2 The Framework Transportation Identification Standard

2.1 Overview 2

2.2 Relationships between the "Real World", Cartography, and Networks, and the Framework Transportation Identification Standard 3

2.2.1 Physical ("Real-World") Domain 3

2.2.2 Cartographic Domain 4

2.2.3 Network Domain 5

2.3 Components of the Transportation Identification Standard 6

2.3.1 **Framework Transportation Segment Reference Point (FTRP)** . 6

2.3.2 **Framework Transportation Segment (FTSeg)** 12

2.4 Connectivity of Framework Transportation Segments 18

2.4.1 Implicit Connectivity 18

2.4.2 Explicit Connectivity 18

2.4.3 Conditions lacking Connectivity 19

2.5 Relating Transportation Segments to Linear Referencing Systems 21

2.6 Relating Attributes of Transportation Segments to FTRP and FTSeg 22

2.7 Unique Identifiers of FTRP and FTSeg 23

2.7.1 Authority-ID 24

2.7.2 Feature Type 24

2.7.3 Numeric Code 25
2.8 Relating “Logical” to “Physical” FTRP and FTSeg 25
2.8.1 Equivalent FTRP and FTSeg 25
2.8.2 The Equivalency Table 26
2.9 Framework Transportation Data Authorities 28
2.9.1 Unique Identifiers for Single-state authorities 29
2.9.2 Unique Identifiers for Multi-state authorities 30
2.9.3 Descriptive Attributes for each Authority 30

2 The Framework Transportation Identification Standard

2.1 Overview

A key piece in creating a national standard for geo-spatial data representing transportation networks is the development, implementation, and general acceptance of a transportation identification standard. The function of such a data standard is to enable database developers to transact updates and to exchange information by defining unique and relatively stable transportation segments that can be assigned a permanent feature identifier.

2.2 Relationships between the "Real World", Cartography, and Networks, and the Framework Transportation Identification Standard

A useful transportation identification standard must successfully address several issues without causing unreasonable extra burden to either database developers or users. First, the standard must be useful in representing the physical or real-world domain of transportation features. Second, the standard must be useful in fulfilling the wide variety of mapping requirements of users. Third, the standard must support a large number of different network applications; for example: *address geo-coding, network pathfinding, vehicle and incident location,* and *highway facility management*. Each of these applications typically segments the network in different ways.

2.2.1 Physical ("Real-World") Domain

Transportation features in the physical or real-world domain consist of tangible objects such as *roads, bridges, railroad tracks, and intersections*. At a minimum, representations of physical objects require information to enable someone to locate and recognize them in the real world. Location information may be purely descriptive (e.g. *"the intersection of the centerlines of 7th & D Streets, SW in Washington, DC"*), or the description may be supplemented by measurements that can be repeated in the field (e.g., GPS coordinates).

This Standard supports the unambiguous identification of unique real-world features by requiring some descriptive information and some positional information about each feature, and by allowing its augmentation with other information when users make it available.

2.2.2 Cartographic Domain

Cartographic objects are used to represent real world features on a map. In vector-based GIS, real-world objects are typically displayed as *points* (or *symbols*), *lines*, or *polygons*. Transportation networks are displayed using points and strings of line segments. While there is no *a priori* requirement that cartographic points and strings must be topologically connected, most GIS software build topology to facilitate spatial and network computations. However, the topology created by the GIS may not be the same as the topology specified in the transportation network (e.g., a node may be placed where two links cross but don't intersect).

Planar coordinates define the relative locations and shapes of cartographic objects on a two-dimensional plane. These coordinates are typically transformations of real world geographic coordinates (e.g., given a specified geodetic datum and projection). However, the relative accuracy of each plotted point is subject to various errors (e.g., physical location measurements, digitizing accuracy, and distortions caused by planar projections

of three-dimensional distances). Consequently, there are differences in both the location and distance measurements between the real world and a map.

This Standard does not attempt to address these cartographic difficulties; nor does it attempt to reconcile the differences that exist among multiple cartographic representations of the same real-world features. However it does propose a standard method for specifying real-world features, so that users of different cartographic representations can more easily exchange updates to both geometric and tabular information.

2.2.3 Network Domain

Network objects consist of *links* and *nodes*, which together form the *network*; these objects are inherently topological. Transportation networks provide information on the feasible paths between specified locations, and on decision points along those paths. Origins and destinations are assumed to be specific as to location, but the location of a decision point need not exist in the physical world (e.g., a decision point might be to drive or take transit). Similarly, a network does not require cartographic coordinates, only a set of choices at each decision point (e.g., the decision point to drive or take transit can be made at any time or place prior to the decision to use transit).

This Standard does not attempt to define topological relationships within any one or more networks, but does provide to the users of multiple networks a stable identifier or real-world features that will not change over the time in which their network application needs change.

