

Data Model for Autonomous Buildings

Interoperability, AI Readiness, and
Low Touch Digital Twin Onboarding
within Siemens Building X

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Head of Building X Data Model



Buildings need to transition towards the future



Sustainable

Autonomous

Profitable

What does it mean for your buildings?



Sustainable

Energy & Sustainability

- Energy & Power Monitoring
- Decarbonization KPIs & Roadmaps
- Compliance Demonstrability



Autonomous

Space & Workplace

- Prediction of Optimal Indoor Conditions
- AI-based Automation of HVAC Systems
- Occupancy Tracking & Space Optimization

Safety & Security

- Visitor Management & Control
- Fire Systems Monitoring & Testing
- Incident & Alarm Management



Profitable

Asset & Maintenance

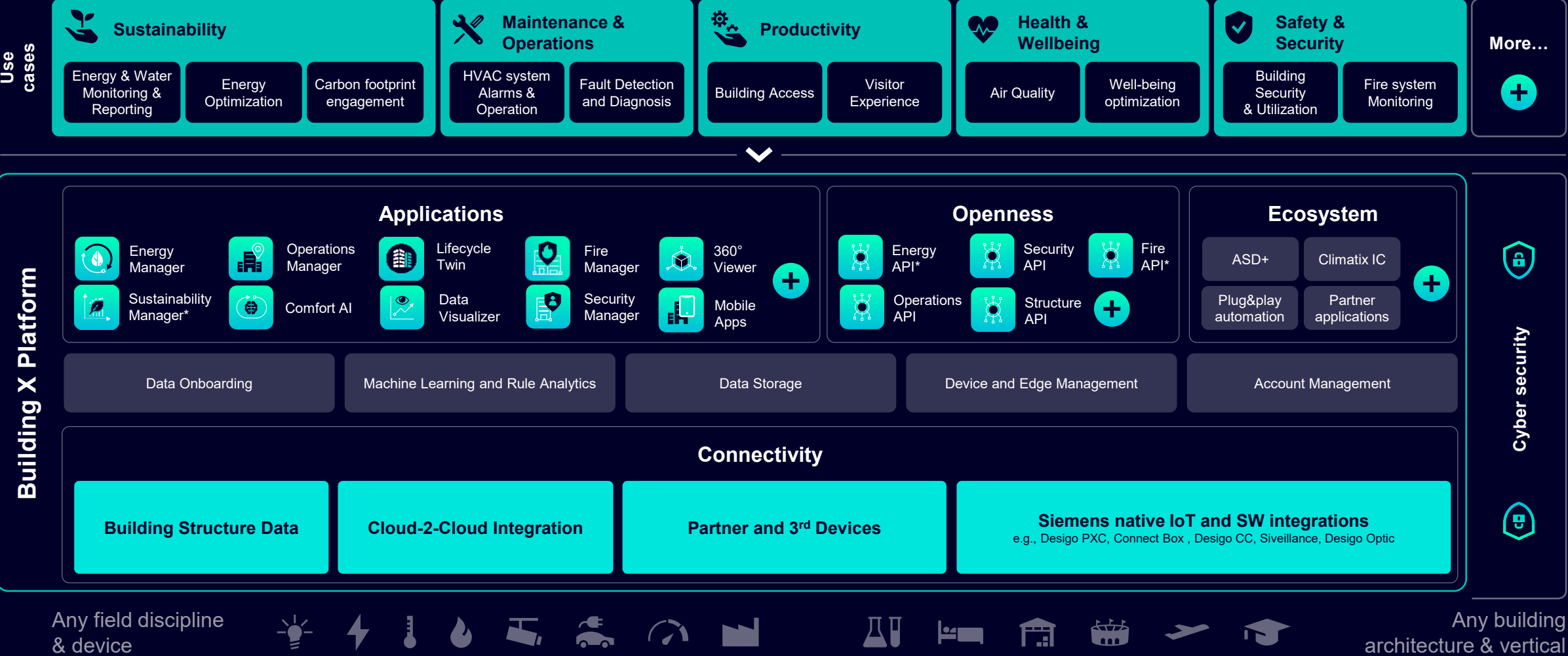
- Critical Spaces Monitoring & Control
- Alarms & Events Management
- Fault Detection & Diagnostics

Building Management

- Holistic Operational Dashboards
- Remote Monitoring & Control
- Automated Reporting

Building X

A digital platform that digitalizes, manages, and optimizes building operations.

