



# Standards for Linear Referencing

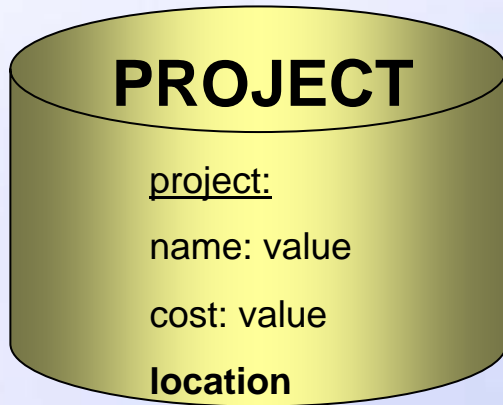
Dr. Paul Scarponcini

Bentley Transportation Data Management

March 31, 2004

Rapid City, South Dakota

# Linear Referencing



(spatial) location:

at some (  $x, y$  ), or  
at lat/long positions

(linear) location:

Along Route 95

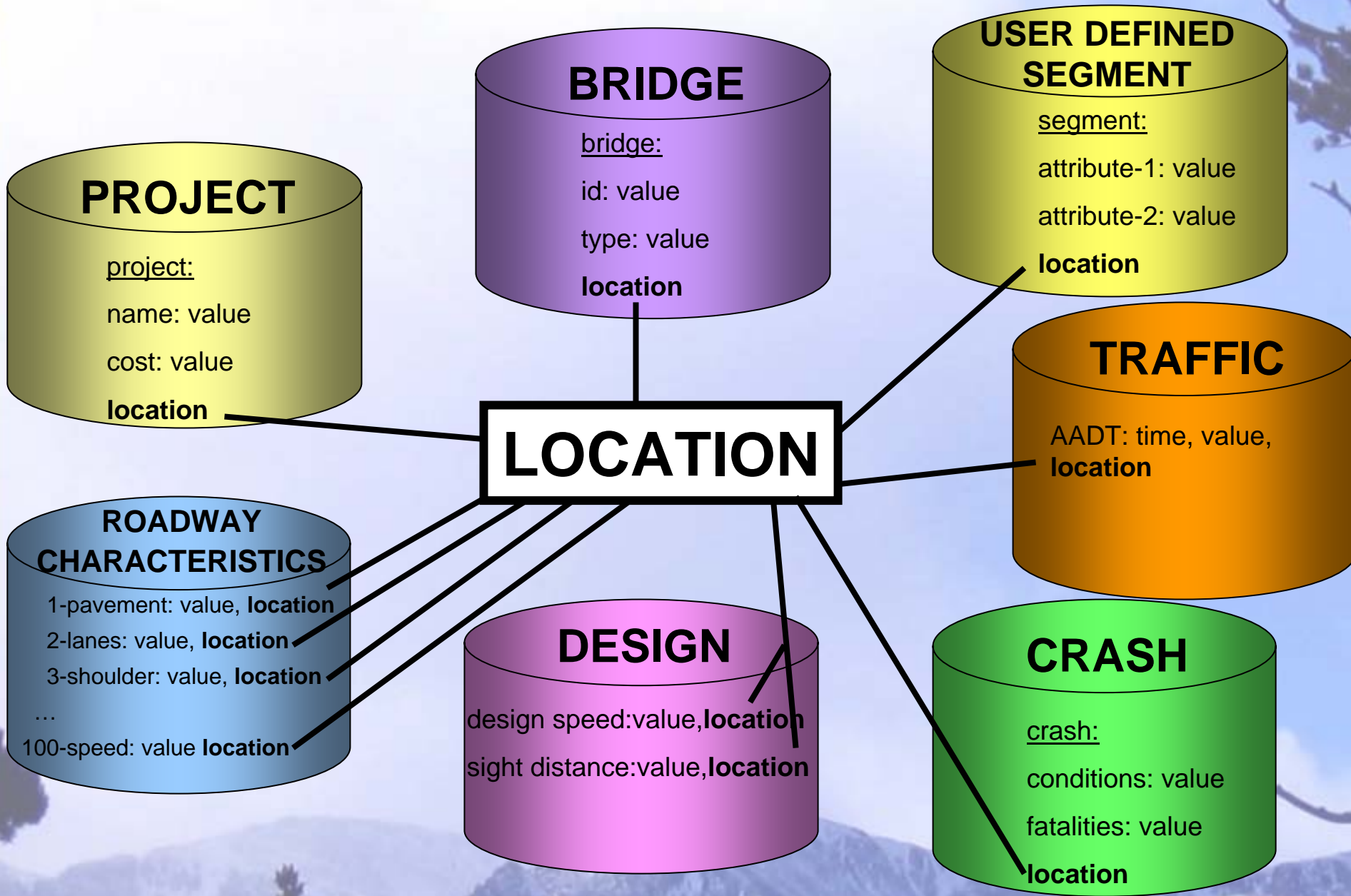
from milepoint 2.1  
to milepoint 2.6

# Linear Referencing

Measuring along a line  
... or any linear element

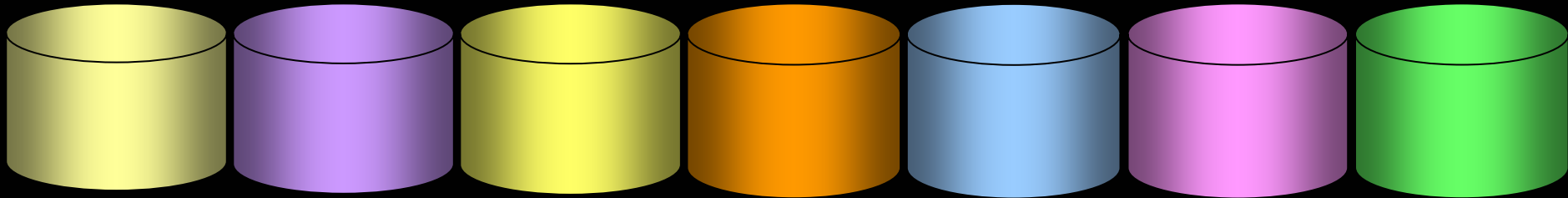
How we measure:

Linear Referencing Method (LRM)