2.3 Components of the Transportation Identification Standard

2.3.1 **Framework Transportation Segment Reference Point (FTRP)** -- *The specified location of a (required) endpoint of a Framework Transportation Segment (FTSeg), or an (optional) reference point offset along the length of the FTSeg, on a physical transportation system.*

A FTRP database record has a unique key consisting of fields 1, 4 and 5 (emboldened); Values are required for all fields, except those designated “optional” or “required when applicable” (see following table.) An FTRP record contains the following information:

#	FTRP Field-Name	Description & Format/Domain
1	**FW-Transportation-Reference-Point-ID**	Permanent and unique identifier for the FTRP Format specified in Section 2.7
2	Location-Description	Unambiguous description of the FTRP that makes it field-recoverable Free text: 255 characters or less

103	3	Category	**P** = Physical; **L** = Logical
104	**4**	**Date**	Date of creation of the record Format YYYYMMDD
105	**5**	**Authority-ID**	Permanent and unique identifier of the organization which created this record. This ID may differ from the ID of the authority which created the original FTRP database entry or subsequent records. Format specified in Section 2.7
106	6	Latitude	Angular distance measured on a meridian north or south from the equator. (NAD83) Format: +/- DD.dddddd; 10 character Decimal degrees Range: +/-0 to 90.000000
107	7	Longitude	Angular distance between the plane of a meridian east or west from the plane of the prime meridian. (NAD83) Format: +/- DDD.dddddd; 11 character Decimal degrees Range: +/-0 to 180.000000
108	8	Horizontal-Accuracy	Maximum estimated error in horizontal location Format: MMM.M; 5 character positive integer, indicating “plus or minus” a number of meters

109	9	Horizontal-Accuracy-Measurement-Method	A code which describes the derivation of the horizontal position, and which allows the user to assess the accuracy and precision of the FTRP latitude and longitude: **100** = Derived from stationary GPS measurement, with no differential correction ***1xx** = Stationary GPS measurement -differentially corrected to "xx" meters; e.g., **105** = differential correction to 5 meter accuracy **200** = Derived from mobile GPS measurement, without differential correction ***2xx** = Derived from mobile GPS measurement, differentially corrected to "xx" meters **300** = Derived from non-GPS survey methods - accuracy unknown ***3xx** = Derived from non-GPS survey methods - accuracy certified to "xx" meters **400** = Digitized from digital orthoimagery - Source scale unknown **4xx** = Digitized from digital orthoimagery - Source scale of image in 000's; e.g. 412 =1:12,000 scale source digital orthophotos. **5xx** = Digitized from paper map sources larger than 1:100,000 scale - Source scale in 000's e.g. 524 = 1:24,000 scale topographic maps **600** = Source scale 1:100,000 digital data - e.g., TIGER/Line or DLG **6xx** = Digitized from paper map sources smaller than 1:100,000 scale - Source scale in 100,000's e.g. 625 = 1:250,000 scale maps **900** = Other *"xx" should be "01" when accuracy certified to 1 meter or less.*

110	10	Elevation *(Optional and Recommended)*	Elevation above/below sea level Format: +/- DDDD.ddd; 9 character Decimal meters
111	11	Vertical-Accuracy-Description *(Required if Elevation is not "blank"*)	Three-character code which describes the derivation of the Elevation, and which allows the user to assess the accuracy and precision of the FTRP elevation: **100** = Derived from stationary GPS measurement, differentially corrected **200** = Derived from stationary GPS measurement, without differential correction **300** = Derived from mobile GPS measurement, differentially corrected **400** = Derived from mobile GPS measurement, without differential correction **500** = Derived from ground survey measurement **600** = Derived from a Digital Elevation Model **900** = Other
112	12	FTSeg-ID *(Required when Applicable)*	Unique identifier of an FTSeg along which this FTRP falls. Format specified in Section 2.7
113	13	FTSeg-Offset-% *(Required if FTSeg-ID is not blank)*	Percentage offset from the FTSeg From-End-Point at which this FTRP falls A positive decimal number greater than or equal to "0" and less than "100". Format: 00.0000; 7 characters
114	14	Status	**P** = Proposed; **A** = Active; **R** = Retired

115 Fields emboldened above are "key" fields – **FTRP-ID, Authority** and **Date**; taken
116 together, they make up a unique key for each record. They are required so that a record
117 which describes a specific FTRP can be improved over time. Multiple authorities and

data users will recognize, access, use, and archive FTRP records that represent a "real world" location, as identified by a particular authority and a particular point in time.

The textual **Location-Description** – which is also required – must be sufficient to allow all users to unambiguously identify that FTRP in the field. However changes in applications and technology will allow the multiple authorities to refine over time the specifics of the Location-Description, coordinates, and accuracy Description. The use of a multi-part key provides relative permanence to the **FTRP-ID**, while allowing the creation of additional database records which can reflect these refinements. As a result, users will be able to embed FTRP within their own data structures, and acquire refined information about them over time (as it is made available by multiple authorities). At the same time they will not have to expend resources on updating internal references to this primary key.