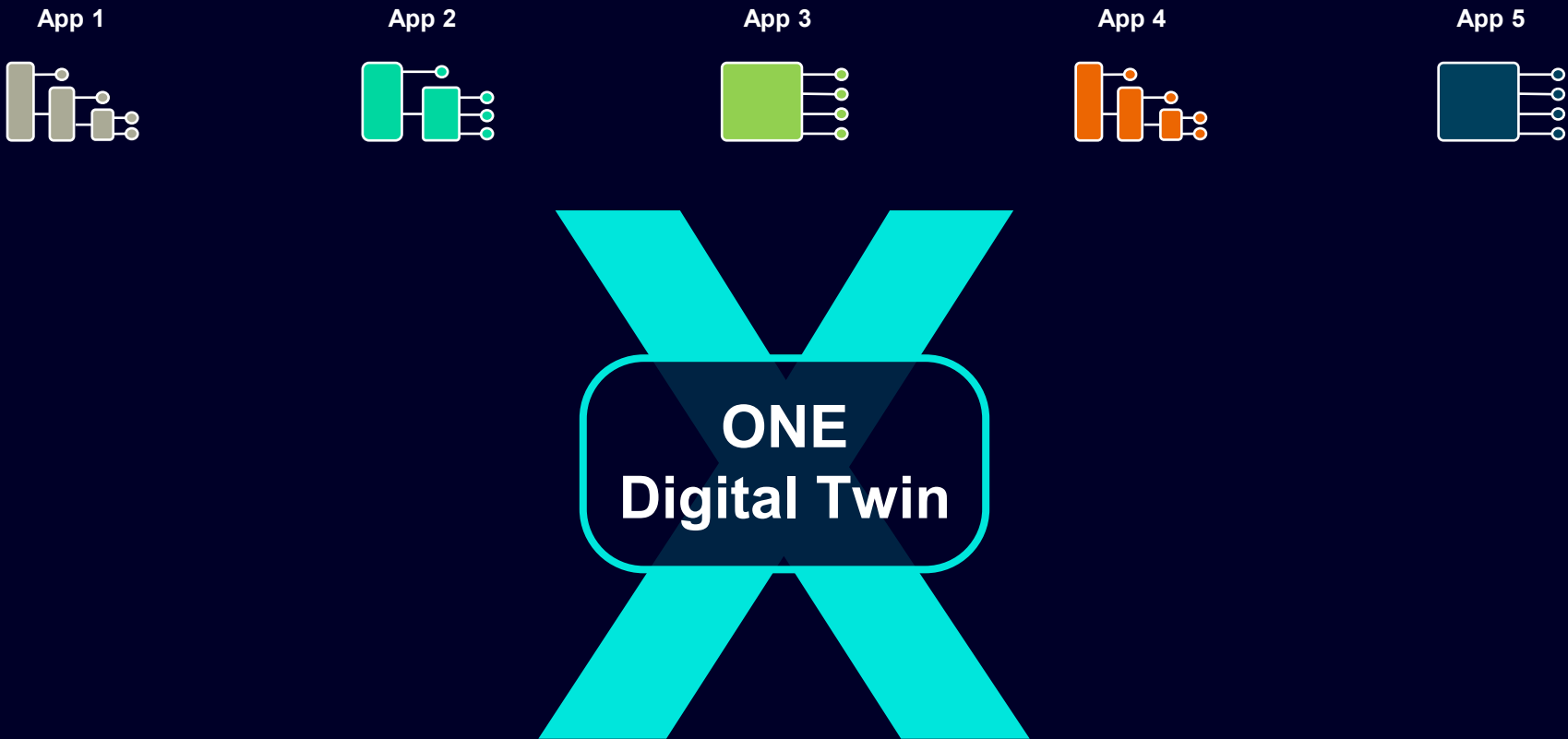


BuildingX

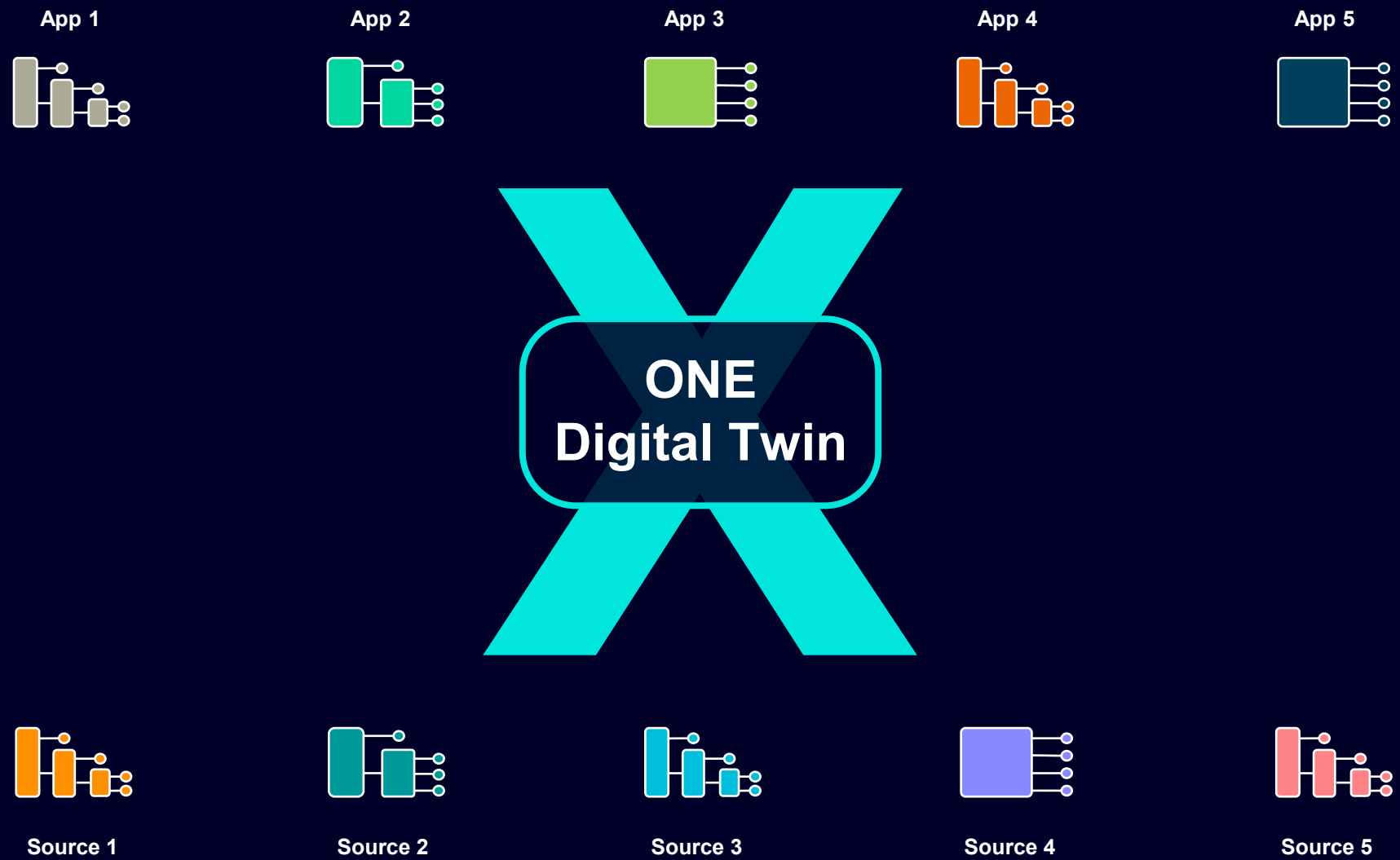
Accurate Digital Twins: Prerequisite for Intended Real-World Behavior & Powerful Functionality



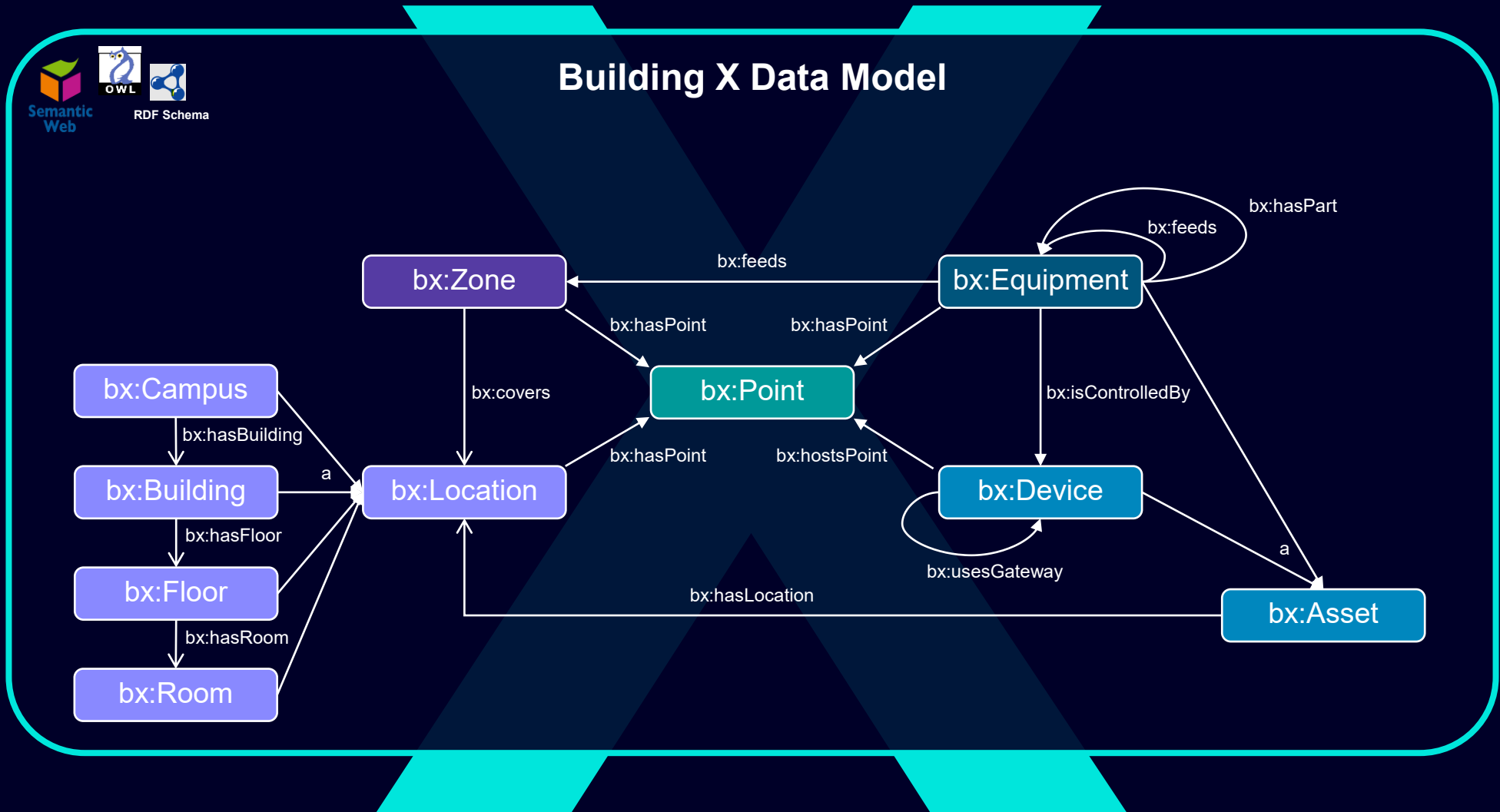
One Twin, Many Demands: The North-Bound Challenge of Varied Data Structure Expectations