# Dilemma:

**PROJECT BRIDGE SEGMENT TRAFFIC ROADWAY DESIGN CRASH**



**location  $\neq$  location  $\neq$  location  $\neq$  location  $\neq$  location  $\neq$  location  $\neq$  location**

**differing Linear Referencing Methods,  
inside and external to the organization**

# Measures

132+00

50 %

© + 1.8 miles

55

4 km

2.5 miles

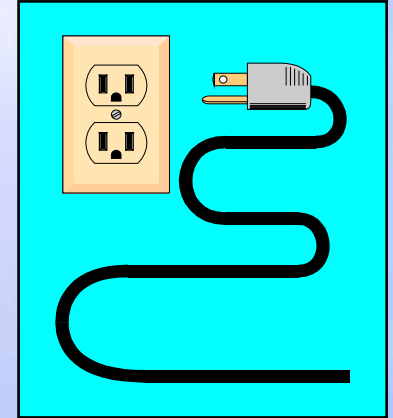
2 + .50 miles

'A' 89+20

2 + .400

# Standards Can Help

**Electrical plugs**

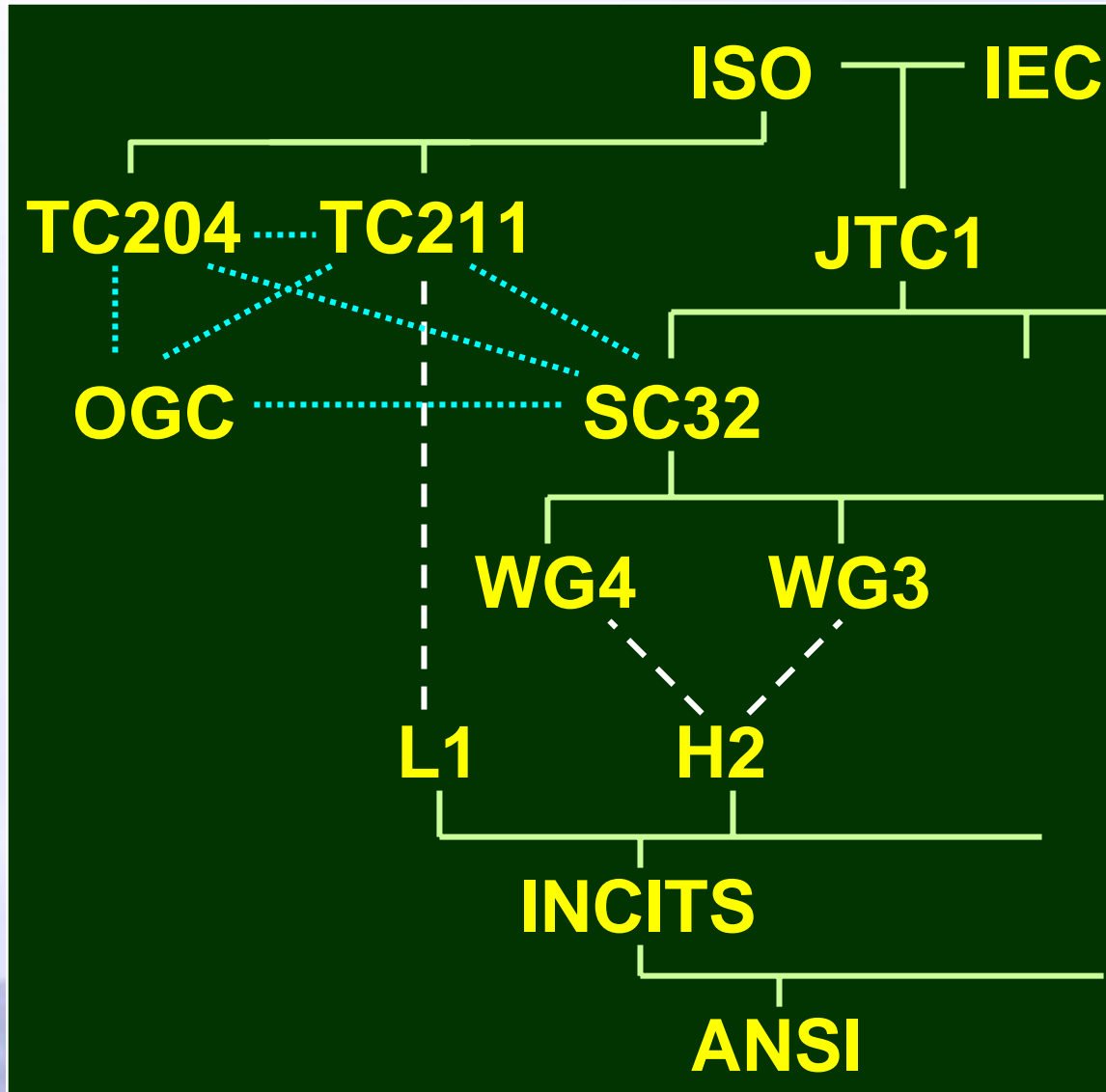


**CD, DVD, USB**



**Bar Codes**

# Where it is happening



**International Organization for Standardization**

**International Electrotechnical Commission**

**Joint Technical Committee**

**Sub Committee**

**Working Group**

**Open GIS Consortium**

**Liaison** .....

**Technical Advisory Group (TAG)** - - - - -

**InterNational Committee for Information Technology Standards**

**American National Standards Institute**



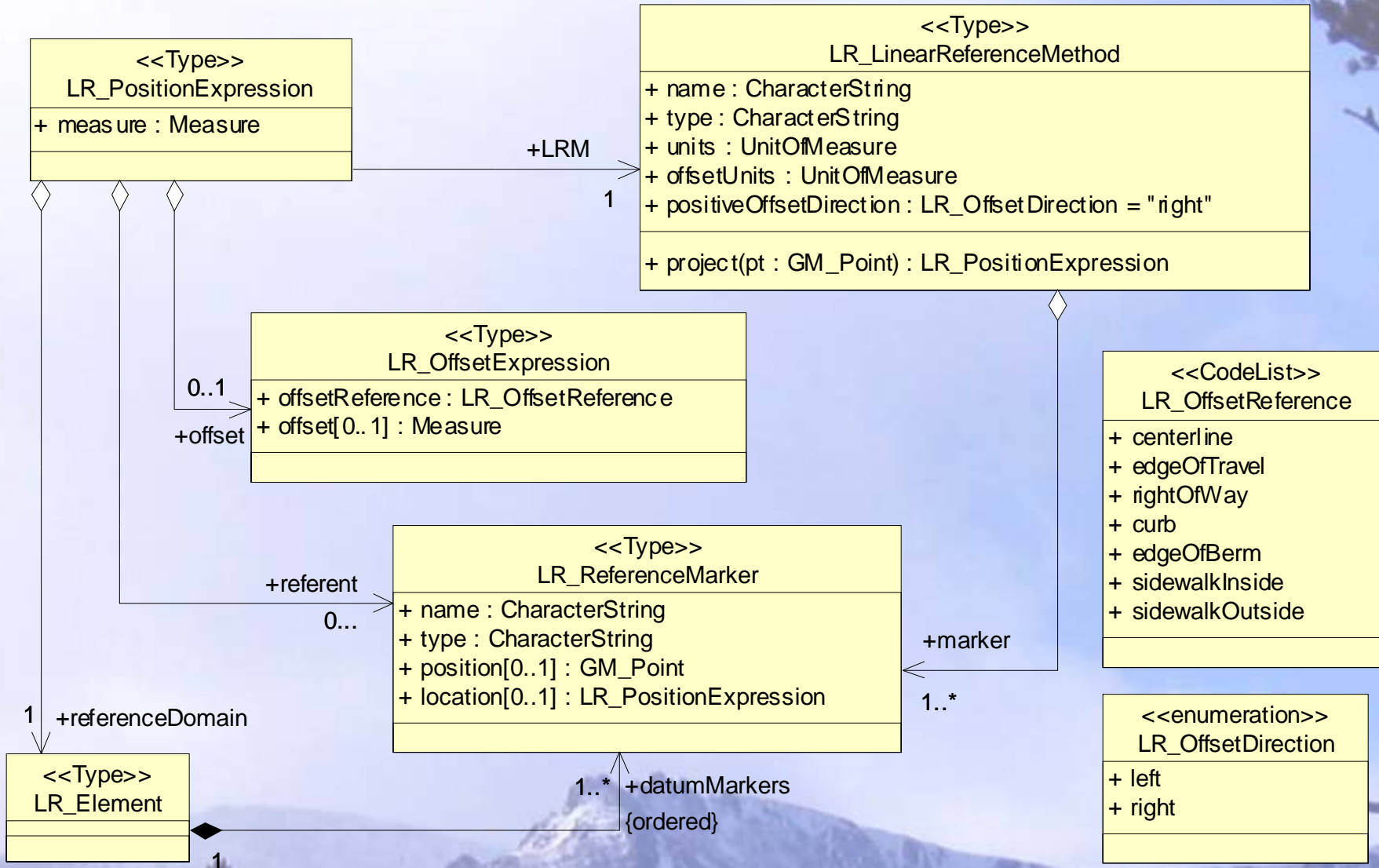
# Current Linear Referencing Standards Activity