Each FTRP is assigned a **Category** of P-Physical or L-Logical; points that are "logical" are most often those used in small-scale representations of more complex physical features. Examples of "logical" points include single-point representations of complex intersections. An FTRP which is "logical" represents a point on or at the end of a FTSeg over which a vehicle cannot pass while remaining within the traveled way.

The **Latitude** and **Longitude** of each FTRP must be provided; associated metadata fields are optional. When the **Elevation** is not blank, a valid **Vertical-Accuracy-Description** code is also required.

An **FTSeg-ID** is not required when the FTRP lies at the terminus of one or more FTSeg and is not offset along the length of another FTSeg. There are three circumstances in which an FTSeg-ID is required. First, the FTRP may terminate one or more FTSeg at a point offset along the length of another segment. These two (or more) physically-connected FTSeg are said to have an "explicit" connection at this FTRP, and this FTRP record must contain this information. Second, a "free-standing" FTRP may be offset along the length of an FTSeg in order to establish the distinction among two or more segments which terminate at the same two endpoints. Finally, a "free-standing" FTRP may be placed along an FTSeg to mark its intersection with an important but unconnected linear feature (jurisdiction boundary, railroad or water bridge). When an **FTSeg-ID** occurs in the record, an **FTSeg-Offset-%** is also required.

A required **Status** code allows authorities to design and share/compare "proposed" FTRP with other interested authorities before coming to agreement on their designation. Also retention of records coded as "retired" enables users to update their databases after FTRP have been retired because of physical re-alignments or reconciliation of duplicate records.

2.3.2 **Framework Transportation Segment (FTSeg)** – *A specified directed path between two Framework Transportation Segment Reference Points along a physical transportation system that identifies a unique segment of that physical system*

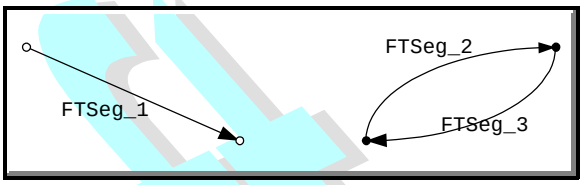

Figure 1 – Unique pathways connecting two FTRP

FTSeg have no explicit geometry other than the locations of associated reference points (FTRP). Most FTSeg terminate at two FTRP. However, cul-de-sac loops may consist of FTSeg which originate and terminate at the same FTRP, and FTSeg may have other FTRP offset along their length. FTSeg should be depicted either by straight lines connecting two FTRP or by curved lines (if two or more FTSeg terminate at the same two FTRP.)[1] FTSeg must meet the following requirements:

1) FTSeg represent a physical component of the transportation network, with unambiguous beginning and end points (FTRP) that can be initially located and subsequently recovered in the field.

[1]Guidelines for cartographic representation of FTRP and FTSeg are provided in Section 1.8.2 of Informative Appendix C.

2) FTSeg are independent of any particular cartographic display or analytical network. The nodes of a particular analytical network may be useful in defining the FTRP which begin and end a FTSeg, but other points may serve as well.

3) FTSeg are stable over time. New links are routinely added, and existing links are routinely split in many transportation networks. The new link may represent a newly constructed road, or it may simply be the inclusion of a set of links (e.g., driveways) to support a particular application. In either case, it should not be necessary to change the existing FTSeg to handle these additional links. In some instances it may be necessary to modify a FTSeg (e.g., a road is realigned, a new road is built, or a railroad track is torn up). Specific update procedures are needed to handle such situations, and are detailed in Section III of this document.

A FTSeg database record has a unique key consisting of fields 1, 5 and 6 (emboldened); all fields are required, unless otherwise indicated (see following table.). An FTSeg record contains the following information:

#	FTSeg Field-Name	Description & Format/Domain
1	**FW-Transportation-Segment-ID**	Permanent and unique identifier for the FTSeg Format specified in Section 2.7
2	From-End-Point	Unique identifier of the FTRP at which this FTSeg begins Format specified in Section 2.7

185	3	To-End-Point	Unique identifier of the FTRP at which this FTSeg ends Format specified in Section 2.7
186	4	Path-Description	Unambiguous description of the path of this FTSeg, which is unique with respect to any other FTSeg which connects the same two End-points. Free text: 255 characters or less
187	**5**	**Date**	Date of creation of the record Form YYYYMMDD
188	**6**	**Authority-ID**	Permanent and unique identifier of the organization which created the record. This ID may differ from the ID of the authority which created the original FTSeg database entry or subsequent records. Format specified in Section 2.9
189	7	Category	**P** = Physical; **L** = Logical

