SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J1746

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Submitted for recognition as an American National Standard

ISP-Vehicle Location Referencing Standard

1. ***Scope—***This SAE Standard is intended to be used for the communication of spatial data references between central sites and mobile vehicles on roads. References can be communicated from central site to vehicles, or from vehicles to central sites. The document may also be used where appropriate by other ITS applications requiring location references between data sets.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2374—Location Referencing Message Specification

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 8824-1:1995—Information technology—Abstract syntax notation one (ASN.1): Specification of basic notation

ISO 8824-2:1995—Information technology—Abstract syntax notation one (ASN.1): Information object specification

2.2 **Related Publications—**The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) PUBLICATIONS—Available from AASHTO, Suite 225, 444 N. Capital St. NW, Washington, DC 20001.

GIS-T '95 – Reinterpreting the Location Referencing Problem: A Protocol Approach—Proceedings, Geographic Information Systems for Transportation Symposium (GIS-T)—Reno, NV, April 3-5, 1995, Goodwin, C., S. Gordon, and D. Siegel.

TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

2.2.2 FEDERAL HIGHWAY ADMINISTRATION DOCUMENTS—Available from U.S. DOT, FHWA, Office of Safety and Traffic Operations, ITS Research Division, HSR 10, 6300 Georgetown Pike, McLean, VA 22101.

Task A: Spatial Data Interoperability Protocol For ITS Project—Location Reference Protocol Requirements, December 29, 1995, Goodwin, C., Siegel, D., and Gordon, S.
Task B: Spatial Data Interoperability Protocol For ITS Project – Location Reference Message Protocol Preliminary Specification, February 29, 1996, Goodwin, C., Siegel, D., and Gordon, S.
Task B: Spatial Data Interoperability Protocol For ITS Project – Location Reference Message Specification: Final Design, June 28, 1996, Goodwin, C., Siegel, D., and Gordon, S.
Task B: Spatial Data Interoperability Protocol for ITS Project – Location Reference Message Specification: Revision A, September 18, 1996, Goodwin, C., Siegel, D., and Gordon, S.
Task B: Spatial Data Interoperability Protocol for ITS Project – Location Reference Message Specification: Revision B (MDI), May 22, 1997, Goodwin, C., Siegel, D., and Gordon, S.
Task C: Spatial Data Interoperability Protocol For ITS Project – The ITS Datum Preliminary Data Structure and Content, February 25, 1996, Siegel, D., Goodwin, C., and Gordon, S.
Task C: Spatial Data Interoperability Protocol For ITS Project – ITS Data Final Design Report, June 28, 1996, Siegel, D., Goodwin, C., and Gordon, S.
Task A3: Nationwide Map Database and Location Referencing System Project – Functional Requirements for National Map Databases for ITS, December 31, 1994, Goodwin, C., Xiong, D., and Gordon, S.
Task B3: Nationwide Map Database and Location Referencing System Project – Technical Requirements for National Map Databases for ITS, July 31, 1995, Goodwin, C., and Gordon, S.
Task F1: Nationwide Map Database and Location Referencing System Project – Recommendation for Location Referencing for ITS, December 31, 1994, Goodwin, C., Gordon, S., and Xiong, D.

2.2.3 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) DOCUMENTS—Available from IEEE Customer Service, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.

1489:1999—Standard for Data Dictionaries for Intelligent Transportation Systems

2.2.4 INTELLIGENT TRANSPORTATION SOCIETY (ITS) OF AMERICA DOCUMENTS—Available from ITS America, 400 Virginia Avenue, SW, Suite 800, Washington, DC 20024-2730.

Standard Location (SLR) System: Road Name ID Scheme – Proceedings of the ITS America Annual Meeting, 1994, Ramakrishnan, R., C. Collier, and D. Behr
U.S. National Architecture Program documents on world-wide web - http://www.itsa.org/archdocs/national.html

2.2.5 NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY (NIST) DOCUMENT—Available from NIST, FIPS PUB 173, U.S. Government Printing Office, National Technical Information Service U.S. Department of Commerce, Springfield VA 22161.

FIPS PUB 173 – Spatial Data Transfer Standard (SDTS), 1992

2.2.6 OAK RIDGE NATIONAL LABORATORY DOCUMENTS—Available from Oak Ridge National Laboratory, Center for Transportation Analysis, Oak Ridge, TN 37831.

Location Referencing for ITS – White Paper prepared for Oak Ridge National Laboratory and the National ITS Architecture Program, Goodwin, C.
The Location Reference Message Protocol for ITS Applications – White Paper Prepared for Nationwide Map Database and Location Referencing System Project, Goodwin, C., and Xiong, D.

