

### Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Abbreviated terms and UML notation
4.1	Abbreviated terms
4.2	UML notation
5	Conformance
5.1	Conformance overview
5.2	Conformance classes
5.2.1	General
5.2.2	Data type conformance
5.2.3	Operation conformance
6	Linear referencing
6.1	Background
6.1.1	Linear referencing concepts
6.1.1.1	General
6.1.1.2	Linear element
6.1.1.3	Linear Referencing Method (LRM)
6.1.1.4	Distance expression
6.1.1.4.1	Distance along
6.1.1.4.2	Referents
6.1.1.4.3	Offsets
6.1.1.5	Linearly located events
6.1.1.5.1	Feature and attribute events
6.1.1.5.2	Event location
6.1.1.5.3	Event time
6.1.1.6	Linear segmentation
6.1.2	Linear referencing packages
6.2	Package: Linear Referencing System
6.2.1	Semantics
6.2.2	PositionExpression
6.2.2.1	Semantics
6.2.2.2	Role: linearElement: LinearElement
6.2.2.3	Role: distanceExpression: DistanceExpression
6.2.2.4	Role: LRM: LinearReferencingMethod
6.2.3	LinearElement
6.2.3.1	Semantics
6.2.3.2	Attribute: linearElement: LinearElementType
6.2.4	LinearElementType
6.2.4.1	Semantics
6.2.5	ILinearElement
6.2.5.1	Semantics
6.2.5.2	Operation: defaultLRM
6.2.5.3	Operation: measure
6.2.5.4	Operation: translateToInstance
6.2.5.5	Operation: translateToType

- 6.2.6 IFeature
- 6.2.6.1 Semantics
- 6.2.6.2 Role: referent[0..\*]: Referent
- 6.2.7 ISpatial
- 6.2.7.1 Semantics
- 6.2.7.2 Operation: IrPosition
- 6.2.7.3 Operation: point
- 6.2.8 LinearReferencingMethod
- 6.2.8.1 Semantics
- 6.2.8.2 Attribute: name: CharacterString
- 6.2.8.3 Attribute: type: LRMTType
- 6.2.8.4 Attribute: units: UnitOfMeasure
- 6.2.8.5 Attribute: constraint[0..\*]: CharacterString
- 6.2.8.6 Attribute: positiveDistanceAlongDirection: DistanceAlongDirection = "same"
- 6.2.8.7 Attribute: measureMultiplier[0..1]: Number
- 6.2.9 DistanceAlongDirection
- 6.2.10 LRMTType
- 6.2.11 DistanceExpression
- 6.2.11.1 Semantics
- 6.2.11.2 Attribute: distanceAlong: Measure
- 6.2.11.3 Role: fromReferent[0..1]: Referent
- 6.2.12 Referent
- 6.2.12.1 Semantics
- 6.2.12.2 Attribute: name: CharacterString
- 6.2.12.3 Attribute: type: ReferentType
- 6.2.12.4 Attribute: position[0..1]: Point
- 6.2.12.5 Attribute: location[0..1]: PositionExpression
- 6.2.12.6 Attribute: restartValue[0..1]: ValueExpression
- 6.2.13 ReferentType
- 6.2.13.1 Semantics
- 6.2.14 ValueExpression
- 6.2.14.1 Semantics
- 6.2.14.2 Attribute: value: Measure
- 6.2.14.3 Role: LRM: LinearReferencingMethod
- 6.3 Package: Linear Referencing Towards Referent
- 6.3.1 Semantics
- 6.3.2 LRMWithTowardsReferent
- 6.3.2.1 Semantics
- 6.3.2.2 Attribute: type: LRMTType
- 6.3.3 DistanceExpression
- 6.3.3.1 Role: towardsReferent[0..1]: Referent
- 6.4 Package: Linear Referencing Offset
- 6.4.1 Semantics
- 6.4.2 LRMWithOffset
- 6.4.2.1 Semantics
- 6.4.2.2 Attribute: offsetUnits: UnitOfMeasure
- 6.4.2.3 Attribute: positiveLateralOffsetDirection: LateralOffsetDirection = "right"
- 6.4.2.4 Attribute: positiveVerticalOffsetDirection: VerticalOffsetDirection = "up"
- 6.4.3 LateralOffsetDirection
- 6.4.4 VerticalOffsetDirection
- 6.4.5 LateralOffsetDistanceExpression
- 6.4.5.1 Semantics
- 6.4.5.2 Role: lateralOffsetExpression[0..1]: LateralOffsetExpression
- 6.4.5.3 Role: verticalOffsetExpression[0..1]: VerticalOffsetExpression
- 6.4.6 LateralOffsetExpression
- 6.4.6.1 Semantics
- 6.4.6.2 Attribute: offsetLateralDistance[0..1]: Measure
- 6.4.6.3 Attribute: lateralOffsetReferent[0..1]: LateralOffsetReferent
- 6.4.7 LateralOffsetReferent
- 6.4.8 VerticalOffsetExpression
- 6.4.8.1 Semantics
- 6.4.8.2 Attribute: offsetVerticalDistance[0..1]: Measure
- 6.4.8.3 Attribute: verticalOffsetReferent[0..1]: VerticalOffsetReferent
- 6.4.9 VerticalOffsetReferent