- ISO TC211 19133 (Navigation and Tracking) – one of many ways of defining a position
- Geospatial One-Stop (Transportation) – incorporates 19133
- OGC Abstract Specification Topic 2 (Coordinate Referencing Systems) – simple only – profile?
- SAE J2266 (Location Referencing Message Specification - LRMS)
- ISO TC204 (Graphic Data Files - XGDF)
- OGC GML 3

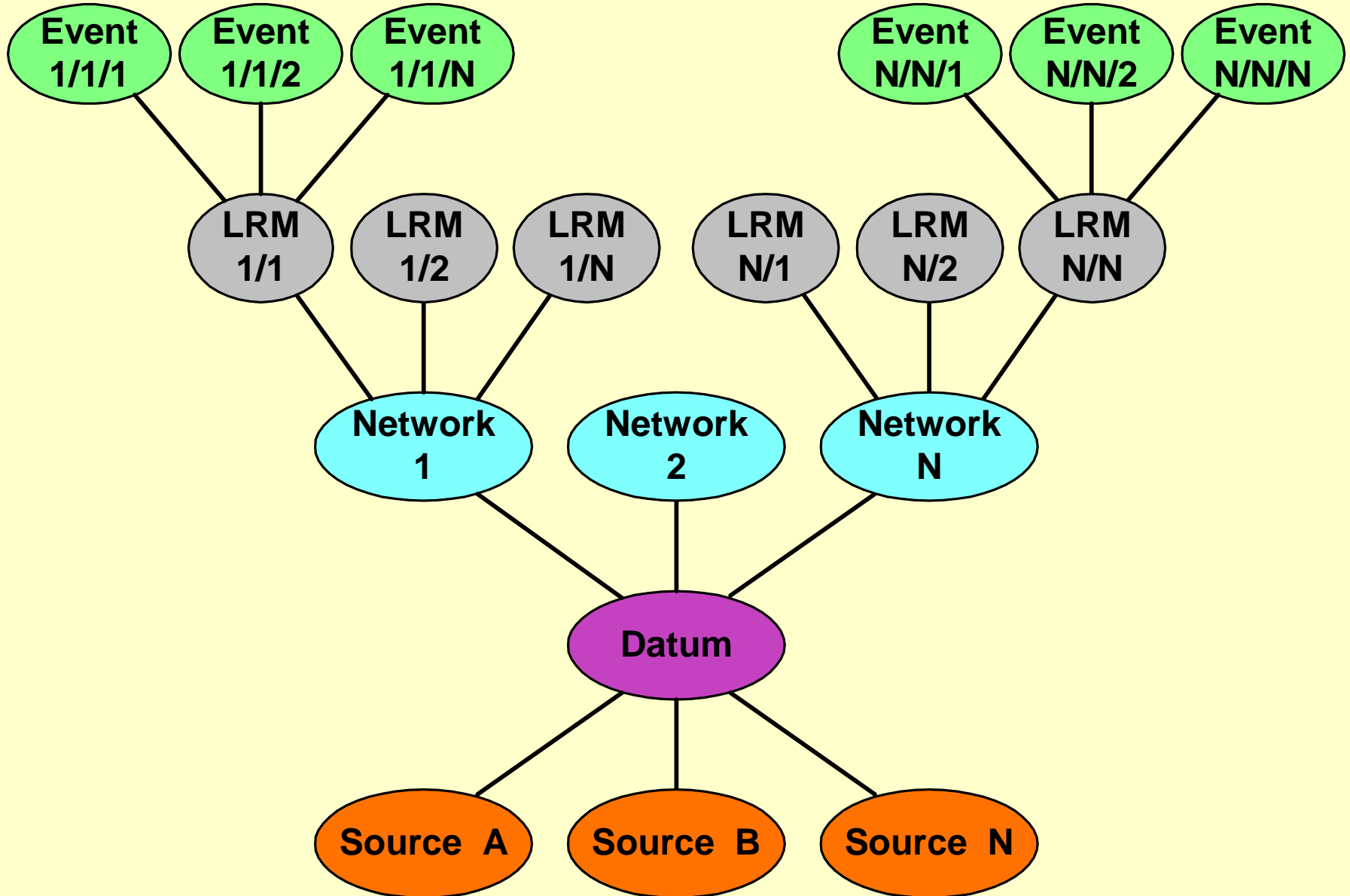
# ISO TC211 Geographic Information/Geomatics Projects

19101 – Reference model	19120 – Functional standards (Report)
19103 – Conceptual schema language	19121 – Imagery and gridded data
19104 – Terminology	19122 – Qualifications and certification of personnel (Report)
19105 – Conformance and testing	19123 – Schema for coverage geometry and functions
19106 – Profiles	19124 – Imagery and gridded data components
19107 – Spatial schema	19125 – Simple feature access
19108 – Temporal schema	19126 – Profile – FACC Data Dictionary
19109 – Rules for applications schema	19127 – Geodetic codes and parameters
19110 – Methodology for feature cataloguing	19128 – Web Map server interface
19111 – Spatial referencing by coordinates	19129 – Imagery, gridded and coverage data framework
19112 – Spatial referencing by geographical identifiers	19130 – Sensor and data models for imagery and gridded data
19113 – Quality principles	19131 – Data product specifications
19114 – Quality evaluation procedures	19132 – Location based services possible standards
19115 – Metadata	19133 – Location based services tracking and navigation
19116 – Positioning services	19134 – Multimodal location based services for routing and navigation
19117 – Portrayal	19135 – Procedures for registration of geographical information items
19118 – Encoding	19136 – Geography Markup Language
19119 – Services	19137 – Generally used profiles of the spatial schema and of similar important other schemas

