developers should seek to maximize the similarities with other profiles, particularly with similar profiles in the same family.

A family of profiles is an informal set of profiles that have many common characteristics and that have translators with many identical functions, usually because they are based on similar high-level data models. For example, the Topological Vector Profile, the DIGEST Vector Profile, the Transportation Network Profile, the AUSLIG Vector Profile, and the NonTopological Vector Profile may be in the same family of vector profiles. The translators for profiles within the vector family of profiles should have more functions in common functions than functions which are different. In general, the grouping of profiles into families can foster software reusability, and in particular, will increase the reuse of translator functions and testing functions.

There may also be a type of multiple inheritance among profile families. For example, the DIGEST Vector Profile may be a member of the large vector family, the smaller topological vector family, and the DIGEST family which could include possible DIGEST Raster and DIGEST Spaghetti profiles.

MULTIPLE DATA PRODUCTS SHARING ONE PROFILE

As noted earlier, a profile should not be so specific that it is related to just one native format, one product, or one theme. A profile should be flexible enough to be shared by multiple data formats and data structures that have a similar data model. The relationship, or mapping, between a specific product and an SDTS profile should be clearly described in a product mapping document. There can be several product mapping documents for each profile, e.g., DLG-3 to TVP, TIGER to TVP. Figure 1 shows the relationships between the SDTS base standard, profiles of SDTS, and specific products that are mapped to profiles. Some product mapping documents are available on-line as noted below in the specific profile status descriptions.

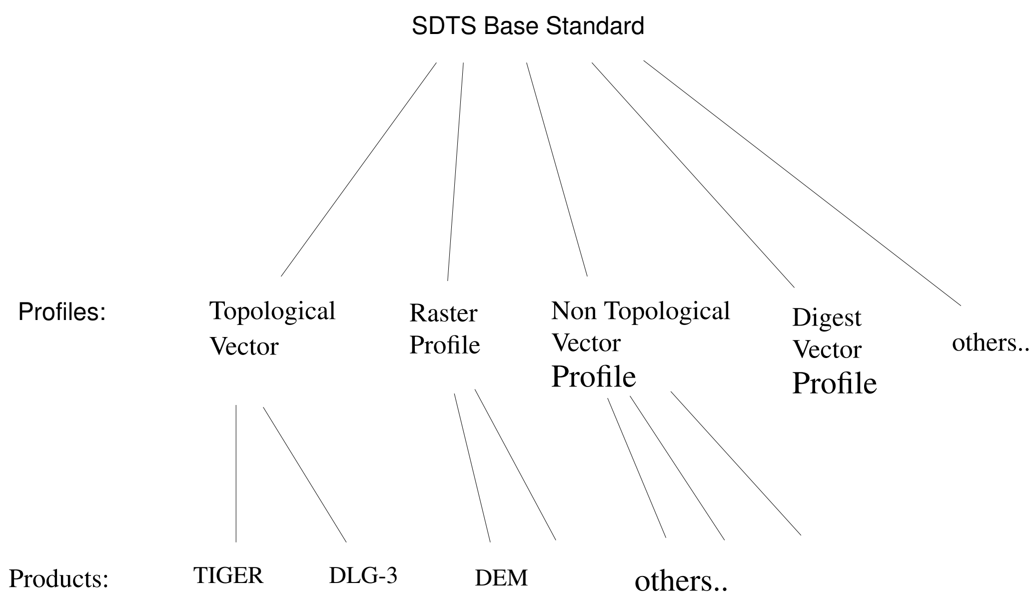

Figure 1 . Relationship between base standard, profiles, and products.

STATUS OF PROFILES

The following is a list of the profiles discussed in this section. Many of these are only suggestions and may not become actual profiles. Additional profiles may also be planned by other groups but are not know to the authors at this time. Information in this section is subject to additions and corrections. Additional information is sought by the SDTS task force (sdts@usgs.gov).