190	8	Intermediate-Point *(Required when Applicable)*	Identifier of the FTRP located at an intermediate point on the FTSeg for the purpose of distinguishing this FTSeg from (one or more) other FTSeg which share the same end points. Format specified in Section 2.7
191	9	State	Two-character code indicating the State, territory or equivalent entity within which the transportation segment begins and ends Codes are specified in FIPS 6-4
192	10	Length *(Optional and Recommended)*	Measured length of the segment Format: DDDD.ddd; 8 character Decimal meters
193	11	Length-Accuracy-Description *(Required if Length is not "blank")*	Three-character code which describes the derivation of the Length measurement, and which allows the user to assess the accuracy and precision of the FTSeg length: **100** = Measured by a transportation measurement device ("fifth wheel") **200** = Measured by an automobile odometer or analogous device **310** = Computed from a digital vector database scaled at smaller than 1:12000 **320** = Computed from a digital vector database scaled at from 1:12000 to 1:100,000 **330** = Computed from a digital vector database scaled at greater than 100,000 **900** = Other
194	12	Status	**P** = Proposed; **A** = Active; **R** = Retired

195 Fields identified as "key" fields are required in order that FTSeg records can be improved
196 by multiple authorities over time, archived, and accessed by different users, just as FTRP

records can be. The **From-End-Point** and **To-End-Point** values are required in order to unambiguously delineate each FTSeg. (Refer to description **Intermediate-Point**, below.)

A textual **Path-Description** that is sufficiently complete as to allow other users to unambiguously identify the course of the FTSeg in the field is also required.

Each FTSeg is assigned a **Category** of P - "Physical" or L - "Logical;" segments that are "logical" are most often those used in small-scale representations of more complex physical features. Examples of "logical" segments include single-line representations of divided highways. An FTSeg which is "logical" represents a transportation segment over which a vehicle cannot pass while remaining within the traveled way. An FTSeg should be designated as physical ONLY if it begins and ends at a physical FTRP.

An FTSeg record must include a **Intermediate-Point** consisting of a single FTRP-ID whenever the FTSeg in question terminates at the same two FTRP as one or more other FTSeg. The additional FTRP identified in this field should represent an intermediate point along the FTSeg, judiciously selected in order to assure that the multiple FTSeg which terminate at the same FTRP are unambiguously differentiated.

A required **State** code allows authorities and users to more easily identify records of possible interest. Further information can be found in FIPS Publication 6-4 at http://www.itl.nist.gov/div897/pubs/fip6-4.htm .

Length and associated metadata are optional. A required **Status** code allows authorities to design and share/compare "proposed" FTSeg with other interested authorities before coming to agreement on their designation. Also retention of records coded as "retired" enables users to update their databases after FTSeg have been retired because of physical re-alignments or reconciliation of duplicate records.

While FTSeg have no explicit geometry themselves, they may be represented by a variety of cartographic line segments depicting their shape and location on the earth. The line

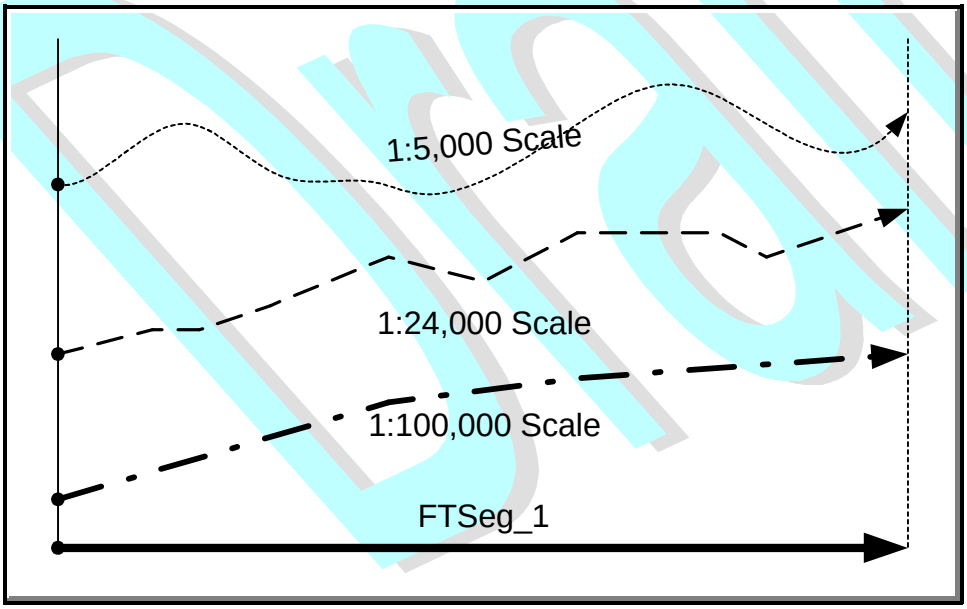

Figure 2 – Representation of a FTSeg and a variety of cartographic line segments which it identifies

segments may be more or less complex, reflecting different scales of resolution, map projections, or structural detail.