2.2.7 TRANSPORTATION RESEARCH BOARD PUBLICATION—Available from Transportation Research Board, 2101 Constitution Ave, NW, Washington, DC 20418.

Transportation Research Circular 412 – Primer on Intelligent Vehicle Highway Systems, 1993

2.2.8 UNITED STATES GEOLOGICAL SURVEY PUBLICATION—Available from US Geological Survey, U.S. Government Printing Office, Washington, DC 20402.

U.S. Geological Survey Circular 1048 – An Enhanced Digital Line Graph Design, 1989

2.2.9 INTERNATIONAL STANDARDS ORGANIZATION—Members of the ISO maintain registers of currently valid ISO/IEC International Standards. For the USA, the member of ISO is the American National Standards Institute (ANSI), which may be contacted at 11 West 42nd Street, 13th Floor, New York, New York 10036.

ISO 8825-1:1995—Information technology—ASN.1 Encoding rules: Specification of basic encoding rules (BER), canonical encoding rules (CER) and distinguished encoding rules (DER)
ISO 8825-2:1995—Information technology—ASN.1 Encoding rules: Specification of packed encoding rules (PER)
ISO/IEC 6709—Standard representation of latitude longitude and altitude for geographic points

2.2.10 U.S.NATIONAL IMAGERY AND MAPPING AGENCY, WASHINGTON, D.C., WORLD GEODETIC SYSTEM 84 (WGS84)

3. Definitions

3.1 Altitude—Elevation above or below a reference datum, as defined in FIPSPUB 70-1 (NIST, 1992); the z-value in a spatial address.

3.2 Coordinates—Pairs of numbers expressing horizontal distances along orthogonal axes; alternatively, triplets of numbers measuring horizontal and vertical distances. (NIST, 1992)

3.3 Datum—A set of parameters and control points used to accurately define the three-dimensional shape of the Earth (e.g., as an ellipsoid). The corresponding datum is the basis for a planar coordinate system. (MnDOT 1993)

3.4 Geodetic Datum—A mathematical model of the Earth's shape. (Krzanowski et al, 1993) A geometric set of five quantities which serves as a locational reference or base for other quantities. The five quantities are the latitude and longitude of an initial point, the azimuth of a line from this point and two constants necessary to define the terrestrial spheroid. (MnDOT 1993)

3.5 Information Service Provider (ISP)—In the context of the LRMS, a public or private entity which may be responsible for gathering, fusing, analyzing, and/or reporting transportation related information to users, including vehicles and non-mobile users.

3.6 Junction—A collection of more than one node that represents a logical feature, such as a complex intersection. (Shuman, 1993)

3.7 Link—A topological connection between two nodes. A link may contain additional intermediate coordinates (shape points) to better represent the shape of curved features (Shuman, 1993). A link may be directed by ordering its nodes.

3.8 Link Identifiers (or Link-ID)—An identifier assigned to a link. Link-IDs may be arbitrary, or may be assigned by convention to assure that multiple occurrences of the same ID will not occur within one network or within the universe of similar networks or databases.

3.9 Location Referencing System—System of determining the position of an entity relative to other entities or to some external frame of reference.

3.10 Measured Distance—Cumulative distance measured along a road centerline from a reference node.

3.11 NAD (North American Datum)—The official reference ellipsoid used for the primary geodetic network in North America. (MnDOT 1993)

3.12 NAD27 (North American Datum 1927)—Geodetic datum defined by the geographic position of triangulation station Meades Ranch and the azimuth from that station to station Waldo on the Clarke spheroid of 1866. (MnDOT 1993)

3.13 NAD83 (North American Datum 1983)—Geodetic datum defining an Earth-fitting ellipsoid and for relating existing coordinate systems to the Earth's center of mass. It is based on both satellite and terrestrial data used in developing the Geodetic Reference System of 1980 and later the World Geodetic System of 1984 (WGS-84). This improved Earth-centered model slightly changes the latitude and longitude of almost every point in North America with respect to the earlier NAD27 datum. (MnDOT 1993)

3.14 Node (0-cell)—A topologically significant point, such as a simple intersection of roadways or other linear features, or an endpoint of such a feature. (Shuman, 1993)

3.15 Node Identifier (or Node-ID)—An identifier assigned to a node. Node-IDs may be arbitrary, or may be assigned by convention to assure that multiple occurrences of the same ID will not occur within one network or within the universe of similar networks or databases.

3.16 Reference Ellipsoid—The mathematical model of the Earth used in geodetic computations. (Krzanowski et al, 1993)

3.17 Reference Node—A node with respect to which distance measurements are made. In the ISP-Vehicle profile, Reference Nodes are simple intersection or endpoint nodes.