1. Topological Vector Profile, SDTS Part 4
2. Raster Profile, SDTS Part 5
3. Point Profile, SDTS Part 6
4. Transportation Network Profile
5. CADD Profile
6. DX-90 Hydrographic Data Profile
7. Cadastral Data Transfer Standard (Profile)
8. Image Profile
9. Primitive, NonTopological Vector Profile
10. AUSLIG Vector Data Profile (Australian)
11. South Korean Profile
12. Harmonized DIGEST/SP-57/GDF/NTF/SDTS/IHO/ISO Profile
13. ITS or ISO GDF (Transportation) Profile
14. Advanced Public Transportation Systems Profile
15. Commercial Vehicle Operations Profile
16. Advanced Vehicle Control Systems Profile
17. DIGEST Vector Profile
18. DIGEST Vector Profile Chain-Node
19. DIGEST Vector Profile Spaghetti
20. DIGEST Matrix Profile
21. DIGEST Raster Profile
22. Object-Based or Feature-Based Profile and (or) Profile for Transactions, OGIS, Multiple Representations, Dynamic Content, etc.
23. Graphic Profile
24. MCAMLIS, Local Government Profile
25. Mining Profile
26. Utility Profile
27. VPF Relational Form Profile
28. Mixed Vector Profile

1. Topological Vector Profile (TVP), SDTS Part 4

Intended Use --

The TVP is designed to transfer digital geospatial vector data that conforms to a planar graph and has both "chain to node" and "chain to area" topological relationships. Chains, nodes, points, areas, and composite objects are the primary components. Census TIGER data and USGS DLG data can use the TVP. The TVP can accommodate both feature-based and nonfeature-based data.

Primary Sponsors, Interested Groups, and Contacts --

USGS and Census plan to use the TVP for data distribution. EPA is investigating TVP use for River Reach data. FWS has some sample National Wetland Inventory data in TVP.

Contact the SDTS task force via e-mail at	sdts@usgs.gov
Additional information is available on-line at the SDTS web site	http://mcmcweb.er.usgs.gov/sdts

Documents --

The TVP exists as a documented part (Part 4) of FIPS 173-1 (SDTS). Version 1.0 of the TVP is dated June 10, 1994. A draft ANSI version of the TVP is dated December 13, 1995. The TVP document is available for sale by the National Technical Information Service in Springfield, Virginia, or via WWW at the SDTS web site http://mcmcweb.er.usgs.gov/sdts

Additional documents, that describe the specific product mappings to SDTS-TVP from TIGER, DLG-3, and DLG-F, are also available at the SDTS web site.

Several articles on SDTS and the TVP have been in GIS-related journals including "Understanding SDTS Topological Vector Profile Implementation" by Bob Lazar in the June 1996 issue of *Geo Info Systems*. The ESRI White Paper "SDTS-Supporting the Spatial Data Transfer Standard in ARC/INFO" is available at

http://www.esri.com/resources/papers/papers.html

Software --

Software that supports the TVP is part of the Common Software Platform (CSP) of public-domain tools for access and interface to SDTS. Contact the SDTS task force (sdts@usgs.gov) or check the SDTS web site for details.

Translators --

TVP translators are supported by ESRI (Arc/INFO 7.04 and above), Intergraph (MGE), GRASS, and ERDAS (using ESRI translator); are planned by MapInfo, GDS, UNISYS, SAFE, and Laser-Scan (for Korea); and are being considered by Applied Geographics, Autodesk, and SmallWorld based on customer demand.

Data --

Sample TIGER, DLG, and NWI data is available in SDTS-TVP. Nationwide USGS 2-million and 100K DLG-3 transportation, hydrography, PLSS, and boundaries data is now available in the TVP. 24K DLG-3 data is currently being mass converted to the TVP and should be available later in 1996.

Conformance Testing --

A beta series of conformance testing involving NIST, USGS, Intergraph, and ADC is being conducted in mid 1996. Official conformance testing will begin after beta testing is completed.

Future Plans --

ANSI and ISO approval for the TVP (SDTS Part 4), along with Parts 1, 2, 3, & 5 of SDTS, will be sought. Development and approval of conformance testing tools and procedures will be completed in 1996. More USGS data in SDTS-TVP will become available in 1996. SDTS will be the standard distribution format for USGS-NMD digital geospatial data products. Better tools and experience with TVP translators are being investigated.

2. Raster Profile (RP), SDTS Part 5

Intended Use --

The RP is designed to transfer digital geospatial raster, grid, and image data. The primary SDTS objects are grids and grid cells. USGS intends to use the RP for the distribution of DEM's. Future use of the RP for DOQ's and DRG's is also being considered. The current RP can reference separate files using compression standards.