2.4 Connectivity of Framework Transportation Segments

FTSeg may be used to construct topological networks, but do not represent a topological network by themselves. All topological relationships between entities in the data standard are contained within the FTRP and FTSeg data records. Connectivity among two or more FTSeg is defined either implicitly or explicitly.

2.4.1 Implicit Connectivity

Two FTSeg are said to be *implicitly* connected if they share a common FTRP end point.

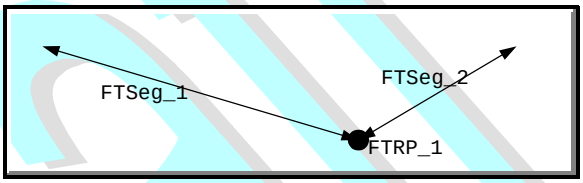

Figure 3 – Implicit Connectivity of two FTSeg at FTRP_1

2.4.2 Explicit Connectivity

Two FTSeg are connected *explicitly* if the Segment-ID of one FTSeg appears in the **FTSeg-ID** field (field #12) of an FTRP record which represents the "to" or "from" end points of another FTSeg. In the following example `P3` is an end point of `FTSeg_2` and `P4` is an end point of `FTSeg_3`. Neither point is an end point on `FTSeg_1`, which is made up of the entire line segment from `P1` to `P2`.

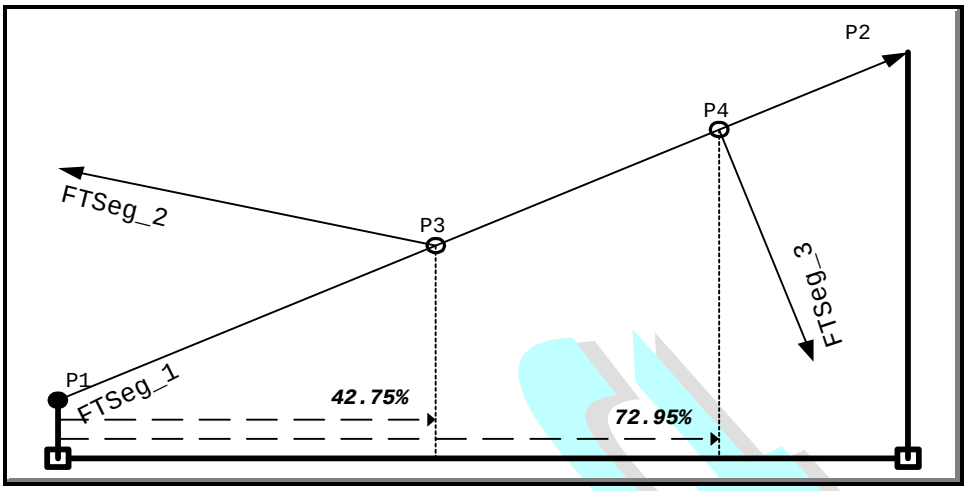

Figure 4 – Segments FTSeg_2 and FTSeg_3 are explicitly connected to FTSeg_1 (See FTRP table below)

In the figure above FTSeg_2 and FTSeg_3 terminate on FTSeg_1 at P3 and P4 respectively. The values entered in the fields of the FTRP data records which provide for connectivity are as follows:

Field #1- FTRP-ID	Fields #2 - #9	Field #12- FTSeg-ID	Field #13- FTSeg-Offset-%
P1	Other Data		
P2	"		
P3	"	FTSeg_1	42.75%
P4	"	FTSeg_1	72.95%

2.4.3 Conditions lacking Connectivity

The topological properties of FTSeg consist exclusively of the implicit connectivity resulting from a shared FTRP, and the explicit connectivity described above. This means

that FTSeg may cross one another without necessarily connecting. Further, two *different* FTRP may exist at the *same location* without being connected.

FTSeg_1 and FTSeg_2 may cross without the need for a FTRP at the crossover, as in the figure at right. There is no connectivity between the physical transportation segments illustrated in this figure; no topological connection exists for such FTSeg unless a FTRP is defined in order to provide for an explicit or implicit topological connection.

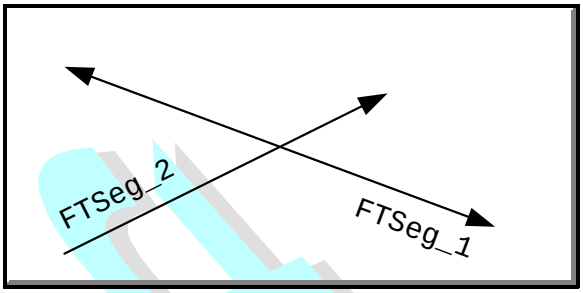

Figure 5

Multiple FTSeg may begin or end at the same FTRP, and two such FTRP may occupy the same location, without implying either that the two FTRP are identical, or that the two sets of FTSeg are connected. The figure at right shows that FTSeg_1 and FTSeg_2 are connected implicitly at FTRP1. Likewise FTSeg_3 and FTSeg_4 are connected implicitly at FTRP2. Although FTRP1 and FTRP2 are in the same location, no implicit connection between the two FTRP exists.