# ISO TC211 19133



# NCHRP LRS Data Model



# Generalized Model for Location Referencing

Developed in 1998

Introduced at GIS-T '99, San Diego

Published for peer review in US and International,  
Civil and GIS Journals:

*Journal of Computing in Civil Engineering*, Jan '01

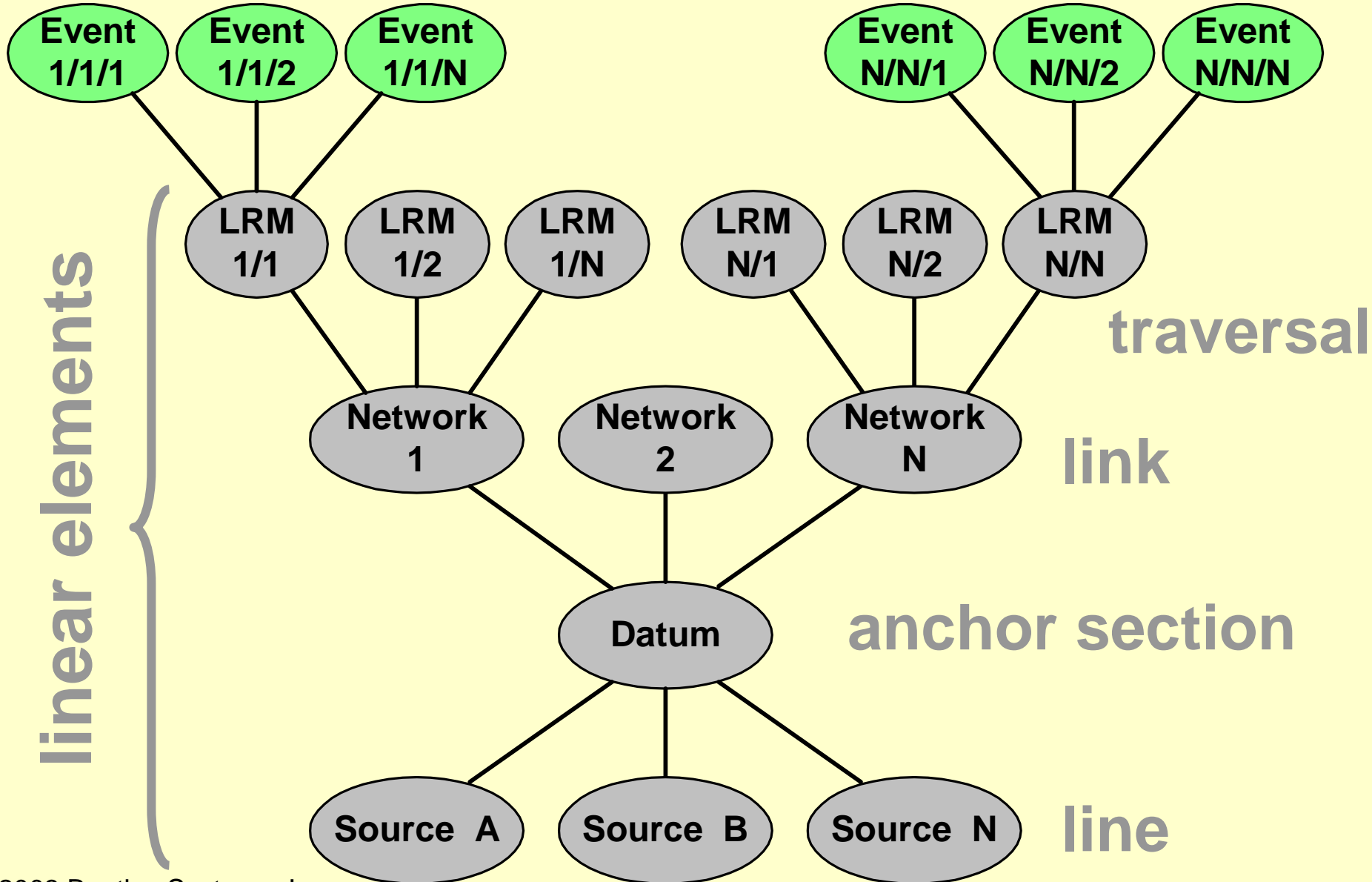
*Geoinformatica*, Mar '02

Implemented at Mn/DOT 2001-02

Commercial Product 2002

Pending ISO Standard (TC211 19133 DIS)

# Generalized Model



# Location Expression (LX)

$$\mathbf{LX = ( LRM, LE, DX )}$$

**LX = linear expression**

**LRM = Linear Referencing Method**

**LE = linear element**

**DX = distance expression**

# Locations

( **HOW**, **WHAT**, **Measure** )

( **LRM**, **Linear Element**, **Measure** )

( **MilePoint**, **Route: I-95**, **2.5** )

( **KilometerPoint**, **Route: I-95**, **4** )

( **Percentage**, **Link: Link 1034**, **50** )

( **Mile Post**, **Route: US-40**, **2 + .50** )

( **Reference Post**, **Route: I-95**, **2 + .400** )

( **County MilePoint**, **Route: I-95**, **©+1.8** )

( **Station**, **Alignment: Project 42**, **132+00** )

( **Address**, **Street: Smith Rd.**, **55** )