Primary Sponsors, Interested Groups, and Contacts --

USGS plans to use the RP for data distribution. DOD-DMA, CIO, NASA, and other imagery agencies are also involved in RP discussions, development, and use.

Contact the SDTS task force at	sdts@usgs.gov
Additional information is available on-line at the SDTS web site	http://mcmcweb.er.usgs.gov/sdts

Documents --

The RP exists as a documented part (Part 5) of SDTS. A draft ANSI version of the RP is dated December 13, 1995. The RP document is available from the SDTS task force (sdts@usgs.gov) or via WWW at the SDTS web site

http://mcmcweb.er.usgs.gov/sdts

An additional document that describes the product mapping to SDTS-RP from USGS DEM is also available at the SDTS web site.

"Developing a Raster Profile for the Spatial Data Transfer Standard" by Dave Greenlee is in the December 1992 issue of *Cartography and Geographic Information Systems*.

Software --

The Common Software Platform provides SDTS access tools that can be used for the RP.

Translators --

RP translators have been developed for ERDAS and MicroDEM.

Data --

Sample DEM data in SDTS-RP for Mt. St. Helens is available at the SDTS web site. The SDTS site also has sample multispectral image and thematic data from ERDAS. Nationwide DEM data mass converted to the RP and will be available in 1997.

Conformance Testing --

Arrangements for conformance testing with NIST will be coordinated by USGS Rocky Mountain Mapping Center in Lakewood, Colorado. Development of conformance testing data may be done through an innovative partnership.

Future Plans --

ANSI and ISO approval for the RP (SDTS Part 5), along with Parts 1, 2, 3, & 4 of SDTS, will be sought. FIPS approval by NIST is also needed. Development and approval of conformance testing tools and procedures is planned. More data (DEM's) in SDTS-RP will become available in 1997. More RP translators are anticipated.

Negotiations are underway to harmonize the RP with raster and image standards from DOD/DMA, CIO, and NATO (e.g., NITFS, NITF 2.0, BIF, DIGEST RPF, DTED, HDF). There is a need to identify and explore common interests with the GeoTIFF effort. There has been some mention of separate profiles for remote sensing raster data (i.e., the image profile) and for gridded digital elevation model data as part of the harmonization with CIO and DMA. The OGIS activity is also seeking to improve the raster data model portion of their specification relative to Earth imagery standards.

3. Point Profile, SDTS Part 6

a.k.a. Point Data Profile (PDP)
High Precision Point Profile (HPPP)
Geodetic Control Point Profile (GCPP)

Intended Use --

The Point Profile is designed to transfer digital geospatial point data that can have very precise locations. Points are the primary components. Chains, areas, grid cells, and topological relationships are not supported. NGS geodetic control point data and BLM survey point data can use this profile.

Primary Sponsors, Interested Groups, and Contacts --

The FGDC Federal Geodetic Control Subcommittee (FGCS), NOAA National Geophysical Data Center (NGDC), and NOAA NGS are the primary sponsors and coordinators for this profile. NGS plans to distribute data for more than one-million control points using the SDTS Point Profile.

Additional interest in the point profile has come from BLM, the Software Information Systems Council of Ag Electronics Association (AEA) (precision agriculture), and from the Survey Data Management System (SDMS) task force of the American Association of State Highway Transportation Officials (AASHTO).

Contact the SDTS task force via e-mail at sdts@usgs.gov
Additional information is available on-line at the SDTS web site http://mcmcweb.er.usgs.gov/sdts

Documents --

NOAA and USGS have worked to develop a draft document for the Point Profile that uses the TVP document as a guide. Version 0.5 of the Point Profile (SDTS Part 6) is dated July 11, 1996. The current version will be available at the SDTS web site.

Software --

Software that supports the Point Profile will be part of the Common Software Platform (CSP) of public-domain tools for access and interface to SDTS. Contact the SDTS task force (sdts@usgs.gov) for details.

Translators --

NOAA has been in contact with ESRI per a Point Profile translator based on the current TVP translator.

Data --

NOAA NGS plans to distribute data for more than one-million control points using the SDTS Point Profile.

Conformance Testing --

Conformance testing will be arranged after NIST approval.

Future Plans --

NOAA and USGS are actively pursuing NIST approval as a FIPS and FGDC approval. ANSI approval may be an alternative to NIST approval due to current changes in the NIST role.