3.18 Topology—The logical relationships among map features in a digital base map. It can be used to characterize spatial relationships such as connectivity and adjacency.

3.19 World Geodetic System of 1984 (WGS-84)—An earth-centered global reference frame, including an earth model, based on satellite and terrestrial data. It contains primary parameters that define the shape, angular velocity, and the earth mass of an earth ellipsoid, and secondary parameters that define a gravity model of the earth. Primary parameters are used to derive latitude-longitude coordinates (horizontal datum). Secondary parameters are used for determining the orbits of GPS navigation satellites and define a coarse vertical datum; therefore WGS-84 is a complete geodetic system. EGM-96 is a refined model established in 1996.

4. The Cross-Streets Method of Location Referencing

4.1 The Cross-Streets Profile—The Cross-Streets method of Location Referencing is based on the Cross-Streets Profile in the Location Referencing Message Specification Information Report, SAE J2374. The Cross-Streets Profile uses intersecting (crossing) streets to identify nodes and is illustrated in Figure 1. Up to three street names may be used, called the 'on' name, the 'from' name, and the 'to' name. Offsets from the intersection of 'on' and 'from' streets are used to identify point and segment locations on the link defined by 'on,' 'from,' and 'to.' Inclusion of two streets is required to identify an intersection. Adding a third street (i.e., two intersections along the same road) identifies the specific road segment and extent of a position along a road.

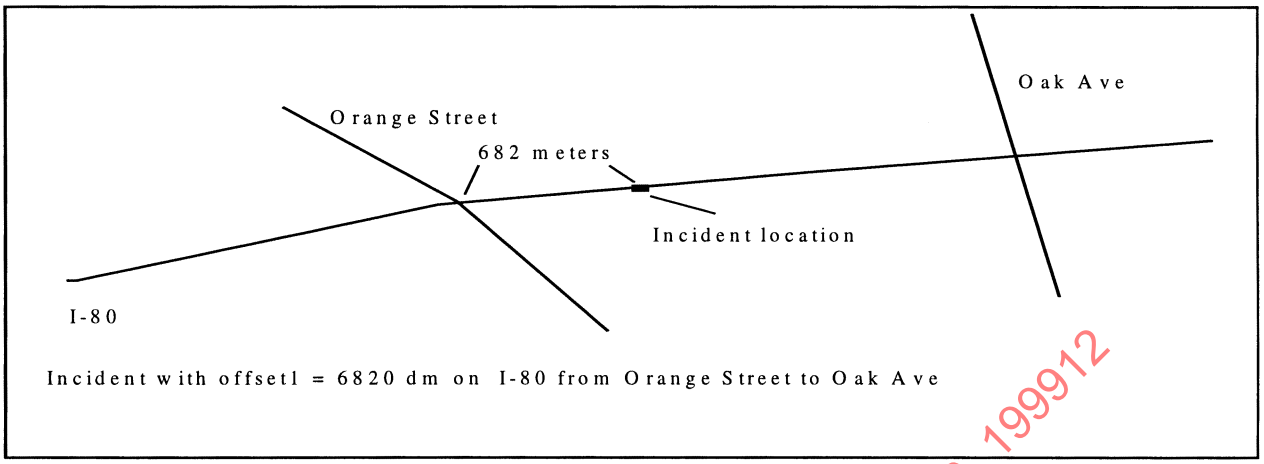

FIGURE 1—THE CROSS-STREETS REFERENCING METHOD

4.2 The Standard ISP-Vehicle Location Referencing Format—The Standard Location Referencing Format emphasizes coordinates of the intersections, rather than street names. A standard location reference passes coordinates of the centerline intersection of streets, supplemented by street names when available to resolve coordinate ambiguities. The format applies to simple street centerline intersections only; complex intersections can be built up from a set of such simple references but are not specified in this Standard. The Standard Location Referencing Format is given in Table 1. A non-normative ASN.1 representation is provided in Appendix A , and examples of encoding are provided in Appendix B.

4.3 The Standard Location Referencing Format Data Elements

4.3.1 ON STREET BYTE COUNT—The number of ASCII characters that will be used to convey the 'on' street name in the reference.

4.3.2 FROM STREET BYTE COUNT—The number of ASCII characters that will be used to convey the 'from' street name in the reference.

4.3.3 TO STREET BYTE COUNT—The number of ASCII characters that will be used to convey the 'to' street name in the reference.

4.3.4 ON STREET NAME—A stream of ASCII characters comprising the 'on' street name, of size On Street Byte Count. On Street Name is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers.

