附录 B

下面是面向导航应用的语义增强型多层室内导航数据表示机制的 UML 部分数据字典示例。

（1）NavIndoorFeatures

Section	Content
Name	NavIndoorFeatures
Definition	IndoorFeatures 扩展体；除 layers:ThematicLayer 外，允许挂载语义注释层（设施/信息）
Super classes	IndoorFeatures
Aggregation(Role → Class [Card])	layers→ThematicLayer [1..]（继承）annotationLayers→ NavAnnotationLayer [0..]interLayerConnections → InterLayerConnection [0..*]（继承）
Properties	—
Constraints (ID → Constraint)	—

（2）NavAnnotationLayer(abstract)

Section	Content
Name	NavAnnotationLayer
Definition	非几何/拓扑主题层；把设施与信息锚定到既有拓扑（Cell/Node/Edge/State/Transition）。
Super classes	GML AbstractFeature
Aggregation(Role → Class [Card])	members → Facility | StaticInfo | DynamicInfo [0..]anchors {derived} → CellSpace | Node | Edge | State | Transition [0..]
Properties	theme→ NavAnnotationTheme {Facility, Information} [1..1]
Constraints (ID → Constraint)	sne/ann-anchors-derived → anchors = (members.locatedAt ∪ members.target)sne/ann-same-container → (members ∪ anchors) SHALL belong to the same IndoorFeatures as this layer.sne/ann-member-has-target →

Section	Content
	Facility MUST have locatedAt; StaticInfo/DynamicInfo MUST have non-empty target.

（3）SpatialLayoutLayer

Section	Content
Name	SpatialLayoutLayer
Definition	ThematicLayer 的语义化特化：Primal 仅包含“空间区域/通行区域/功能区域”的 CellSpace，Dual用Node/Edge 表达连通，用于路径推理。
Super classes	IndoorFeatures
Aggregation(Role → Class [Card])	layers → ThematicLayer [1..]（继承）annotationLayers → NavAnnotationLayer [0..]interLayerConnections → InterLayerConnection [0..*]（继承）
Properties	semanticExtension → Boolean [1..1]（继承）theme → ThemeLayerValue = SpatialLayout [1..1]
Constraints (ID → Constraint)	sne/layout-primal-types → primalSpace.cellSpaceMember ⊆{SpaceRegion,AccessRegion,FunctionRegion}.sne/layout-dual-scope→若存在 dualSpace，其 Node/Edge 必须满足IndoorGML 规则；每个 Node.duality 指向本 primalSpace 中的某个 CellSpace。sne/layout-mincells → 若存在 primalSpace，其 cellSpaceMember 数量 ≥ 1。

（4）SpaceRegion

Section	Content
Name	SpaceRegion
Definition	表示室内“空间区域”单元（如商铺、中庭、休息区等）。
Super classes	CellSpace
Aggregation(Role → Class [Card])	—
Properties	category → SpaceRegionType {shopArea, atriumArea, restArea, restroomArea?} [0..1](如采用“卫生间=功能区域”，可不使用restroomArea)
Constraints (ID → Constraint)	—

（5）FunctionRegion

Section	Content
Name	FunctionRegion
Definition	表示室内“功能区域”单元（如卫生间、后勤区、母婴室等）。
Super classes	CellSpace
Aggregation (Role → Class [Card])	serviceFor → SpaceRegion [0..*]
Properties	functionType → FunctionRegionType {restroom, backOffice, nursingRoom, lounge} [1..1]
Constraints (ID → Constraint)	—

（6）AccessRegion

Section	Content
Name	AccessRegion
Definition	表示“通行区域”单元；包含水平流动空间（走廊/过道/门厅）与垂直交通落地空间（电梯/楼 梯/扶梯的 Lobby/Landing）。门/入口/出口的通行规则通过 InformationLayer 绑定到 Edge/CellBoundary/Node。
Super classes	CellSpace
Aggregation (Role → Class [Card])	—
Properties	accessType → AccessRegionType {corridor, doorwayHall, elevatorLobby, stairLanding, escalatorLanding} [1..1]
Constraints (ID → Constraint)	—

说明：垂直交通系统通过“各层 Landing/Lobby（AccessRegion）+Node/Edge 跨层连接”表达；出入口/门 作为边界/通道更贴合 IndoorGML，因此其“状态、权限、仅出/仅入”等属性建议绑定到 Edge（或 CellBoundary / Node）。

（7）Facility (abstract)

Section	Content
Name	Facility (abstract)