4. Transportation Network Profile (TNP)

a.k.a. DOT Volpe Profile

Intended Use --

The TNP is designed to transfer digital geospatial data about transportation networks (e.g., roadways, railways, navigable waterways, transit systems). To accommodate overpasses, TNP data does not need to conform to a planar graph. Chain to node relationships are the only required topological relationships between spatial primitives. Areas are not required. Linear referencing is supported. The primary SDTS objects are network chains, nodes, and composite objects (used for routes). The US DOT intends to use the TNP for data distribution and data exchange. The most recent version of the TNP also accommodates some major requirements from ITS America in their recommendation for a separate, GDF-based, ITS profile to SDTS.

Primary Sponsors, Interested Groups, and Contacts --

The FGDC Ground Transportation Sub-Committee and the US DOT Bureau of Transportation Statistics (BTS) are the primary sponsors of the TNP. The various modal agencies (e.g., FHWA, FRA) in DOT are planning to use the TNP.

Additional information is available on-line at the BTS web site http://www.bts.gov/
or the FGDC Ground Transportation Subcommittee (GTSC) web site http://www.bts.gov/fgdc/fgdc.html

Documents --

Requirements for the TVP have been documented. Version 1.1 of the TNP is dated February 1, 1996 and is available at the BTS or FGDC GTSC web sites

Software --

SDTS TNP Encoding Software has been developed at the US DOT Volpe National Transportation Systems Center, Cambridge, Massachusetts. Information is available at the FGDC GTSC web site.

Data --

Sample railway data in SDTS-TNP is available.

Future Plans --

FGDC SWG and NIST FIPS approval for the TNP may be sought later in 1996 after some issues are resolved. There may be more efforts to harmonize the TNP with any ITS profiles to SDTS by accommodating major ITS requirements. There may be efforts to include the full NCHRP / Pooled Fund LRS model into the TNP and (or) support the proposed new linear referencing geo-datum of LRS anchor points. Additional study of the relationship of the TNP to transportation standards in Canada (i.e., DIGEST-VPF) and in Europe (i.e., GDF) may occur as all these standards approach ISO approval.

5. Computer-Aided Drafting and Design (CADD) Profile

Intended Use --

The purpose of a CADD profile to SDTS is for CADD users who are doing GIS-type activities. It is not needed if CADD users are doing typical CADD work without spatial data requirements. A CADD profile to SDTS should have an easy translation to PDES-STEP/CADD.

The CADD or CAD profile may require the use of SDTS arcs (i.e., mathematically defined curves such as circles and splines) in addition to other vector elements. Topological relationships may not be required. 3-D volume elements may be required.

Primary Sponsors, Interested Groups, and Contacts --

The FGDC Facilities Working Group and the U.S. Army Corps of Engineers through the DOD Tri-Service CADD/GIS Technology Center are the primary sponsors of the CADD Profile. The Tri-Service Center has selected Cordant (with subcontractors ADC and Aztech) and Intergraph to work on the initial investigation of a CADD Profile. Additional interest in a CADD profile has come from Autodesk.

Some information on the Facilities Working Group efforts toward a CADD Profile is available through the main FGDC web site http://www.fgdc.gov

Documents --

"Scope of Work" contracts for the SDTS CADD Profile were awarded by the Tri-Service group to Cordant and to Intergraph in late 1995. Results of these two investigations should be available in August 1996.

Future Plans --

Phase two of the generic CADD profile development effort may begin in the late summer of 1996. Information from the Intergraph and Cordant reports as well as the current TVP document will be used to develop a CADD profile document. A proposal for this activity will also be submitted to the FGDC Standards Working Group.

The role of an SDTS CADD Profile in relationship to ANSI IGES, PDES/STEP, and ISO 10303 should be investigated. The extension of PDES to accommodate GIS through an ISO 10303 application protocol for GIS has been mentioned. The DWG graphics file format has also been mentioned as a possible industry standard for geospatial and CAD data.

A January 1996 A/E/C Systems article indicates that an object-based model is recommended for CAD data exchange. Additional investigation is needed to determine if the CADD profile may also be used as an object-based profile. There may also be overlap between the CADD Profile and a nontopological vector profile.

6. Hydrographic Vector Profile (HVP)

a.k.a. DX-90 Profile
Nautical Charting Profile

Intended Use --
The HVP will be designed to exchange nautical charting data. The HVP will be compatible with the IHO exchange format DX-90.