4.3.5 FROM STREET NAME—A stream of ASCII characters comprising the 'from' street name, of size From Street Byte Count. From Street Name is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers.

TABLE 1—THE STANDARD ISP-VEHICLE LOCATION REFERENCING FORMAT

Byte Count	Content	Data Type	Data Values/Range	Units
1	OnStreetByteCount	Integer (0..255)		bytes
1	FromStreetByteCount	Integer (0..255)		bytes
1	ToStreetByteCount	Integer (0..255)		bytes
OnStreetByteCount	OnStreetName	OctetString	(0..OnStreetByteCount)	
FromStreetByteCount	FromStreetName	OctetString	(0..FromStreetByteCount)	
ToStreetByteCount	ToStreetName	OctetString	(0..ToStreetByteCount)	
1	HorizontalDatum	Integer (0..7)	(0 = other, 1 = WGS84 (WGS-84 World Geodetic System of 1984), 2 = WGS96 (WGS-84 with EGM-96 extension of 1986), 3 = NAD83 (North American Datum of 1983), 4 = NAD27 (North American Datum of 1927), 5 = reserved1, 6 = reserved2, 7 = reserved3)	
4	StartLongitude	Integer	(–180 000 000..180 000 000)	microdegrees
4	StartLatitude	Integer	(–90 000 000..90 000 000)	microdegrees
4	EngLongitude	Integer	(–180 000 000..180 000 000)	microdegrees
	EndLatitude	Integer	(–90 000 000..90 000 000)	microdegrees
1	VerticalDatum	Integer (0..7)	(0 = other, 1 = not-provided 2 = WGS84 (WGS-84 World Geodetic System of 1984), 3 = NAVD88 (North American Vertical Datum of 1988), 4 = Vertical Level Code 5 = reserved1, 6 = reserved2, 7 = reserved3)	
2	StartAltitude	Integer	(–8191 --> 57 344) (–7 --> +7	decimeter Level Code
2	EndAltitude	Integer	(–8191 --> 57 344 (–7 --> 7)	decimeter Level Code
3	Offset1	Integer	(–8 388 607..8 388 607)	decimeters
3	Offset2	Integer	(–8 388 607..8 388 607)	decimeters
1	Side	Integer (0..3)	0 = unknown, 1 = right, 2 = left, 3 = both)	

4.3.6 TO STREET NAME—A stream of ASCII characters comprising the 'to' street name, of size To Street Byte Count. To Street Name is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers.

4.3.7 HORIZONTAL DATUM—The specification of the horizontal component of a geodetic datum, i.e., a set of parameters and control points used to accurately define the three-dimensional shape of the Earth, for a node or link.

4.3.8 START LONGITUDE—The geographic longitude of a node specified by {Start Longitude, Start Latitude}, corresponding to the intersection specified by {On Street Name, From Street Name}.

4.3.9 START LATITUDE—The geographic latitude of a node specified by {Start Longitude, Start Latitude}, corresponding to the intersection specified by {On Street Name, From Street Name}.

4.3.10 END LONGITUDE—The geographic longitude of a node specified by {End Longitude, End Latitude}, corresponding to the intersection specified by {On Street Name, To Street Name}.

4.3.11 END LATITUDE—The geographic latitude of a node specified by {End Longitude, End Latitude}, corresponding to the intersection specified by {On Street Name, To Street Name}.

4.3.12 VERTICAL DATUM—The specification of the vertical component of a geodetic datum, i.e., a set of parameters and control points used to accurately define the three-dimensional shape of the Earth, for a node. Alternatively, Vertical Datum may specify that altitudes are to be expressed in terms of a vertical level code.

4.3.13 START ALTITUDE—The distance above the reference vertical datum specified by Vertical Datum of a node specified by {Start Longitude, Start Latitude} and/or the intersection specified by {On Street Name, From Street Name}. End Altitude is the distance above the reference vertical datum specified by Vertical Datum of a node specified by {End Longitude, End Latitude} and/or the intersection specified by {On Street Name, To Street Name}.

4.3.14 OFFSET1—The location of a point along a street specified by On Street Name, in terms of measured distance along the street from the start node specified by {Start Longitude, Start Latitude} and/or {On Street Name, From Street Name}. Offset1 values may be positive for distances measured along the link terminated by the node located by {End Longitude, End Latitude} and/or {On Street Name, To Street Name}, zero, or negative for distances measured along the street before the link. Note that directionality, and therefore offset sign (expressed in decimeters), requires specification of a complete link.