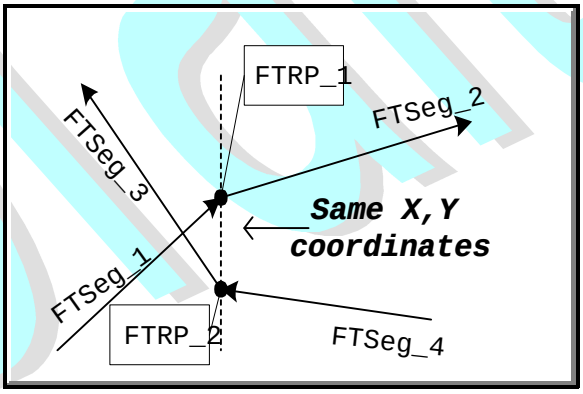

Figure 6

Using both implicit and explicit connectivity encoded in FTRP records, selected subsets of FTSeg may be combined to create custom networks. The only requirement for the derivation of such networks is that any FTSeg included in the network must connect -- implicitly or explicitly -- with another FTSeg that is also part of the network.

2.5 Relating Transportation Segments to Linear Referencing Systems

Once a network has been created, other transportation application layers can be built upon it, including *identified routes, linear referencing methods*, and *linearly referenced points* and *linear events*. All of these application layers can ultimately be mapped back to the FTRP and FTSeg through the specific network links and nodes on which these application layers were built. Geometric shape is not a required part of network *links, routes,* or *linear events*. Any of these may be constructed without coordinates. All that is required to construct the network layer (links and nodes) is the topological connections of the FTSeg. Construction of routes and linear referencing methods is accomplished through an ordered listing of the links (or parts of links) that comprise each route.

EXAMPLE: Emergency service authorities may wish to define a "Road-Name" Route to support vehicle dispatch. They can do so by defining the "official" road name as an attribute associated with all or a part of each link. The ordered listing of all the links associated with each "official" road name will define the "Road-Name" Route.

2.6 Relating Attributes of Transportation Segments to FTRP and FTSeg

Organizations that wish to share information about different transportation databases will have an interest in identifying those "real world" attributes (e.g. functional class, name or route number, and street address ranges) of value within their applications. The identification of such attributes, definition of their domains or formats is not a part of this Standard.

Information about these attributes will be defined by national standards and practices, or by the users of the data for a particular geography. Often the values of defined attributes of linear features will not relate to 100% of the length of a particular FTSeg. These attributes -- in addition to attributes pertaining to an FTRP or a complete FTSeg -- can be shared by means of a table that relates the particular attribute values to one or more FTRP or FTSeg, as follows:

#	Field_Name	Description & Format/Domain
1	FW-Transportation-Segment-ID-or-Reference-Point-ID	Permanent and unique identifier for the FTSeg or FTRP with which an attribute is associated Format specified in Section 2.7
2	Date	Date of creation of the attribute record Format YYYYMMDD
3	Authority-ID	Permanent and unique identifier of the authority which shares the attribute. Format specified in Section 2.9

4	Start-Offset *(required if the ID in Field-1 identifies an FTSeg)*	Percentage offset from the FTSeg From-End-Point at which this attribute value commences; default value = “00.0000" A positive decimal number greater than or equal to “0" and less than “100" with format: +00.0000
5	End-Offset *(required if the ID in Field-1 identifies an FTSeg)*	Percentage offset from the FTSeg From-End-Point at which this attribute value ends A positive decimal number greater than “0" and less than or equal to “100" with format: +00.0000
6	Attribute-Name	Free text: 128 characters or less
7	Attribute-Value	Attribute value

Values are required for all fields. **Attribute-Name** and **Attribute-Value** apply to the FTRP or FTSeg (or portion thereof) identified in field 1. Information about different named attributes (e.g., “Route-#” and “Road-Name”) must be conveyed in separate records pertaining to each FTRP or FTSeg (or portion thereof). Metadata about each named attribute should accompany the database table, and should conform to the FGDC Content Standard for Digital GeoSpatial Metadata (version 2.0).

2.7 Unique Identifiers of FTRP and FTSeg

Each FTRP and FTSeg has a unique and permanent identification code of fixed length in the following format:

FTRP -- AAAAA.XXXXXXXX

FTSeg – AAAAA.FF.XXXXXXXX

2.7.1 Authority-ID

AAAAA – Each FTRP and FTSeg identifier includes the unique identifier of an Framework Transportation Data Authority. This code identifies the organization which generated the first database entry, or "originating" record describing the FTRP or FTSeg. An Authority-ID also occurs in a separate data base field in each FTRP and FTSeg record. This field records the identity of an authority which improves database records about FTRP or FTSeg subsequent to the creation of the unique FTRP or FTSeg identifiers. (Specifications for creating identifiers for each authority are the topic of a following section.).