Primary Sponsors, Interested Groups, and Contacts --
The FGDC Bathymetric Subcommittee and the NOAA National Ocean Service are the primary sponsors and coordinators for this profile. Some information on the Bathymetric Subcommittee efforts toward a Hydrographic Profile is available through the main FGDC web site http://www.fgdc.gov

Future Plans --
The relationship of the HVP to other ECDIS, hydrographic, and bathymetics standards (e.g., SP-57, S-44) may be established or clarified. A hydrographic raster profile related to ECDIS may also be considered in the context of British Admiralty standards for raster charts (ARCS).

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7. Cadastral Data Transfer Profile

a.k.a. FGDC Cadastral Subcommittee Data Transfer Standard

Intended Use --
The Cadastral Data Transfer Standard will support the vendor-neutral transfer of cadastral data.

Primary Sponsors, Interested Groups, and Contacts --
The FGDC Cadastral Subcommittee and the Bureau of Land Management are the primary sponsors and coordinators for this profile. Information on the Cadastral Subcommittee efforts toward Cadastral standards is available through the main FGDC web site http://www.fgdc.gov

Future Plans --
Work on the Cadastral Data Transfer Standard was placed on hold until completion of the Content Standard for Cadastral Data.

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8. Image Profile

As noted earlier for the Raster Profile (RP), negotiations are underway to harmonize the RP with raster and image standards from DOD/DMA, CIO, and NATO (e.g., NITFS, NITF 2.0, BIF, DIGEST RPF, DTED, HDF). One possibility is for a separate image profile or remote sensing profile to SDTS that is a subprofile to the RP.

9. NonTopological Vector Profile (NTVP) Profile

a.k.a. Primitive SDTS Vector Profile
SDTS Lite
SDTS Spaghetti Profile
Primitive Transfer Standard (PTS)

Intended Use --

An NTVP or primitive profile has been suggested as a way to transfer digital vector geospatial data that is not constrained to a planar graph and not structured using topological relationships. This type of data is sometimes referred to as "spaghetti" data and may use SDTS strings. Graphic, topological, and raster elements would not be allowed. One purpose of this "primitive" profile is to simplify SDTS for desktop systems and low end map data users, and make it work for "the little guy." All-ASCII and limited-metadata requirements have also been mentioned.

The USGS may use the NTVP for the distribution of tagged vector contour (TVC) data. The USFS could use the NTVP for the distribution of cartographic feature file (CFF) data.

Primary Sponsors, Interested Groups, and Contacts --

USGS researchers in Reston and Woods Hole, in addition to individuals from the Virginia State Geologist's Office and the Dept. of Geology at the College of William and Mary have been the primary sponsors for this initiative.

Future Plans --

Information from the June 1996 Woods Hole meeting on this issue will be available soon.

The requirements for an NTVP may overlap some of the requirements for a CADD profile, an object-based profile, or a DIGEST spaghetti profile. This should be investigated.

10. AUSLIG Profile for Topologically Structured, Attributed, Vector Data

The combined Australia and New Zealand standards group at the Australasian Spatial Data Exchange Centre (AUSDEC) has adopted SDTS with some modifications. A 1991 draft document for the AUSLIG profile to SDTS was developed. More recent information on this activity is available in "Internationalizing SDTS: An Australasian Experience" by Don Miller and Richard Hume in the July 1994 issue of *Cartography and Geographic Information Systems*.

11. South Korea Profile

In October of 1995 the Republic of Korea selected SDTS as their primary spatial data transfer. They will also use DIGEST-VPF when required for military purposes to match NATO standards. One or more profiles to SDTS may be part of this decision. A Korean Urban Information System initiative has adopted SDTS TVP as their transfer standard and has contracted with Laser-Scan for the development of translation tools.

12. ISO Harmonized Standard

Use of a profile or multiple profiles to SDTS may be one method to achieve harmonization with other standards such as DIGEST-VPF, GDF, DX-90, SP-57, SAIF, and NTF. As these and other standards vie for approval at the international level by ISO there may be strong effort to harmonize or reconcile competing spatial data exchange standards.