4.3.15 OFFSET2—The location of a second point along a street specified by On Street Name, in terms of measured distance along the street from the start node specified by {Start Longitude, Start Latitude} and/or {On Street Name, From Street Name}. Offset1 values may be positive for distances measured along the link terminated by the node located by {End Longitude, End Latitude} and/or {On Street Name, To Street Name}, zero, or negative for distances measured along the street before the link. Note that directionality, and therefore offset sign, requires specification of a complete link.

4.3.16 SIDE—The centerline or boundary of a transportation link on which an event, object, or action is positioned. Side is right-hand or left-hand relative to the direction of travel from the start node located by {Start Longitude, Start Latitude} and/or {On Street Name, From Street Name} to the point indicated by Offset1, or to the node indicated by {End Longitude, End Latitude} and/or {On Street Name, To Street Name}. Side may also indicate that an event, object, or action is located on both sides of the road.

PREPARED BY THE SAE MAP DATABASE COMMITTEE

APPENDIX A

THE ASN.1 FORM OF THE STANDARD LOCATION REFERENCING FORMAT

A.1 ***Message Structure—***The following ASN.1 Module provides the formal definition of the ISP-Vehicle Profile. The Data Elements referenced in this structure are defined in Section A.2.

```
-- ISP-Vehicle Profile Standard Format

LRProfile-ISP-Vehicle DEFINITIONS:: =  BEGIN

ISP-Vehicle-Profile:: =  SEQUENCE  {
    ISPVehicle-OnStreet-txt                 VisibleString (SIZE(0..255)),
    ISPVehicle-FromStreet-txt               VisibleString (SIZE(0..255)),
    ISPVehicle-ToStreet-txt                 VisibleString (SIZE(0..255)),
    ISPVehicle-Side-cd                      ENUMERATED {unknown (0), right (1), left (2), both (3),
    ISPVehicle-Points                       X-StreetPoints,
    ISPVehicle-Offset1-qty                  INTEGER (–8 388 607..8 388 607),
    ISPVehicle-Offset2-qty                  INTEGER (–8 388 607..8 388 607)}

X-StreetPoints :: =  SEQUENCE {
    ISPVehiclePoints-HorizontalDatum-cd     ENUMERATED {other (0), wgs84 (1), wgs84-egm96 (2),
                                            nad83 (3), nad27 (4),reserved1 (5), reserved2 (6),
                                            reserved3 (7)},
    ISPVehiclePoints-VerticalDatum-cd       ENUMERATED {other (0), not-provided (1),
                                            wgs84 (2), navd88 (3), level-code (4),
                                            reserved1 (5), reserved2 (6), reserved3 (7) },
    ISPVehiclePoints-FromIntersection       GeoPoint,
    ISPVehiclePoints-ToIntersection         GeoPoint}


GeoPoint :: =  SEQUENCE {
    geoPoint-Latitude-qty                   INTEGER (–90 000 000..90 000 000),
    geoPoint-Longitude-qty                  INTEGER (–180 000 000..180 000 000),
    geoPoint-Altitude-qty                   INTEGER (–8192..57 343) }

END
```

A.2 ***Data Element Definitions—***This section provides the precise definition of each Data Element contained in the previous message structure. The referenced Value Domains are defined in A.3. The Data Element definitions are in accordance with IEEE 1489:1999.

Each Data Element is defined according to the following ASN.1 Information Object Specification.

```
    DATA-ELEMENT   :: =  CLASS {
    &descriptivename                PrintableString  (SIZE (0..162))
    &descriptivenamecontext         PrintableString  (SIZE (0..64))
    &definition                     PrintableString  (SIZE (0..65 535))
    &formula                        PrintableString  (SIZE (0..255))        OPTIONAL
    &source                         PrintableString  (SIZE (0..255))        OPTIONAL
    &className                      PrintableString  (SIZE (0..255))
    &classificationSchemeName       PrintableString  (SIZE (0..64))
    &classificationSchemeVersion    NumericString    (SIZE (0..8))
    &dataConceptType                IA5String (SIZE (“Data Element”))
    &keyword                        PrintableString  (SIZE (0..255))        OPTIONAL
```