One Twin, Many Data Sources: The South-Bound Challenge of Unifying Disparate Data Sources



The Building X Data Model: The Unified Common Semantic Language



The Industrial Data Ontology (IDO): The Semantic Anchor for the Building X Data Model



Building X Data Model

Building X IDO Integration Module (Snippets)

```
bx:feeds rdfs:subPropertyOf lis:connectedTo .
```

```
bx:GeoPoint rdfs:subClassOf lis:PointInSpace .
```

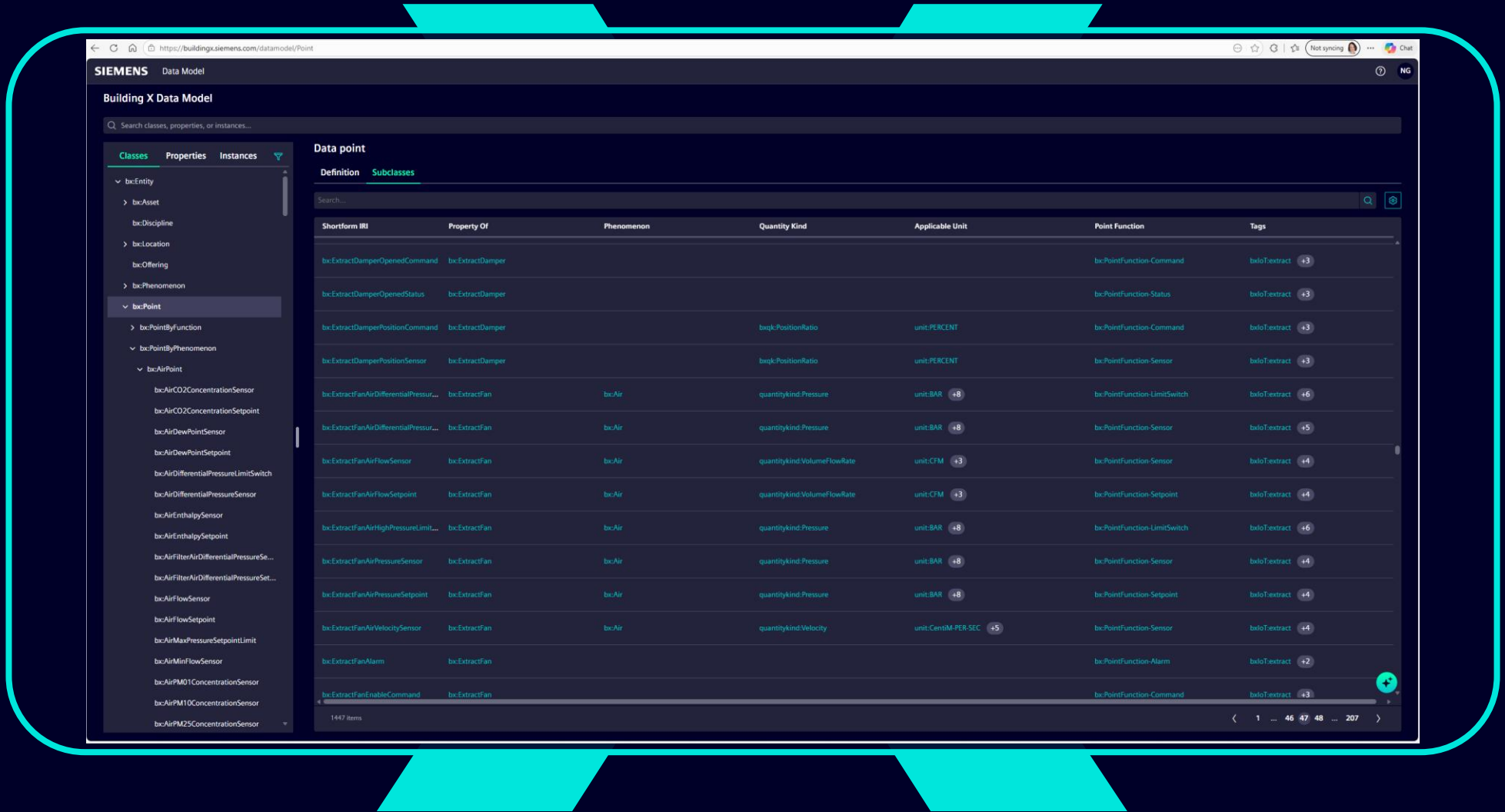
```
bx:GeoArea rdfs:subClassOf lis:PlaneInSpace .
```

```
bx:Location rdfs:subClassOf lis:InanimatePhysicalObject ,  
                             lis:PhysicalArtefact .
```