13. Intelligent Transportation Systems (ITS) Profile(s)

a.k.a. GDF Profile

Interested Groups, Intended Use --

An ITS profile or GDF profile has been suggested by the ITS community (ITS America, NavTech, ETAK, AAA, Ford, Oak Ridge, etc.). This group has some data requirements that are very similar to, but not totally satisfied by, the current TNP. Some members of this group advocate the use of Geographic Data File (GDF) as their data exchange standard and are seeking ISO approval for GDF, which is currently a European CEN standard. There has also been mention of a GDF profile to SDTS, similar to the DIGEST profile.

Documents --

Requirements for an ITS profile were developed by ITS America's Standards and Protocols Subcommittee for Map Database and Information Systems. A meeting on requirements for an ITS profile to SDTS was held Knoxville in September of 1994, when "ITS" was referred to as "IVHS" for Intelligent Vehicle Highway Systems. A report was produced from that meeting.

Future Plans --

The TNP has been modified to satisfy some ITS requirements, and this effort to merge ITS requirements into the TNP for a single transportation profile may continue. ITS includes many groups, and there have been suggestions for separate SDTS profiles or subprofiles for Advanced Public Transportation Systems (APTS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), and other ITS business activities.

ISO TC 204 WG 3 subgroup 3.1 is working on an international map database transfer standard for ITS based on an ISO update of GDF from CEN TC 278. The ISO version of GDF may be available in 1997. GDF uses ISO 8211 (same as SDTS and DIGEST). GDF uses a feature-based model similar to DIGEST-VPF. A profile to SDTS may be one way to harmonize SDTS with GDF and other international standards. This profile may also meet requirements for a feature-based profile to SDTS.

ITS Profile development may be done by Oak Ridge. Recent modifications to the Transportation Network Profile (TNP) satisfy some of the major requirements of ITS America. There is also a possibility of an ITS subprofile to the TNP. Linear referencing and street addresses are issues shared by the TNP and an ITS profile.

14. Advanced Public Transportation Systems Profile (APTS Profile)

The APTS Profile is a possible subprofile to the ITS Profile based on an ITS business area. This profile could also be a transit subprofile to the Transportation Network Profile. Involvement in this profile may be from the Viggen Corp. or the DOT Volpe Center.

15. Commercial Vehicle Operations Profile (CVO Profile)

This profile is a possible subprofile to the ITS Profile based on an ITS business area.

16. Advanced Vehicle Control Systems Profile (AVCS Profile)

This profile is a possible subprofile to the ITS Profile based on an ITS business area.

17. DIGEST Vector Profile (DVP)

a.k.a. DIGEST Vector Profile Full Topological
DIGEST Relational Profile

Intended Use --

The DVP is designed to transfer digital geospatial vector data that conforms to both SDTS and DIGEST. DIGEST is the primary spatial data exchange standard of NATO. DIGEST is also the exchange standard of the civilian transportation community in Canada. The two vector implementations for DIGEST are VPF (DIGEST A) and VRP (DIGEST C). VPF is the format for Digital Chart of the World (DCW). DIGEST content is defined by the FACC feature catalog. The DVP requires FACC use. The data model for DIGEST is feature based.

Primary Sponsors, Interested Groups, and Contacts --

DOD DMA through the IDON Corporation, with input from USGS, was the primary sponsor for this profile.

Documents --

A draft document of the DVP is dated 10-30-92.

Future Plans --

Since the 1992 work by IDON, there has been little activity on the DVP. Renewed effort to harmonize SDTS with DIGEST (and with GDF and DX-90) may occur when all these standards move toward ISO approval. The DIGEST profile will be examined as the need increases for a feature-based profile. Recent information indicates that a VPF relational form profile may be a higher priority for DMA.

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The 1992 DVP document contained recommendations for the other DIGEST profiles to SDTS listed below.

18. DIGEST Vector Profile Chain-Node

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19. DIGEST Vector Profile Spaghetti

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20. DIGEST Matrix Profile

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21. DIGEST Raster Profile

22. Feature-Based Profile

Intended Use --

A possible feature-based or object-based profile has been suggested as a way to transfer geospatial data that conforms to more advanced data models that are feature based (e.g., DLG-F, GDS, SmallWorld, Argus, GDF, DIGEST-VPF, Laser-Scan). This profile (or set of profiles) may also be used to accommodate transaction-based data, seamless data, potentially dynamic content definitions, O-O DBMS's or extended relational DBMS's, multiple representations, OGIS requirements, and FGDC Framework requirements. A feature-based data model uses a semantic, feature level that is distinct from the spatial primitive level. Thus, nonplanar real-world features can be represented even while using a planar graph at the spatial primitive level. The current SDTS Topological Vector Profile (TVP) can accommodate feature-based data using composite objects, but some of the feature-based advantages may be lost or deemphasized. It is possible that the geometric primitives for feature-based data could be raster as well as vector.