&remarks	PrintableString	(SIZE (0..65 535))	OPTIONAL
&aSNName	PrintableString	(SIZE (0..64))	
&representationLayout	PrintableString	(SIZE (0..65 535))	
&valueDomain	PrintableString	(SIZE (0..255))	
&DataType			
&representationClassTerm	PrintableString	(SIZE (0..64))	
&validValueRule	PrintableString	(SIZE (0..65 535))	OPTIONAL
}			
WITH SYNTAX {			
DESCRIPTIVE NAME	&descriptiveName		
DESCRIPTIVE NAME CONTEXT	&descriptiveNameContext		
DEFINITION	&definition		
[FORMULA	&formula]		
[SOURCE	&source]		
CLASS NAME	&className		
CLASSIFICATION SCHEME NAME	&classificationSchemeName		
CLASSIFICATION SCHEME VERSION	&classificationSchemeVersion		
[DATA CONCEPT TYPE	&dataCoinceptType]		
[KEYWORD	&keyword]		
[REMARKS	&remarks]		
ASN NAME	&aSNName		
REPRESENTATION LAYOUT	&representationLayout		
VALUE DOMAIN	&valueDomain		
DATA TYPE	&DataType		
REPRESENTATION CLASS TERM	&representationClassTerm		
[VALID VALUE RULE	&validValueRule]		
}			

A.2.1 GEOPOINT_Longitude_quantity

geoPoint-Longitude-qty	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	GEOPOINT_Longitude_quantity
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The longitude is the geographic latitude of a node specified in microdegrees (10^–6) as measured with the defined horizontal datum. The longitude of 180 degrees West shall be –180 000 000. The longitude of 180 degrees East shall be 180 000 000."
CLASS NAME	Node Description
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	location, longitude, point, spatial
REMARKS	
ASN NAME	geoPoint-Longitude-qty
REPRESENTATION LAYOUT	Longitude expressed as a value in microdegrees (Integer (–180 000 000..180 000 000))
VALUE DOMAIN	Quantity-Integer
DATA TYPE INTEGER	(–180 000 000..180 000 000)
REPRESENTATION CLASS TERM	Longitude
VALID VALUE RULE	From –180 000 000 microdegrees to 180 000 000 microdegrees
}	

A.2.2 GEOPOINT_Latitude_quantity

geoPoint-Latitude-qty	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	GEOPOINT_Latitude_quantity
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The latitude is the geographic latitude of a node specified in microdegrees (10^–6) as measured with the defined horizontal datum. The latitude at the North Pole is 90 000 000. The latitude at the South Pole is –90 000 000."
CLASSIFICATION SCHEME NAME	Node Description
CLASSIFICATION SCHEME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	location, latitude, point, spatial
REMARKS	
ASN NAME	geoPoint-latitude-qty
REPRESENTATION LAYOUT	Latitude expressed as value in microdegrees (Integer (–90 000 000..90 000 000))
VALUE DOMAIN	Quantity-Integer
DATA TYPE INTEGER	(–90 000 000..90 000 000)
REPRESENTATION CLASS TERM	Latitude
VALID VALUE RULE	From –90 000 000 microdegrees to 90 000 000 microdegrees
}	

A.2.3 GEOPOINT_Altitude_quantity

geoPoint-Altitude-qty	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	GEOPOINT_Altitude_quantity
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"A quantity indicating the distance above the defined vertical datum if the defined vertical datum is WGS-84 or NAVD-88. If the defined vertical datum is level code, the valid value range for this data element is –7..7, but the value is still encoded in a field with a defined range of –8192..57 343. If the value of the vertical datum is 'not-provided,' the value indicated for this field shall be zero (0), but is encoded in a field with a range of –8192..57 343. This field does not have a standardized meaning for the other values of vertical datum."
CLASS NAME	Node Description
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORDS	location, altitude, point, spatial
REMARKS	
ASN NAME	geoPoint-Altitude-qty
REPRESENTATION LAYOUT	Altitude expressed as 1) height in meters above the datum (Integer (–8192..57 343)), 2) as a level code (Integer (–7..7)), or 3) not provided (Integer (0)).
VALUE DOMAIN	Quantity-Integer
DATA TYPE INTEGER	(–8192..57 343)

VALID VALUE RULE	If vertical datum is WGS-84 or NAVD-88: from –8192 meters to 57 343 meters. If vertical datum is level code: code from –7 to +7. If vertical datum not provided: 0 For other vertical datum: Undefined
}	

A.2.4 ISP-VEHICLE_ToStreet_text-field

ISPVehicle-ToStreet-txt	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE_ToStreet_text-field
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"A stream of ASCII characters comprising the 'to' street name. ToStreetName is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers."
CLASS NAME	Node Description
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
KEYWORDS	location, spatial
REMARKS	
ASN NAME	ISPVEHICLE-ToStreet-txt
REPRESENTATION LAYOUT	PrintableString (SIZE (0..255))
VALUE DOMAIN	ISO/IEC 10646-1
DATA TYPE	PrintableString (SIZE (0..255))
REPRESENTATION CLASS TERM	text
VALID VALUE RULE	Street name
}	