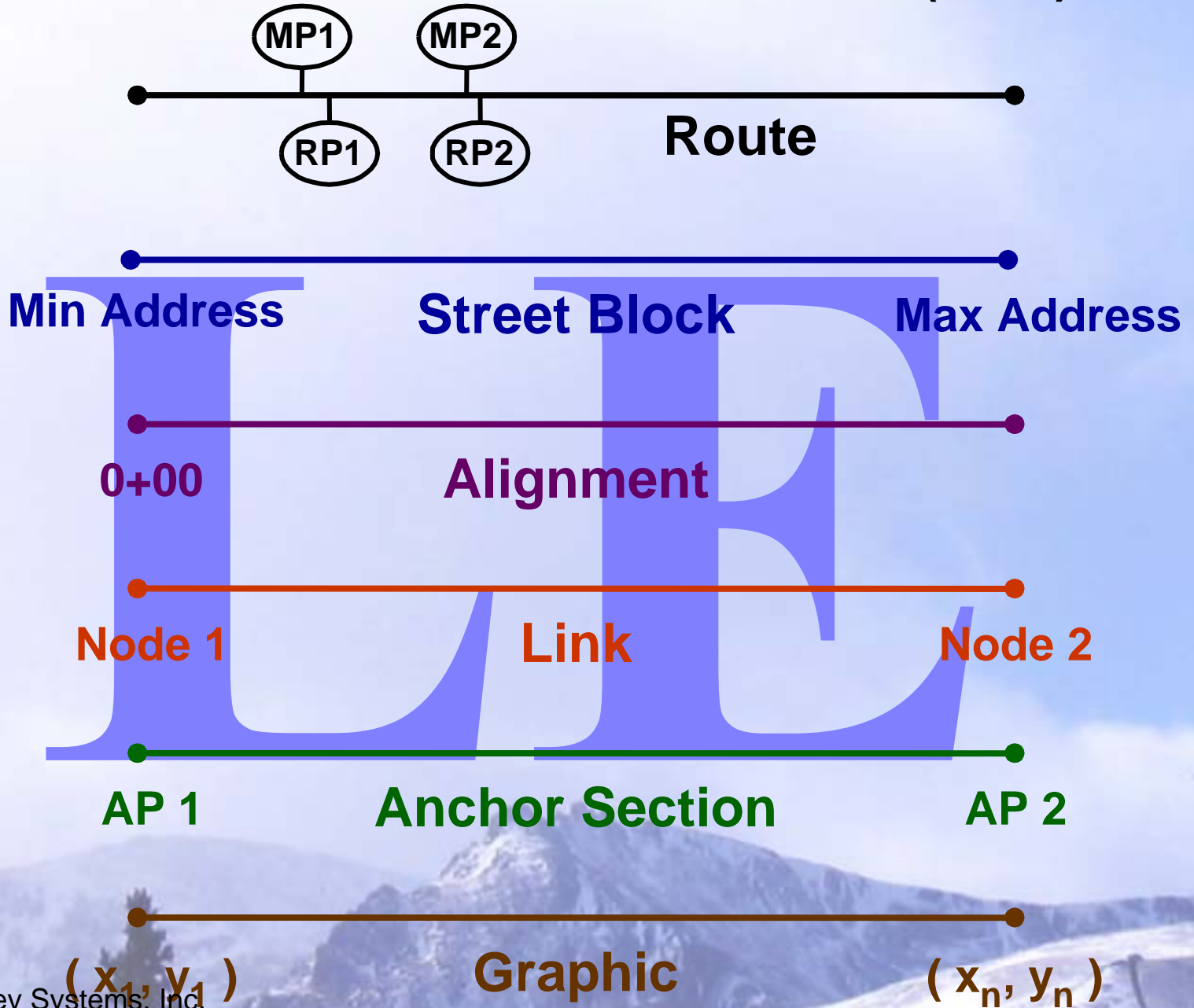


# Linear Reference Methods:

“a way  
to identify  
a specific  
location  
with  
respect to  
a known  
point”

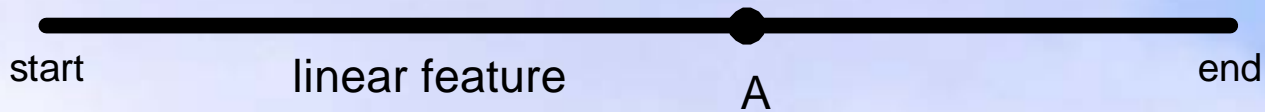
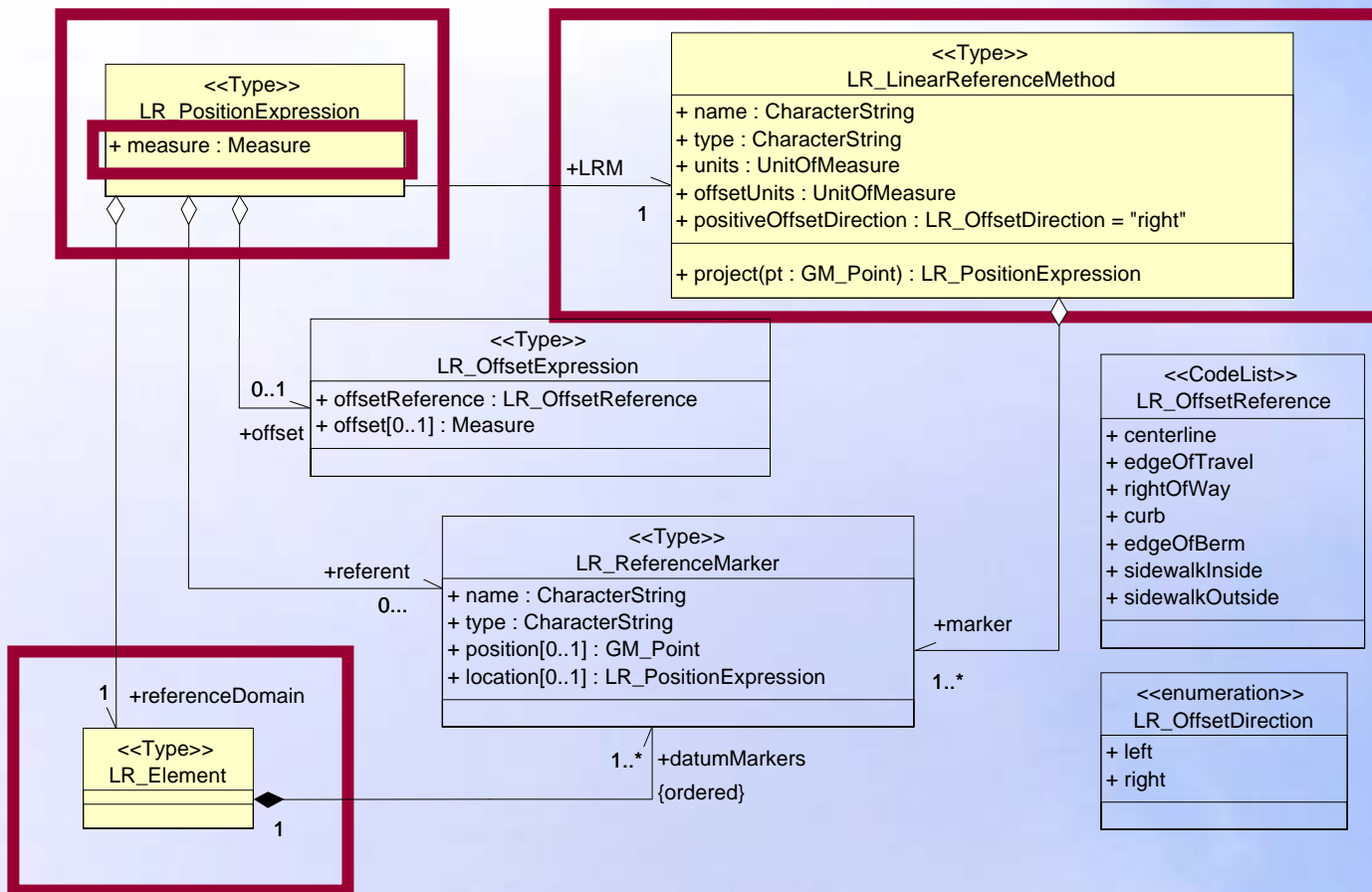
- **Absolute Distance**
  - MilePoint
  - MeterPoint
  - Percentage
- **Relative Distance**
  - MilePost
  - ReferencePost
  - County MilePoint
- **Other**
  - Stationing
  - Address