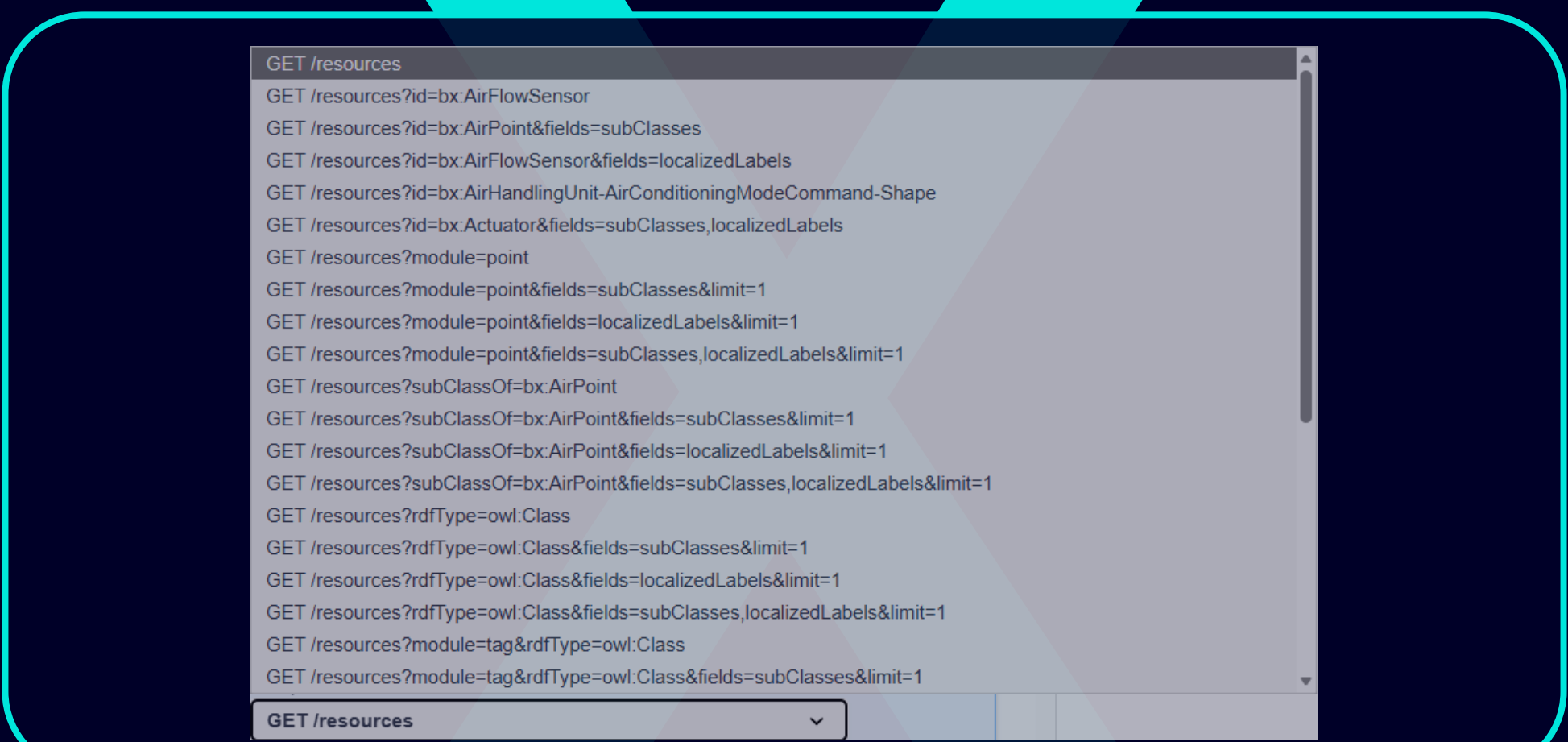
```
bx:Asset rdfs:subClassOf lis:InanimatePhysicalObject ,  
                          lis:PhysicalArtefact .
```

```
bx:hasLocation rdfs:subPropertyOf lis:containedBy .
```