A.2.5 ISP-VEHICLE_Side_code-side

ISPVehicle-Side-cd	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE_Side_code-side
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The centerline or boundary of a link on which an event, object, or action is positioned. Side is right-hand or left-hand relative to the direction of travel from the start node located by {StartLongitude, StartLatitude} and/or {OnStreetName, FromStreetName} to the point indicated by Offset1, or to the node indicated by {EndLongitude, EndLatitude} and/or {OnStreetName, ToStreetName}."
CLASS NAME	Node Description
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORDS	location, spatial
REMARKS	
ASN NAME	ISPVehicle-Side-cd

REPRESENTATION LAYOUT	Integer unsigned (0..3)
VALUE DOMAIN	Code-Side
DATA TYPE ENUMERATED	(unknown(0), right(1), left(2), both(3))
REPRESENTATION CLASS TERM	Code
VALID VALUE RULE	The side of a link (roadway) as defined by the direction determined from a starting node (origin) to an end node where 0) = UNKNOWN, 1) = RIGHT, 2) LEFT, and 3) = RESERVED.
	}

A.2.6 ISP-VEHICLE_OnStreet_text-field

ISPVehicle-OnStreet-txt	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE_OnStreet_text-field
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"A stream of ASCII characters comprising the 'on' street name. OnStreetName is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers."
CLASS NAMENode Description	
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	Location, spatial
REMARKS	
ASN NAME	ISPVehicle-OnStreet-txt
VALUE DOMAIN	ISO/IEC 10646-1
DATA TYPE	VisibleString (SIZE (0..255))
REPRESENTATION CLASS TERM	text.
VALID VALUE RULE	Street name.
}	

A.2.7 ISP-VEHICLE_Offset2_quantity

ISPVehicle-Offset2-qty	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE_Offset2_quantity
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The location of a second point along a street specified by OnStreetName, in terms of measured distance along the street from the start node specified by {StartLongitude, StartLatitude} and/or {OnStreetName, FromStreetName}. Offset2 values may be positive for distances measured along the link terminated by the node located by {EndLongitude, EndLatitude} and/or {OnStreetName, ToStreetName}, zero, or negative for distances measured along the street before the link. Note that directionality, and therefore offset sign, requires specification of a complete link."
CLASS NAMENode Description	

CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORDS	location, spatial
REMARKS	
ASN NAME	ISPVehicle-offset2-qty
REPRESENTATION LAYOUT	Offset distance in meters (Integer signed (–8 388 608..8 388 607))
VALUE DOMAIN	SI-10
DATA TYPE INTEGER	(–8 388 608..8 388 607)
REPRESENTATION CLASS TERM	meter
VALID VALUE RULE	A positive (+) or negative (–) offset distance measurement, calculated on a line from start node to an end node. Negative values indicate the distance is measured before the start node on the line described by the start – end nodes.

}

A.2.8 ISP-VEHICLE_Offset1_quantity

ISPVehicle-Offset1-qty DATA-ELEMENT :: = {

DESCRIPTIVE NAME	ISP-VEHICLE_Offset1_quantity
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The location of a point along a street specified by OnStreetName, in terms of measured distance along the street from the start node specified by {StartLongitude, StartLatitude} and/or {OnStreetName, FromStreetName}. Offset1 values may be positive for distances measured along the link terminated by the node located by {EndLongitude, EndLatitude} and/or {OnStreetName, ToStreetName}, zero, or negative for distances measured along the street before the link. Note that directionality, and therefore offset sign, requires specification of a complete link."
CLASS NAMENode Description	
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	location, spatial
REMARKS	
ASN NAME	ISPVehicle-Offset1-qty
REPRESENTATION LAYOUT	Offset distance in meters (Integer signed (–8 388 608..8 388 607))
VALUE DOMAIN	SI-10
DATA TYPE INTEGER	(–8 388 608..8 388 607)
REPRESENTATION CLASS TERM	meter
VALID VALUE RULE	A positive (+) or negative (–) offset distance measurement, calculated on a line from start node to anend node. Negative values indicate the distance ismeasured before the start node on the line described bythe start – end nodes.