# Linear Elements (LE)

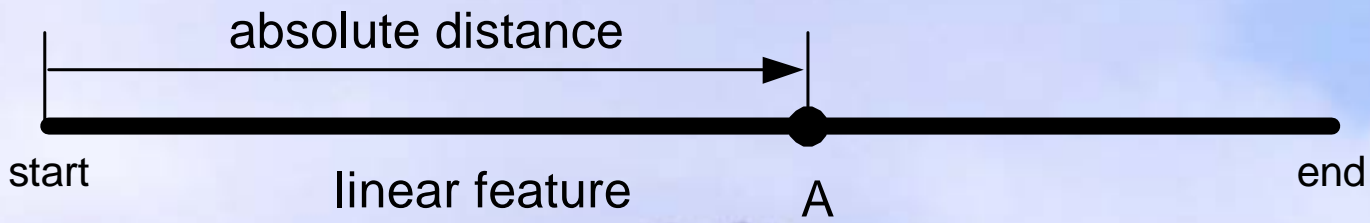
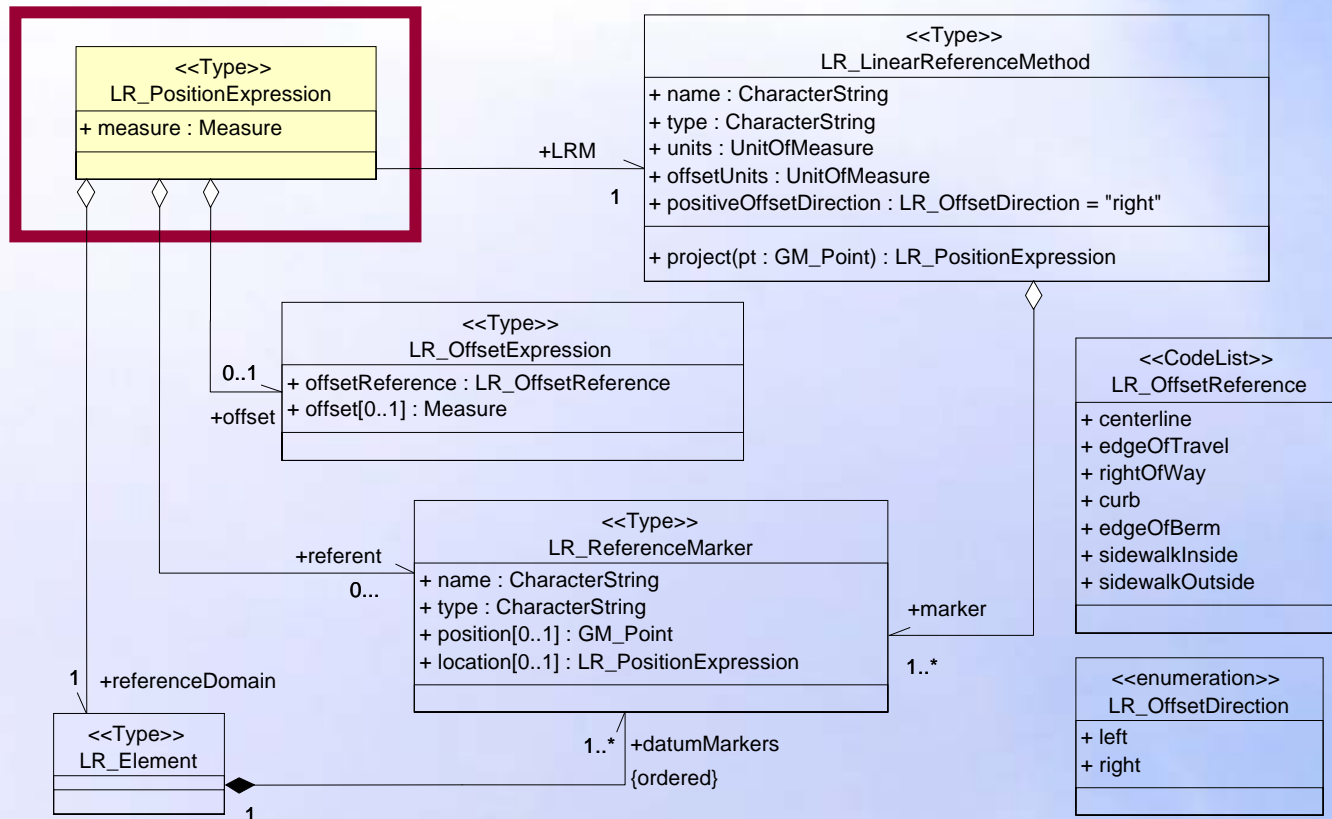


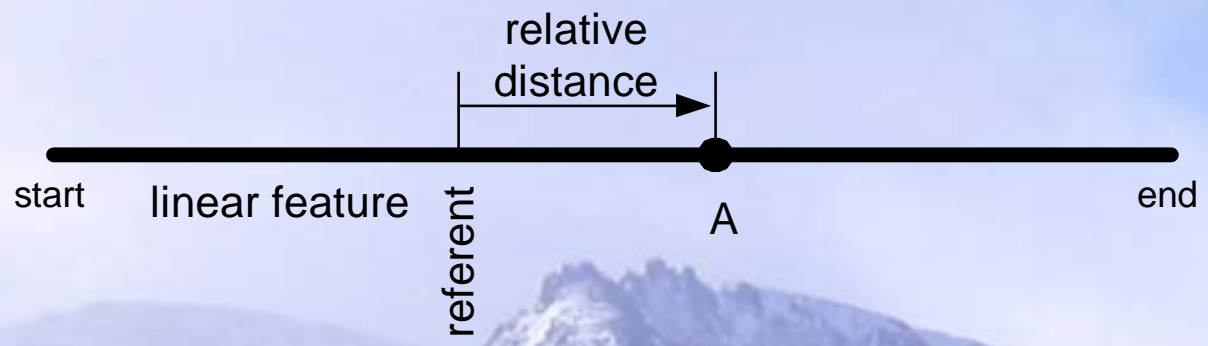
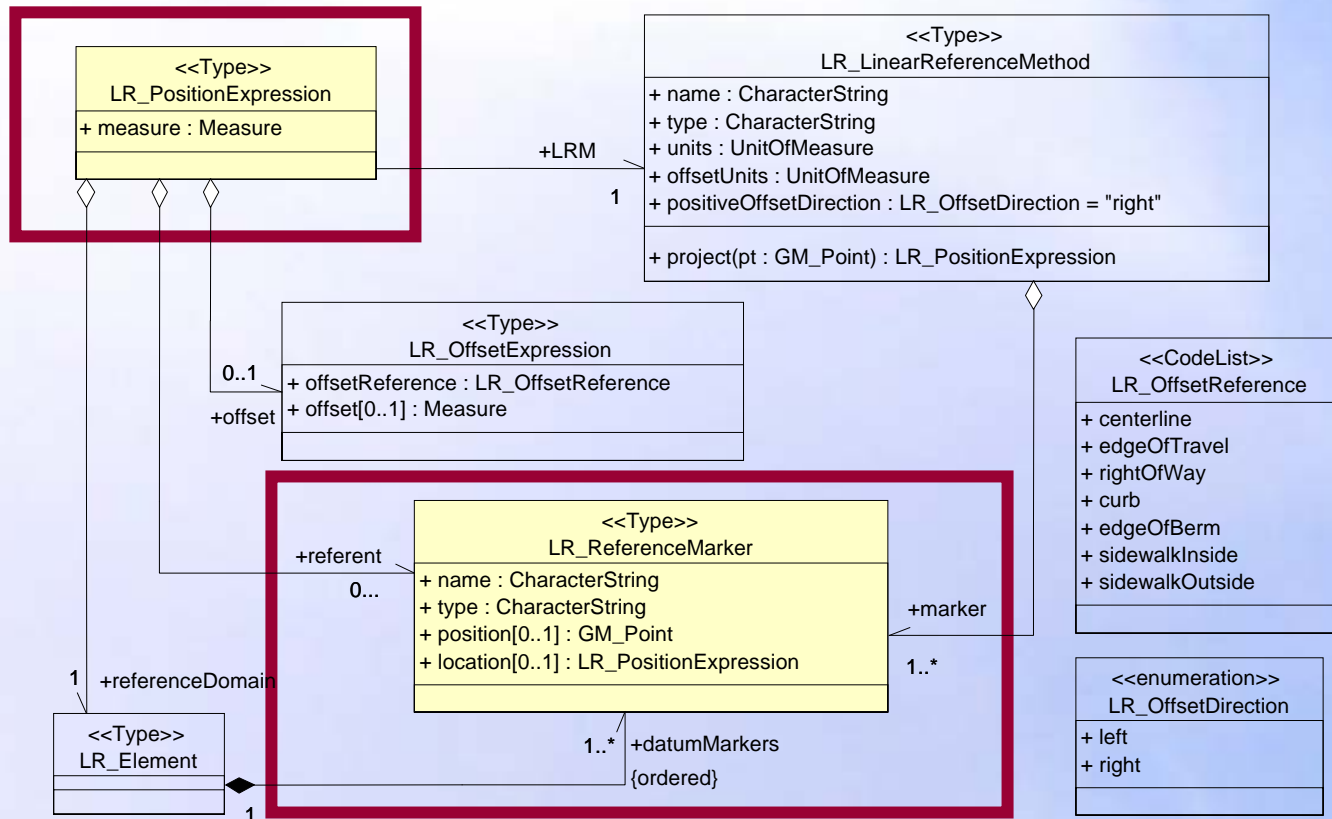
# Distance Expressions (DX)