Section	Content
Definition	导航相关的设施实体（空间/服务/安全/定位）；位于某处并可作用于若干空间或拓扑元素 （如指示牌指向多目标、摄像头覆盖一段走廊边）。
Super classes	GML AbstractFeature
Aggregation (Role → Class [Card])	locatedAt → CellSpace | Node | Edge | State | Transition [1..1]appliesTo → CellSpace | Node | Edge | State | Transition [0..*]
Properties	status → OperationalStatus [0..1]brand → CharacterString [0..1]serviceHours → TM_Period [0..1]geom → GM_Point [0..1]
Constraints (ID → Constraint)	sne/fac-same-container → locatedAt 与任一appliesTo 必须属于同一IndoorFeatures。sne/fac-geom-within (optional)→若 geom 与 locatedAt几何均存在，则 geom 应位于 locatedAt几何内。

Subclasses（含 POI）：

- SpaceFacility(POI)：category:POICategory[0..1](如“口腔 30 诊室”、“特步专卖店”、“A 区 1 号车位”等)。
- ServiceFacility：serviceType: ServiceType [0..1] (母婴室设备、信息终端等)。
- SafetyFacility：safetyType: SafetyType [0..1], coverage: GM_Object [0..1] (消防、监控、应急照明等)。
- PositioningFacility：tech: PositioningTech [1..1], txPower: Real[0..1],coverage: GM_Object [0..1]BLE/Wi-Fi/UWB 信标等；业务上服务通行场景，模型上仍为“设施”)

（8）InformationLayer

Section	Content
Name	InformationLayer
Definition	把“静态信息（商铺信息等）”与“动态信息（通行权限、设备状态、人流量等）”绑定到空间或拓扑元素的注释层。
Super classes	NavAnnotationLayer

Section	Content
Aggregation (Role → Class [Card])	staticInfoMember → StaticInfo [0..]dynamicInfoMember → DynamicInfo [0..]
Properties	theme → Information [1..1]（常量）dataSource → CharacterString [0..*]updatePolicy → CharacterString [0..1]
Constraints (ID → Constraint)	sne/info-anchored → 所有 StaticInfo/DynamicInfo 的 target ⊆ anchors。 sne/info-time-valid → 若 validFor 存在，则 observedAt ∈ validFor。

（9）StaticInfo

Section	Content
Name	StaticInfo
Definition	长期稳定的属性信息（品牌、房间号、营业时间、门类/边类型等）。
Super classes	GML AbstractFeature
Aggregation (Role → Class [Card])	target → SpaceRegion | AccessRegion | FunctionRegion | Facility | Node | Edge | State | Transition [1..*]
Properties	key → CharacterString [1..1]value → CharacterString [1..*]validFrom → DateTime [0..1]validTo → DateTime [0..1]
Constraints (ID → Constraint)	sne/static-valid →若 validFrom 与 validTo 同时存在，则 validFrom≤validTo。

（10）DynamicInfo

Section	Content
Name	DynamicInfo
Definition	短期可变/实时信息（人流密度、排队时间、通行权限/仅出仅入、设施状态、促销活动等）。
Super classes	GML AbstractFeature
Aggregation (Role → Class [Card])	target → SpaceRegion | AccessRegion | FunctionRegion | Facility | Node | Edge | State | Transition [1..*]
Properties	type → DynamicInfoType [1..1] (occupancy, queueTime, accessPolicy, status, promotion ...)value → Record | Literal [1..*]observedAt → DateTime [1..1]validFor → TM_Period [0..1]source → CharacterString [0..1]
Constraints (ID → Constraint)	sne/dyn-valid → 若 validFor 存在，则 observedAt ∈ validFor。

（11）Derived Relations（派生关系，用于查询/导航）

Relation	Domain → Range	Note
LocatedAt	Facility → CellSpace|Node|Edge |State|Transition	设施“位于”关系
Contains	SpaceRegion | FunctionRegion → Facility (POI)	区域“包含”兴趣点/设施
IsConnectedTo	CellSpace ↔ CellSpace	由 DualSpace 的 Edge.connects (NodeA,NodeB)派生
IsReachableBy	Facility × Edge* → Facility	基于 Node/Edge 图的可达性
IsAdjacentTo	CellSpace ↔ CellSpace	几何/拓扑邻接；可由共享 CellBoundary 推导
DependsOn	SpaceRegion → AccessRegion	空间区域对通行区域的依赖（例：店铺依赖主走廊）
Services	FunctionRegion → SpaceRegion	功能区域为空间区域提供服务（例：卫生间→周边店铺）

A Enumrations（节选）

- SpaceRegionType = { shopArea, atriumArea, restArea, restroomArea }
- FunctionRegionType = { restroom, backOffice, nursingRoom, lounge }
- AccessRegionType = { corridor, doorwayHall, elevatorLobby, stairLanding, escalatorLanding}
- POICategory,ServiceType,SafetyType,PositioningTech,DynamicInfoType,OperationalStatus = extensible code lists