}

A.2.9 ISP-VEHICLE_FromStreet_text-field

ISPVehicle-FromStreet-txt	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE_FromStreet_text-field
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"A stream of ASCII characters comprising the cross street name 'from' which offset distances are measured. FromStreet is a free-form character expression of a street name, including any type, prefix, or suffix information. It is expected that heuristics will be applied in software at the receiving side of a transfer to interpret and compare street name information between datasets. Consistent use of street naming conventions in data sets will reduce ambiguity in street name transfers."
CLASS NAME	Node Description
CLASSIFICATION SCHEME NAME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	location, spatial
REMARKS	
ASN NAME	ISPVehicle-FromStreet-txt
REPRESENTATION LAYOUT	From street name as a VisibleString
VALUE DOMAIN	ISO/IEC 10646-1
DATA TYPE	VisibleString (SIZE (0..255))
VALID VALUE RULE	Cross street name.
}	

A.2.10 ISP-VEHICLE-POINTS_VerticalDatum_code-vertical-datum

ISPVehiclePoints-VerticalDatum-cd	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE-POINTS_VerticalDatum_code-vertical-datum
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	"The specification of the vertical component of a geodetic datum, i.e., a set of parameters and control points used to accurately define the three-dimensional shape of the Earth, for a node. Alternatively, VerticalDatum may specify that altitudes are to be expressed in terms of a vertical level code."
CLASS NAMENode Description	
CLASSIFICATION SCHEME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
KEYWORD	
REMARKS	
ASN NAME	ISPVehiclePoints-VerticalDatum-cd
REPRESENTATION LAYOUT	Integer unsigned
VALUE DOMAIN	Code-Vertical_Datum
DATA TYPE ENUMERATED	(Other (0), not-provided (1), wgs84(2), navd88 (3), level-code (4), reserved1 (5), reserved2 (6), reserved3 (7))
REPRESENTATION CLASS TERM	code
VALID VALUE RULE	Vertical datum type where: 0 = other, 1 = not provided, 2 = wgs84, 3 = navd88, 4 = level-code, 5 = reserved1, 6 = reserved2, and 7 = reserved3.
}	

A.2.11 ISP-VEHICLE-POINTS_HorizontalDatum_code-horizontal-datum

ISPVehiclePoints-HorizontalDatum-cd	DATA-ELEMENT :: = {
DESCRIPTIVE NAME	ISP-VEHICLE-POINTS_HorizontalDatum_code-horizontal-datum
DESCRIPTIVE NAME CONTEXT	ITS
DEFINITION	“The specification of the horizontal component of a geodetic datum, i.e., a set of parameters and control points used to accurately define the three-dimensional shape of the Earth, for a node or link.”
CLASS NAME	Node Description
CLASSIFICATION SCHEME	ITS Classification Scheme
CLASSIFICATION SCHEME VERSION	9710
DATA CONCEPT TYPE	Data Element
KEYWORD	
REMARKS	
ASN NAME	ISPVehiclePoints-HorizontalDatum-cd
REPRESENTATION LAYOUT	Integer unsigned
VALUE DOMAIN	Code-Horizontal_Datum
DATA TYPE ENUMERATED	(other (0), wgs84(1), wgs84-egm96 (2), nad83 (3), nad27 (4), reserved1 (5), reserved2 (6), reserved 3 (7))
REPRESENTATION CLASS TERM	code
VALID VALUE RULE	The horizontal datum where the datum is defined as: other (0), wgs84 (1), wgs84-egm96 (2), nad83 (3), nad27 (4), reserved1 (5), reserved2 (6), reserved3 (7)

A.3 Value Domain Definitions—This section provides the precise definition of each Value Domain referenced in the previous Data Elements. The Value Domain definitions are defined in accordance with IEEE 1489:1999. Each Value Domain is defined according to the following ASN.1 Information Object Specification.

VALUE-DOMAIN:: = CLASS {

&descriptiveName	PrintableString (SIZE (0..255))	
&descriptiveNameContext	PrintableString (SIZE (..40))	
&definition	PrintableString (SIZE (0..65535))	
&formula	PrintableString (SIZE (0..255))	OPTIONAL
&source	PrintableString (SIZE (0..255))	OPTIONAL
&className	PrintableSring (SIZE (0..255))	OPTIONAL
&classificationSchemeName	PrintableString (SIZE (0..64))	
&classificationSchemeVersion	NumericString (SIZE (0..8))	
&dataConceptType	IA5String (SIZE (“Value Domain”))	
&keyword	PrintableString (SIZE (0..255))	OPTIONAL
&related DataConcept	PrintableString (SIZE (0..255))	OPTIONAL
&relationshipType	PrintableString (SIZE (0..255))	OPTIONAL
&remarks	PrintableString (SIZE (0..2000))	OPTIONAL
&representationLayout	PrintableString (SIZE (0..65535))	
&DataType		
&representationClassTerm	PrintableString (SIZE (0..64))	OPTIONAL
&validValueRule	PrintableString (SIZE (0..65535))	
}		
WITH SYNTAX {		
DESCRIPTIVE NAME	&descriptiveName	
DESCRIPTIVE NAME CONTEXT	&descriptiveNameContext	