2.7.2 Feature Type

FF – Each FTSeg represents a portion of a linear transportation feature. The feature type should be indicated, so as to allow the representation of connections between road and non-road FTSeg. Allowable values are:

FF	Description
FE	Ferry - A scheduled conveyance of motorized vehicles across water from one FTSeg to another.
RR	Railroad - A maintained way consisting of two parallel rails for the passage of trains or trolleys

RD	Roadway - A cleared and maintained way for the passage of motorized vehicles
TR	Trail - A cleared path (as through woods or wilderness) not usually trafficked by motorized vehicles because of width or seasonal conditions, or A trail (e.g. bike path) which is not intended for the use of motorized vehicles

2.7.3 Numeric Code

XXXXXXXX is a zero-filled non-meaningful numeric identifier of eight characters in length for each FTRP or FTSeg.

2.8 Relating "Logical" to "Physical" FTRP and FTSeg

2.8.1 Equivalent FTRP and FTSeg

An FTRP or FTSeg which is assigned a Category of "physical" represents a point or a transportation segment over which a vehicle can pass while remaining within the traveled way. Traveled ways separated by a physical barrier may be represented by two physical FTSeg, and each physical FTSeg must begin and end at a physical FTRP. Many data authorities will maintain databases in which traveled ways separated by a physical barrier are represented by two sets of arcs, which can be mapped as separate lines.

However, other data authorities may maintain databases in which parallel traveled ways separated by a physical barrier are represented by a single set of arcs; e.g. a small-scale representation of an Interstate highway. Such authorities may create and/or use FTRP and FTSeg which are assigned a category of "logical." The figure at right illustrates the representation of a physically divided traveled way in a "Large-scale county" as two (physical) segments in one database (`FTSeg_1` and `FTSeg_3`), and as a single (logical) segment (`FTSeg_2`) in another database. All three FTSeg records must be connected to the segment `FTSeg_4`, which represents the continuation of the same road within the contiguous "small-scale" county. `FTSeg_2` and `FTSeg_4` are implicitly connected at `FTRP_B`; however, the connectivity of "logical" `FTSeg_4` with "physical" `FTSeg_1` and `FTSeg_3` must be accomplished through entries in the equivalency table.

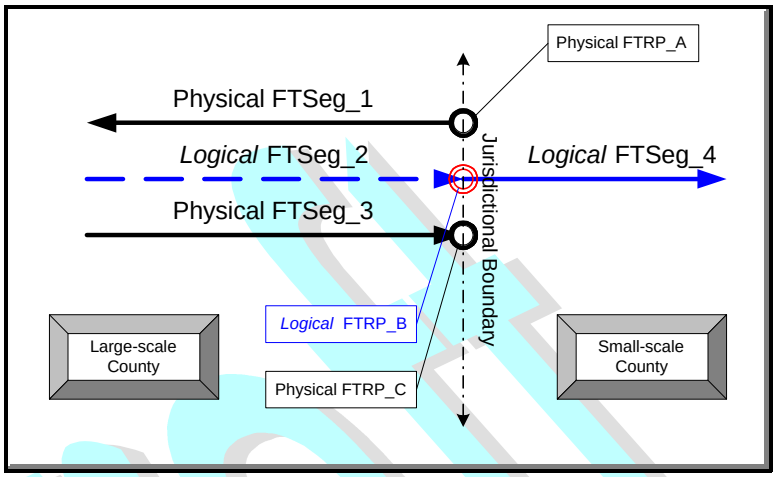

Figure 7 - Connectivity between "Single line" and "Dual line" representations of a Divided Roadway

2.8.2 The Equivalency Table

At points of connectivity between such differing representations of the traveled way(s) all physical segments must be capable of connecting with the logical segment(s) in databases that represent the features in contiguous jurisdictions; the inverse is also true. And wherever multiple authorities maintain databases describing equivalent features within the same jurisdiction (i.e., the representations are of the same point or line features), the logical and physical FTRP and FTSeg must be related through entries in the equivalency table, so they can support exchange of attribute across these databases.

Equivalence is sustained by the maintenance of data records that capture relationships between physical and logical FTRP and FTSeg. One physical FTRP may have 0 or 1 or more logical FTRP which are equivalent. Also, one physical FTSeg may have 0 or 1 or more logical FTSeg which are equivalent. Since one logical FTRP (or FTSeg) may also have 0 or 1 or more physical FTRP (or FTSeg) which are equivalent, the table supports "many-to-many" relationships, and is in the form of an unordered list of tuples:

#	Equivalency Table Field-Name	Description & Format/Domain
1	FTRP_ID or FTSeg_ID	Permanent and unique identifier for the FTRP or FTSeg Format specified in Section 2.7
2	Equivalent_FTRP_ID or Equivalent_FTSeg_ID	Permanent and unique identifier for the FTRP or FTSeg which is equivalent Format specified in Section 2.7

Figure 7 (above) above shows that physical `FTSeg_1` and `FTSeg_3` are equivalent to logical `FTSeg_2`. Likewise, the FTRP which terminate these segments are equivalent: physical `FTRP_A` and `FTRP_C` are equivalent to logical `FTRP_B`. Multiple entries in the table, as illustrated, will establish these equivalencies; the ordering of the entries, and which element of the tuple is recorded in which field makes no difference. Users of the multiple representations of these transportation features in both counties will be able to link entries in the equivalency table to the information in their own databases about FTRP and FTSeg, and thereby access information maintained by other authorities.