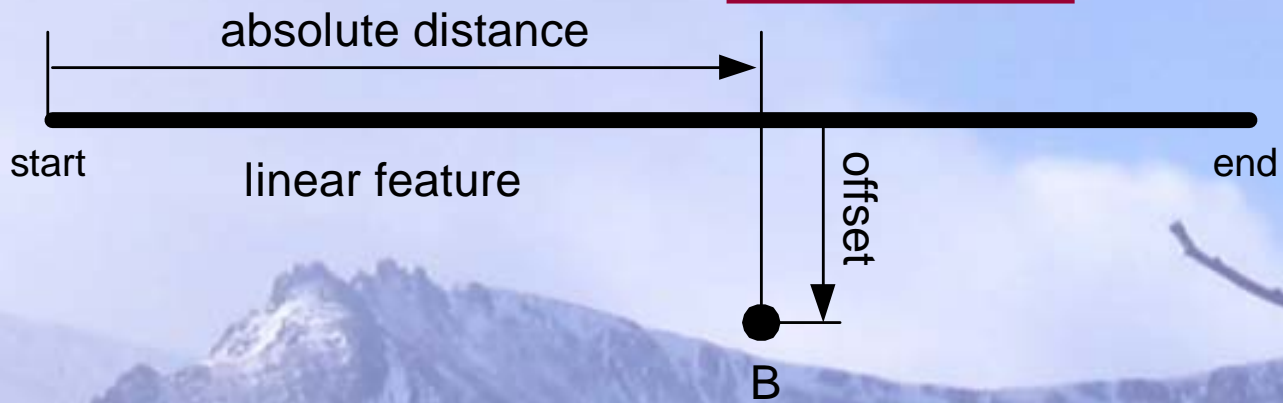
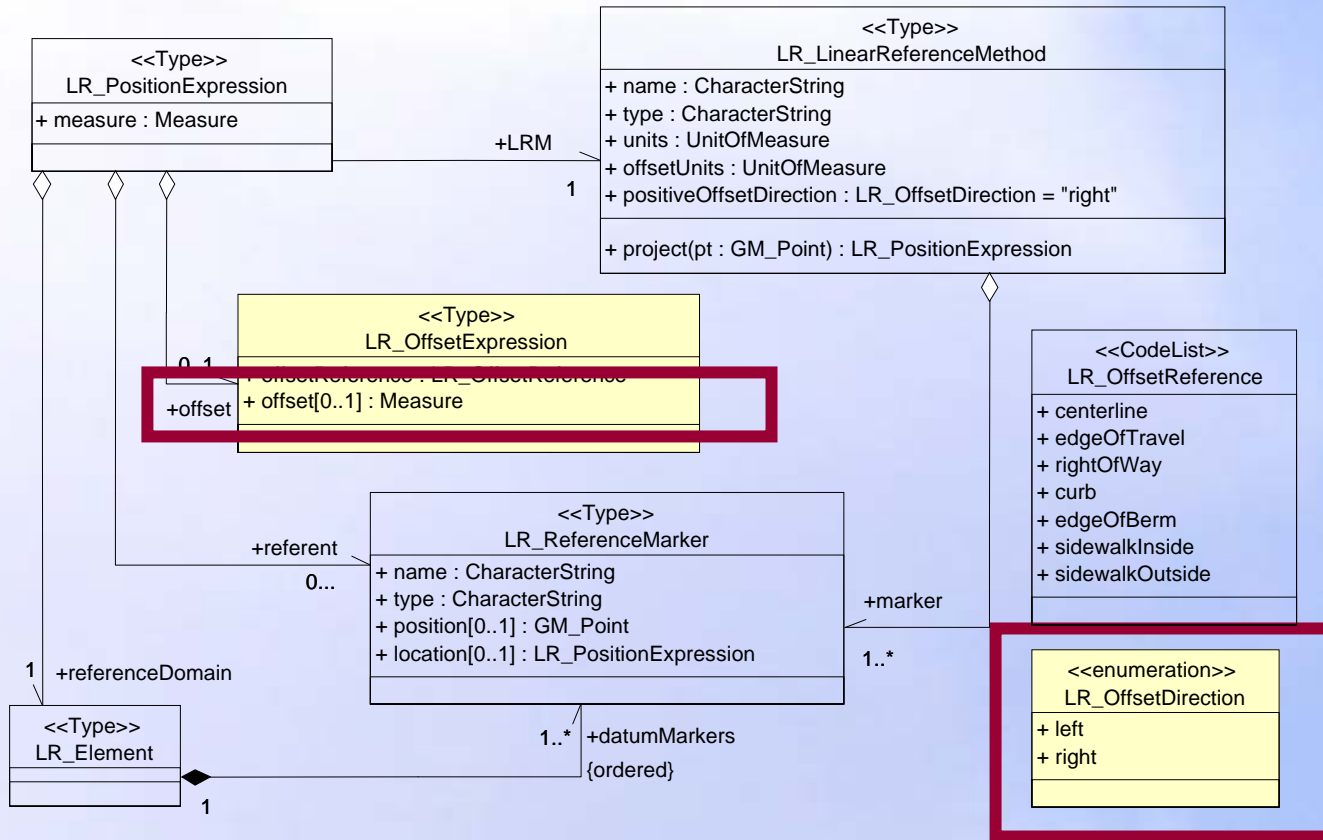
50%  
4 km  
2.5 miles  
55  
'A' 89+20  
© + 1.8 miles  
2 + .400  
2 + .50 miles  
132+00