- 6.4.10 **ICrossSectionalConvention**
- 6.4.10.1 **Semantics**
- 6.4.10.2 **Attribute: name: CharacterString**
- 6.4.10.3 **Role: childXSConventionPart: ICrossSectionalConventionPart**
- 6.4.11 **ICrossSectionalConventionPart**
- 6.4.11.1 **Semantics**
- 6.4.11.2 **Attribute: name: CharacterString**
- 6.4.11.3 **Role: owningXSConvention: ICrossSectionalConvention**
- 6.4.11.4 **Role: nestedXSConventionPart: ICrossSectionalConventionPart**
- 6.4.11.5 **Role: owningXSConventionPart: ICrossSectionalConventionPart**
- 6.5 **Package: Linear Referencing Offset Vector**
- 6.5.1 **Semantics**
- 6.5.2 **VectorOffsetDistanceExpression**
- 6.5.2.1 **Semantics**
- 6.5.2.2 **Role: vectorOffsetExpression[0..1]: VectorOffsetExpression**
- 6.5.3 **VectorOffsetExpression**
- 6.5.3.1 **Semantics**
- 6.5.3.2 **Attribute: offsetVector: Vector**
- 6.5.3.3 **Attribute: vectorCRS[0..1]: CRS**
- 6.6 **Package: Linearly Located Event**
- 6.6.1 **Semantics**
- 6.6.2 **Linearly located event**
- 6.6.2.1 **Semantics**
- 6.6.3 **Event**
- 6.6.3.1 **Semantics**
- 6.6.3.2 **Attribute: eventName: CharacterString**
- 6.6.3.3 **Attribute: location[1..\*]: EventLocation**
- 6.6.3.4 **Attribute: time[0..1]: EventTime**
- 6.6.3.5 **Role: linearElement: LinearElement**
- 6.6.4 **AttributeEvent**
- 6.6.4.1 **Semantics**
- 6.6.4.2 **Attribute: value[0..1]: ANY**
- 6.6.4.3 **Role: attributedFeature: IFeature**
- 6.6.5 **FeatureEvent**
- 6.6.5.1 **Semantics**
- 6.6.5.2 **Role: locatedFeature: IFeature**
- 6.6.6 **EventLocation**
- 6.6.7 **AtLocation**
- 6.6.7.1 **Semantics**
- 6.6.7.2 **Attribute: atPosition: DistanceExpression**
- 6.6.7.3 **Attribute: overridingAtLRM: LinearReferencingMethod [0..1]**
- 6.6.8 **FromToLocation**
- 6.6.8.1 **Semantics**
- 6.6.8.2 **Attribute: fromPosition: DistanceExpression**
- 6.6.8.3 **Attribute: overridingFromLRM: LinearReferencingMethod [0..1]**
- 6.6.8.4 **Attribute: overridingToLRM: LinearReferencingMethod [0..1]**
- 6.6.8.5 **Attribute: toPosition: DistanceExpression**
- 6.6.9 **EventTime**
- 6.6.10 **EventInstant**
- 6.6.10.1 **Semantics**
- 6.6.10.2 **Attribute: atTime: TM\_Instant**
- 6.6.11 **EventPeriod**
- 6.6.11.1 **Semantics**
- 6.6.11.2 **Attribute: duration: TM\_Period**
- 6.7 **Package: Linear Segmentation**
- 6.7.1 **Semantics**
- 6.7.2 **SegmentableFeature**
- 6.7.2.1 **Semantics**
- 6.7.2.2 **Operation: segment**
- 6.7.2.3 **Role: resultantLinearSegmentSet[0..\*]: LinearSegmentSet**
- 6.7.3 **LinearSegmentSet**
- 6.7.3.1 **Semantics**
- 6.7.3.2 **Attribute: eventName[1..\*]: CharacterString**
- 6.7.3.3 **Role: linearElement: LinearElement**