The Building X Data Model App: Enabling the Use of the Common Language & Resolvable IRIs



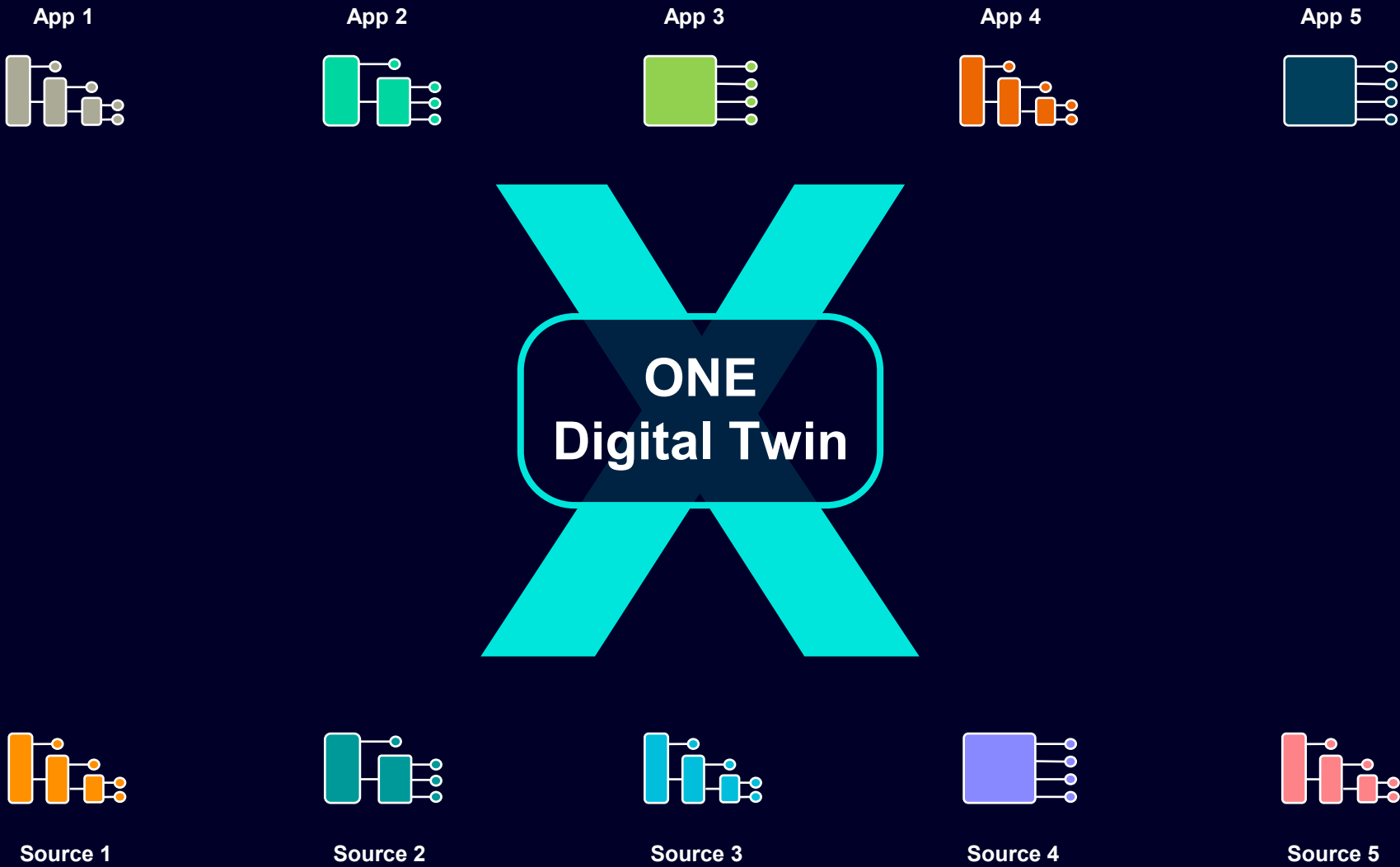
The Building X Data Model REST-API: Exposing the Data Model to Apps & Services