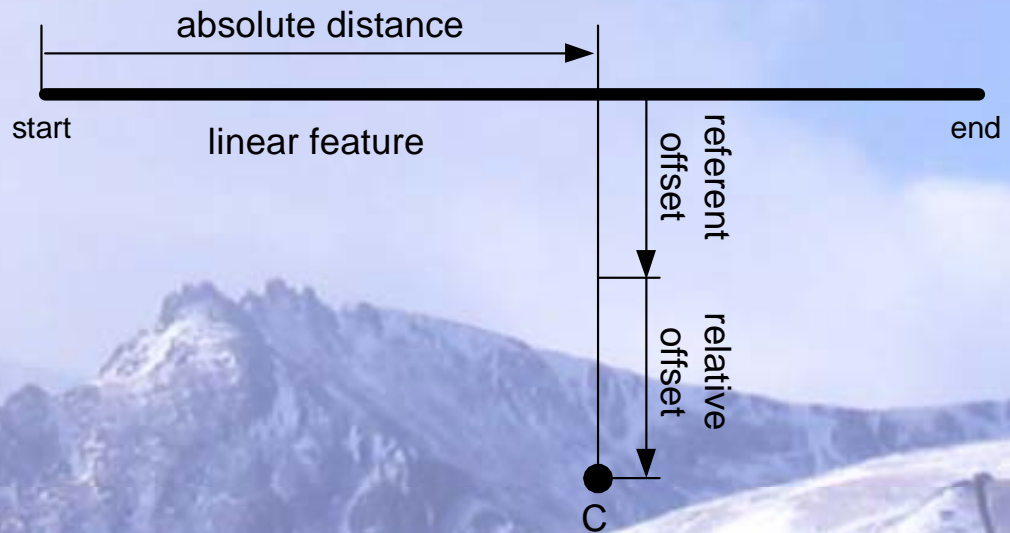
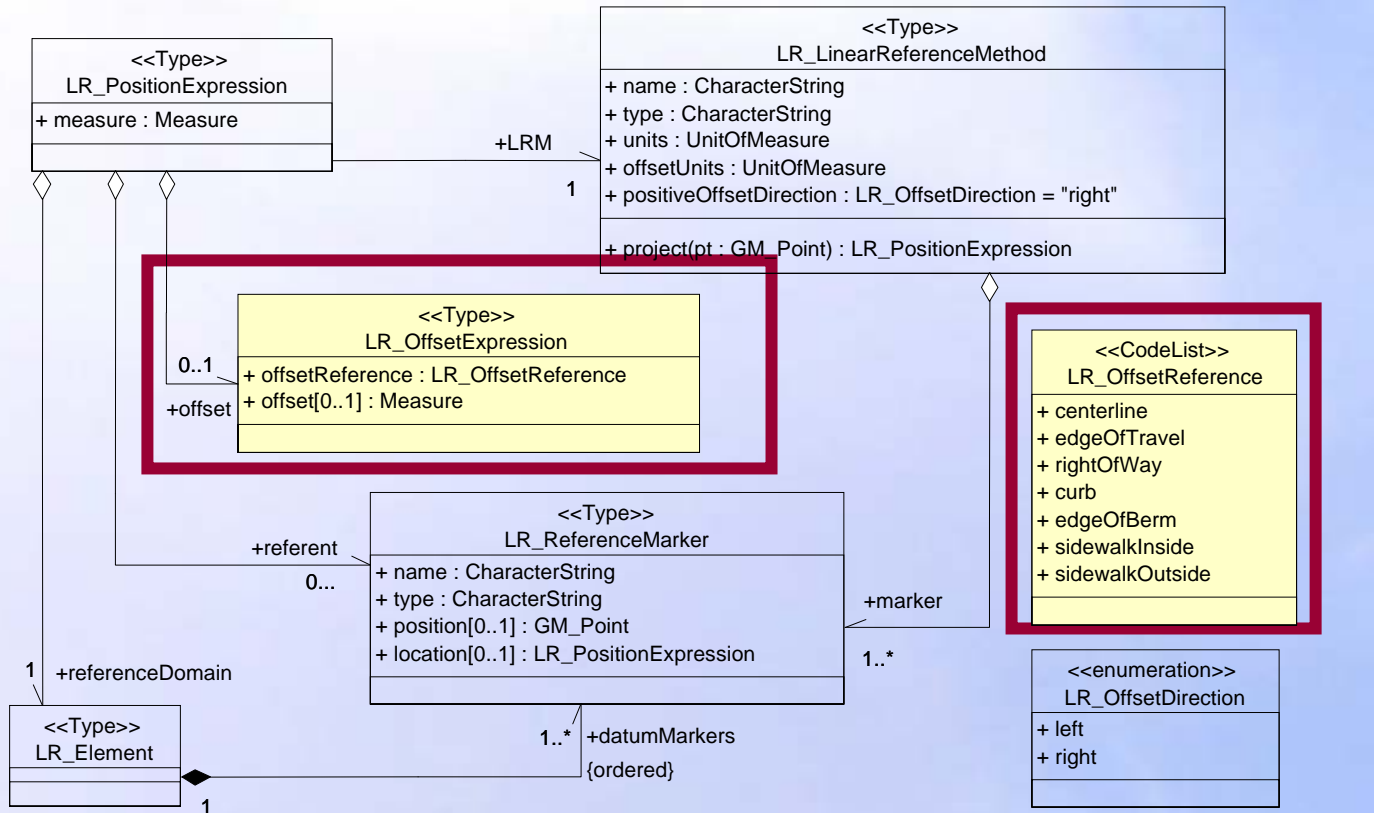


**Position Expression = ( LRM, Linear Element, Measure )**











# Summary

- ISO TC211 19133 has progressed to Draft International Standard (DIS)
- ANSI L1 submittal of Geospatial One-Stop
- Work continues in OGC, TC204 and SAE
- TransXML has just begun  
[www.TransXML.net](http://www.TransXML.net)
- For additional information:  
[paul.scarponcini@bentley.com](mailto:paul.scarponcini@bentley.com)