- 6.7.3.4 Role: segmentedFeature: SegmentableFeature
- 6.7.3.5 Role: linearSegment[1..\*]: LinearSegment
- 6.7.4 LinearSegment
- 6.7.4.1 Semantics
- 6.7.4.2 Attribute: startFeatureLocation: DistanceExpression
- 6.7.4.3 Attribute: endFeatureLocation: DistanceExpression
- 6.7.4.4 Attribute: segmentingAttributeValue[1..\*]: Record
- 6.7.4.5 Role: owningLinearSegmentSet: LinearSegmentSet

#### Annex A (normative) Abstract test suite

- A.1 Data types
  - A.1.1 Data types for Linear Referencing System
  - A.1.2 Data types for Linear Referencing Towards Referent
    - A.1.2.1 Linear Referencing System
    - A.1.2.2 Linear Referencing Towards Referent
  - A.1.3 Data types for Linear Referencing Offset
    - A.1.3.1 Linear Referencing System
    - A.1.3.2 Linear Referencing Offset
  - A.1.4 Data types for Linear Referencing Offset Vector
    - A.1.4.1 Linear Referencing System
    - A.1.4.2 Linear Referencing Offset
    - A.1.4.3 Linear Referencing Offset Vector
  - A.1.5 Data types for Linearly Located Event
    - A.1.5.1 Linear Referencing System
    - A.1.5.2 Linearly Located Event
  - A.1.6 Data types for Linear segmentation
    - A.1.6.1 Linear Referencing System
    - A.1.6.2 Linearly Located Event
    - A.1.6.3 Linear segmentation
- A.2 Operations
  - A.2.1 Operations for Linear Referencing System
  - A.2.2 Operations for Linear Referencing Towards Referent
    - A.2.2.1 Linear Referencing System
    - A.2.2.2 Linear Referencing Towards Referent
  - A.2.3 Operations for Linear Referencing Offset
    - A.2.3.1 Linear Referencing System
    - A.2.3.2 Linear Referencing Offset
  - A.2.4 Operations for Linear Referencing Offset Vector
    - A.2.4.1 Linear Referencing System
    - A.2.4.2 Linear Referencing Offset
    - A.2.4.3 Linear Referencing Offset Vector
  - A.2.5 Operations for Linearly Located Event
    - A.2.5.1 Linear Referencing System
    - A.2.5.2 Linearly Located Event
  - A.2.6 Operations for Linear segmentation
    - A.2.6.1 Linear Referencing System
    - A.2.6.2 Linearly Located Event
    - A.2.6.3 Linear segmentation

#### Annex B (informative) Generalized Model for Linear Referencing

- B.1 Overview
- B.2 Location expression
- B.3 Linear element
- B.4 Linear referencing method (LRM)
- B.5 Distance expression
- B.6 Offset expression
- B.7 Translation

#### Annex C (informative) Commonly used linear referencing methods and models

- C.1 Overview
- C.2 Absolute LRMs
  - C.2.1 General
  - C.2.2 Milepoint
  - C.2.3 True mileage

- C.2.4 Kilometre-point
- C.2.5 Chainage
- C.2.6 Hectometre-point
- C.2.7 Reverse milepoint and kilopoint
- C.2.8 Link offset
- C.2.9 Milepoint with lateral offsets in feet
- C.3 Relative LRMs
- C.3.1 General
- C.3.2 Milepost
- C.3.3 Kilopost
- C.3.4 Kilometre-post
- C.3.5 Reference post
- C.3.6 County milepoint
- C.3.7 Cross street
- C.3.8 Control section
- C.3.9 Measures with uneven distribution
- C.4 Interpolative LRMs
- C.4.1 General
- C.4.2 Percentage
- C.4.3 Normalized
- C.5 Other linear referencing information
- C.5.1 NCHRP 20#27(2) model
- C.5.2 OGC LandInfra — Alignment requirements
- C.5.3 OGC InfraGML 1.0: Part 3 — Alignment model
- C.5.4 IFC 4.1 Alignment model
- C.5.5 Cross-sectional positioning (XSP)

**Annex D (informative) Application Schema example**

- D.1 Overview
- D.2 Package: Application Schema
- D.2.1 LR\_Feature
- D.2.1.1 Semantics
- D.2.2 LR\_Curve
- D.2.2.1 Semantics
- D.2.3 LR\_DirectedEdge
- D.2.3.1 Semantics

**Annex E (informative) Event and segmentation examples**

- E.1 Linearly located feature event example
- E.2 Linearly located attribute event example
- E.3 Secondary LRSS
- E.4 Linear segmentation example

**Annex F (informative) Backwards compatibility with ISO 19148:2012**

Page count: 99