	ID	Equiv-ID
RecNum-1	FTSeg_1	FTSeg_2
RecNum-2	FTSeg_3	FTSeg_2
RecNum-3	FTRP_A	FTRP_C
RecNum-4	FTRP_B	FTRP_C

2.9 Framework Transportation Data Authorities

An NSDI Framework Transportation Data Authority may perform some or all of the functions necessary to build and operate the NSDI Framework. These functions are: *Data Development, Maintenance, and Integration, Data Access, Data Management, Coordination, Executive Guidance, Resource Management* , and *Monitoring and Response*.[2]

[2]NSDI Framework Introduction and Guide, FGDC, 1997, Chapter 4.

Any organization which takes responsibility for proposing, designating, or working in partnership with other organizations to define FTRP and FTSeg is -- for the purposes of this standard -- operating as an "authority." Organizations which act as authorities

1) create or update transportation databases (or plan to do so),

2) share those databases or related attribute sets with others (or plan to do so), and

3) conform database development and maintenance activities to this standard.

Each authority is identified by a permanent, unique, fixed-length code of five characters in the form of **AAAAA**. Information about each authority is maintained in an NSDI Framework Authority Index; (See Part 3 - Implementation Procedures).

2.9.1 Unique Identifiers for Single-state authorities

Organizations which perform authority functions in one state or any part of one state will assume a unique identifier, the first two characters of which consist of the state FIPS code. These characters will duplicate the first two characters in the first section of the FTRP or FTSeg record for many local and state transportation-related public agencies. The following three characters consist of a unique code for each authority located within the state. *EXAMPLE: The Vermont Agency of Transportation could assume an Authority-ID of "50001," the Vermont Enhanced-911 Board could assume the Authority-*

ID of "50002," with other state-specific state, regional and local agencies assuming other identifiers.

2.9.2 Unique Identifiers for Multi-state authorities

Federal agencies, organizations which produce data for multiple states, and non-domestic authorities can all be accommodated by using the code of "00" in the first two characters. The remaining three characters consist of a code unique to each authority. Multi-state authorities which have multiple database maintenance operations or separate geographic units can assume separate Authority-IDs. *EXAMPLE: Some federal agencies which are FGDC members perform data development and maintenance in facilities in multiple regions of the US. Such regional data maintenance facilities may choose to become authorities, and each should use a unique code beginning with "00."*

2.9.3 Descriptive Attributes for each Authority

The information content relating to each authority maintained within the index is based on the "Contact-Information" content specified within the FGDC "Content Standard for Digital GeoSpatial Metadata". It includes the following information:

#	Authority Field-Name	Description & Format/Domain
1	**Authority-ID**	Permanent and unique identifier of the organization. Five character integer

433	2	Authority-Name	Name of the organization acting as an authority Free text: 255 characters or less
434	3	Contact-Person-Primary	Name of a contact person Free text: 255 characters or less
435	4	Contact-Voice-Telephone	Voice telephone number of Contact-Person-Primary Free text: 10 characters
436	5	Contact-Facsimile-Telephone *(optional)*	Fax telephone number of Contact-Person-Primary Free text: 10 characters
437	6	Contact-Electronic-Mail - Address *(optional)*	E-mail address of Contact-Person-Primary Free text: 255 characters or less
438	7	Contact-URL *(optional)*	Universal Resource Locator for Internet access to the Authority Free text: 255 characters or less
439	8	Contact-Instructions	Instructions for contacting the Authority Free text: 255 characters or less
440	9	Authority-Address	Mail delivery address of the Authority Free text: 255 characters or less
441	10	Authority-City	Mail delivery city of the Authority Free text: 255 characters or less
442	11	Authority-State-or-Province	Mail delivery state (US) or province (non-US) of the Authority Free text: 255 characters or less
443	12	Authority-Postal-Code	Mail delivery ZIP (US) or postal code of the Authority Free text: 10 characters or less
444	13	Authority-Country	Mail delivery Country of the Authority Free text: 20 characters or less

445	14	Authority-Information *(optional)*	Information about the geographic area, types of transportation activities, or data maintenance operations in which the Authority is engaged Free text: 255 characters or less
446	15	Index-Access-Information	Information on obtaining access to or a copy of information contained in the authority's FTRP and FTSeg information Free text: 255 characters or less