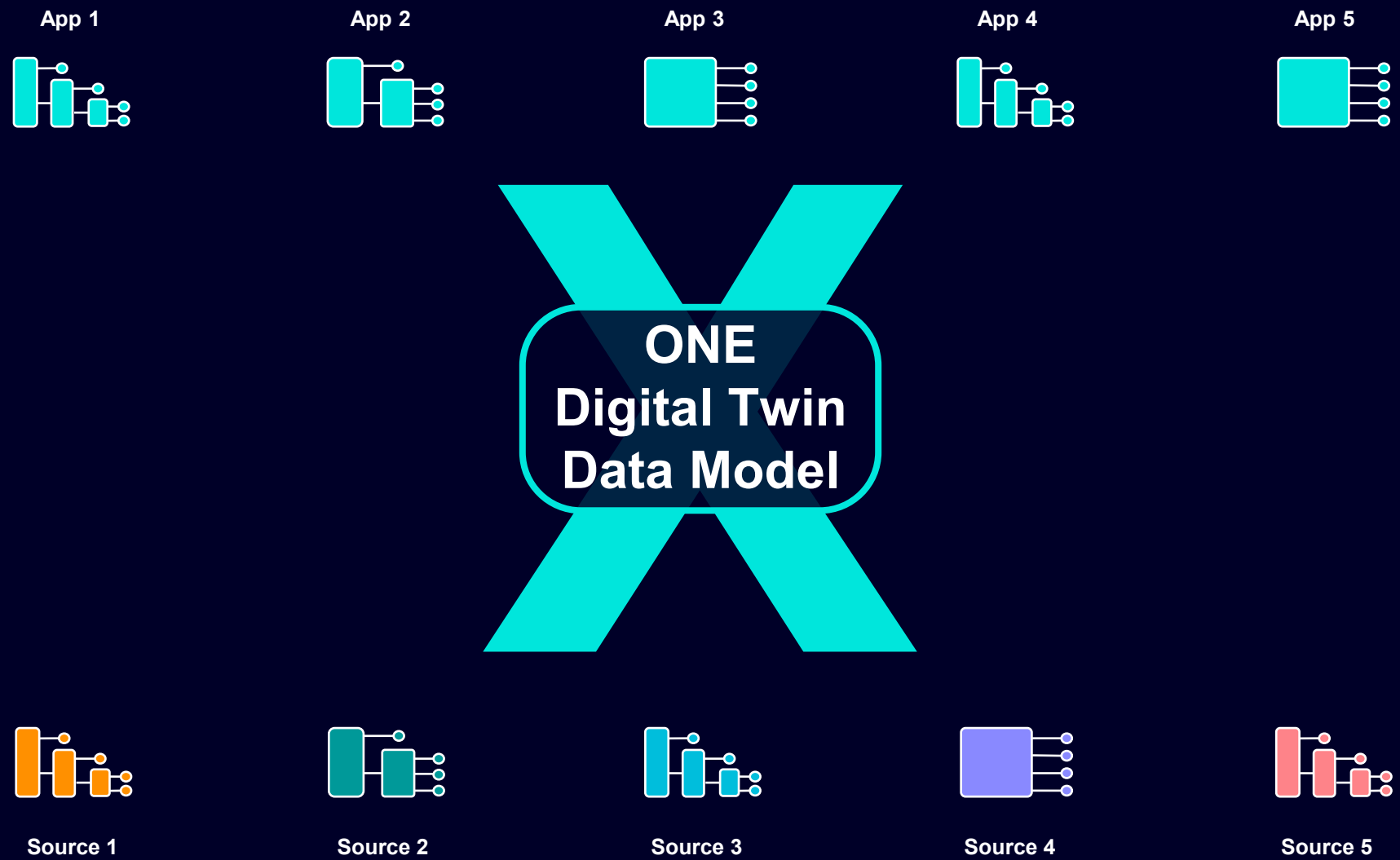
```
GET /resources
GET /resources?id=bx:AirFlowSensor
GET /resources?id=bx:AirPoint&fields=subClasses
GET /resources?id=bx:AirFlowSensor&fields=localizedLabels
GET /resources?id=bx:AirHandlingUnit-AirConditioningModeCommand-Shape
GET /resources?id=bx:Actuator&fields=subClasses,localizedLabels
GET /resources?module=point
GET /resources?module=point&fields=subClasses&limit=1
GET /resources?module=point&fields=localizedLabels&limit=1
GET /resources?module=point&fields=subClasses,localizedLabels&limit=1
GET /resources?subClassOf=bx:AirPoint
GET /resources?subClassOf=bx:AirPoint&fields=subClasses&limit=1
GET /resources?subClassOf=bx:AirPoint&fields=localizedLabels&limit=1
GET /resources?subClassOf=bx:AirPoint&fields=subClasses,localizedLabels&limit=1
GET /resources?rdfType=owl:Class
GET /resources?rdfType=owl:Class&fields=subClasses&limit=1
GET /resources?rdfType=owl:Class&fields=localizedLabels&limit=1
GET /resources?rdfType=owl:Class&fields=subClasses,localizedLabels&limit=1
GET /resources?module=tag&rdfType=owl:Class
GET /resources?module=tag&rdfType=owl:Class&fields=subClasses&limit=1
```