Primary Sponsors, Interested Groups, and Contacts --

USGS DLG-F developers and FGDC Framework developers are interested in a possible feature-based profile.

Future Plans --

The USGS-NMD vector program is moving toward a flexible, feature-based data model in support for FGDC Framework. Requirements from this feature-based approach may accelerate the need for a feature-based profile to SDTS. A feature-based model is also used by DIGEST and GDF. The need to harmonize with these other standards as ISO approval is sought may be related to a feature-based profile or modifications to the DIGEST vector profile. An object-oriented CADD profile may also satisfy some feature-based requirements.

The graphics, mining, local government, and utility profiles were suggested in the past, but there is little information on each of these at this time.

23. Graphics Profile

25. Mining Profile

A mining profile may be one of the few to use SDTS 3-D volumetric objects.

24. MCAMLIS / Local Government Profile

Some interest was expressed in the early 1990's by the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) organization for a local government profile.

26. Utility Profile

27. VPF Relational Form Profile

The Vector Product Format (VPF) and Vector Relational Format (VRF) are military standards for spatial data which conform to a feature-based conceptual data model. An initial 1996 investigation by SAIC for DMA indicates this profile is can be implemented. DMA/NIMA is interested in making a connection between SDTS and VPF. A VPF relational form profile is currently more important to DMA than the DIGEST Vector Profile because of the low level of use within NATO of DIGEST A which is the basis for the DVP. This use of SDTS as an umbrella specification related to application-specific formats like VPF can benefit the international effort to harmonize various spatial data exchange standards.

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28. Mixed Vector Profile

One object-oriented GIS vendor is interested in a possible SDTS vector profile that allows topologically structured planar data, topologically structured non-planar (network) data, and non-topological (spaghetti) data all in the same SDTS transfer. The feasibility of such a profile is currently under discussion.

REFERENCES

Greenlee, David D., 1992, "Developing a Raster Profile for the Spatial Data Transfer Standard" *Cartography and Geographic Information Systems*, Vol. 19, No. 5, December 1992, Special Issue: Implementing the Spatial Data Transfer Standard, J. Morrison and K. Wortman, eds., pp. 300-302.

Hanson, J.B., 1995, "Geographic Data Sharing Using the Spatial Data Transfer Standard," *ACSM/ASPRS Technical Papers*, Vol. 1, Bethesda, Maryland: ACSM, pp. 298-306.

Lazar, Bob, 1996, "Understanding SDTS Topological Vector Profile Implementation," *Geo Info Systems*, Vol. 6, No. 6, June 1996, pp. 42-45.

Miller, D., and R. Hume, 1994, "Internationalizing SDTS: An Australasian Experience," *Cartography and Geographic Information Systems*, Vol. 21, No. 3, July 1994, Special Issue: Current Developments and Use of the Spatial Data Transfer Standard, K. Wortman and B. Buttenfield, eds., pp. 176-179.

National Institute of Standards and Technology (NIST), 1992, *Spatial Data Transfer Standard*, Federal Information Processing Standard 173, Washington, DC: U.S. Department of Commerce.
SDTS Parts 1 through 4 available via WWW at SDTS web site
http://mcmcweb.er.usgs.gov/sdts

Szemraj, J.A., R.G. Fegeas, B.R. Tolar, 1994, "Profile Development for the Spatial Data Transfer Standard," *Cartography and Geographic Information Systems*, Vol. 21, No. 3, July 1994, Special Issue: Current Developments and Use of the Spatial Data Transfer Standard, K. Wortman and B. Buttenfield, eds., pp. 150-154.

Szemraj, J.A., and B.R. Tolar, 1993, "Profile Development for the Spatial Data Transfer Standard," *GIS/LIS '93 Proceedings*, Vol. 2, Bethesda, Maryland: ASPRS, ACSM, AAG, URISA, AM/FM, pp. 663-670.
Available via WWW at SDTS web site
http://mcmcweb.er.usgs.gov/sdts