GET /resources

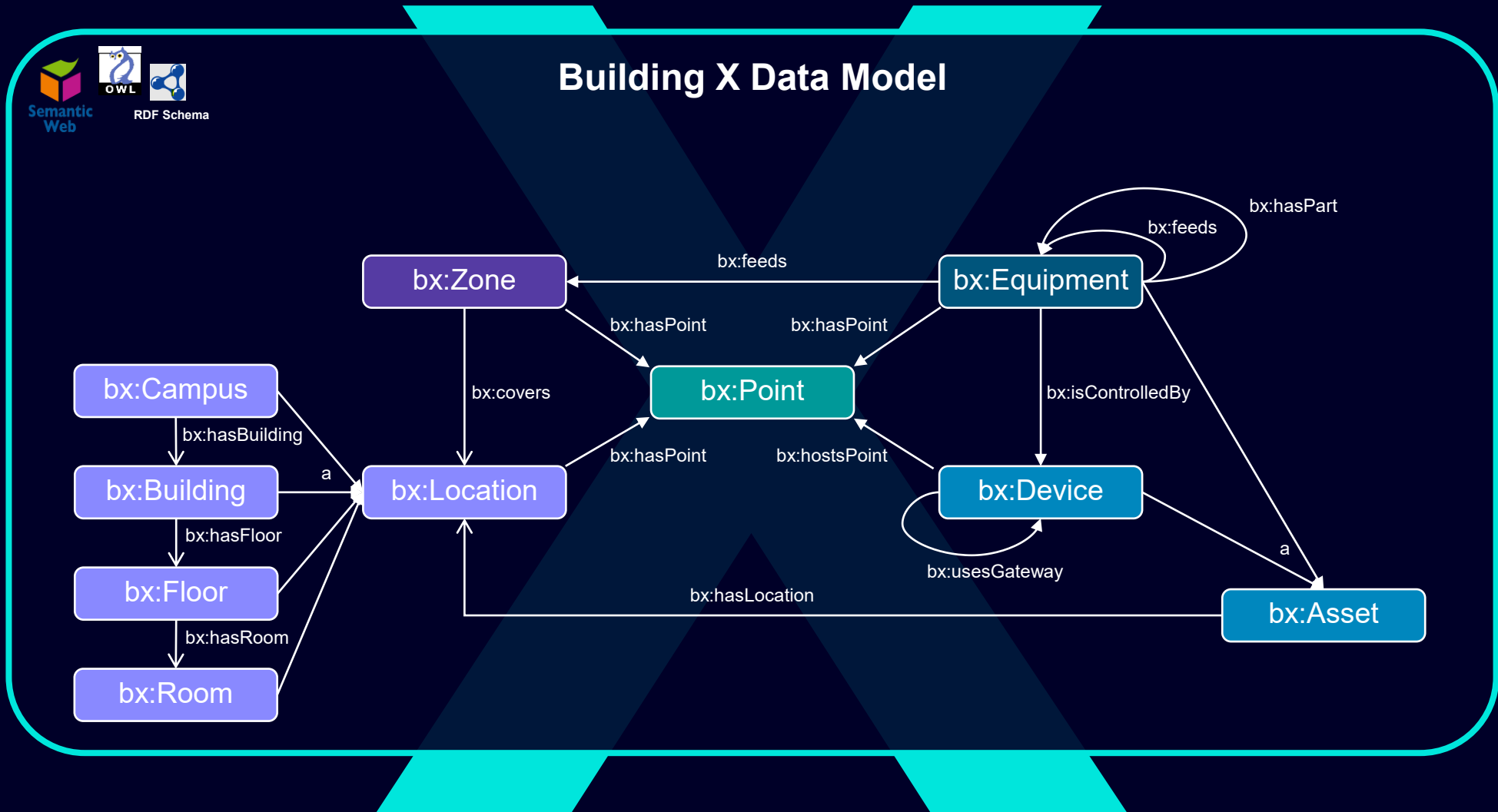
One Digital Twin: Many Demands & Many Data Sources



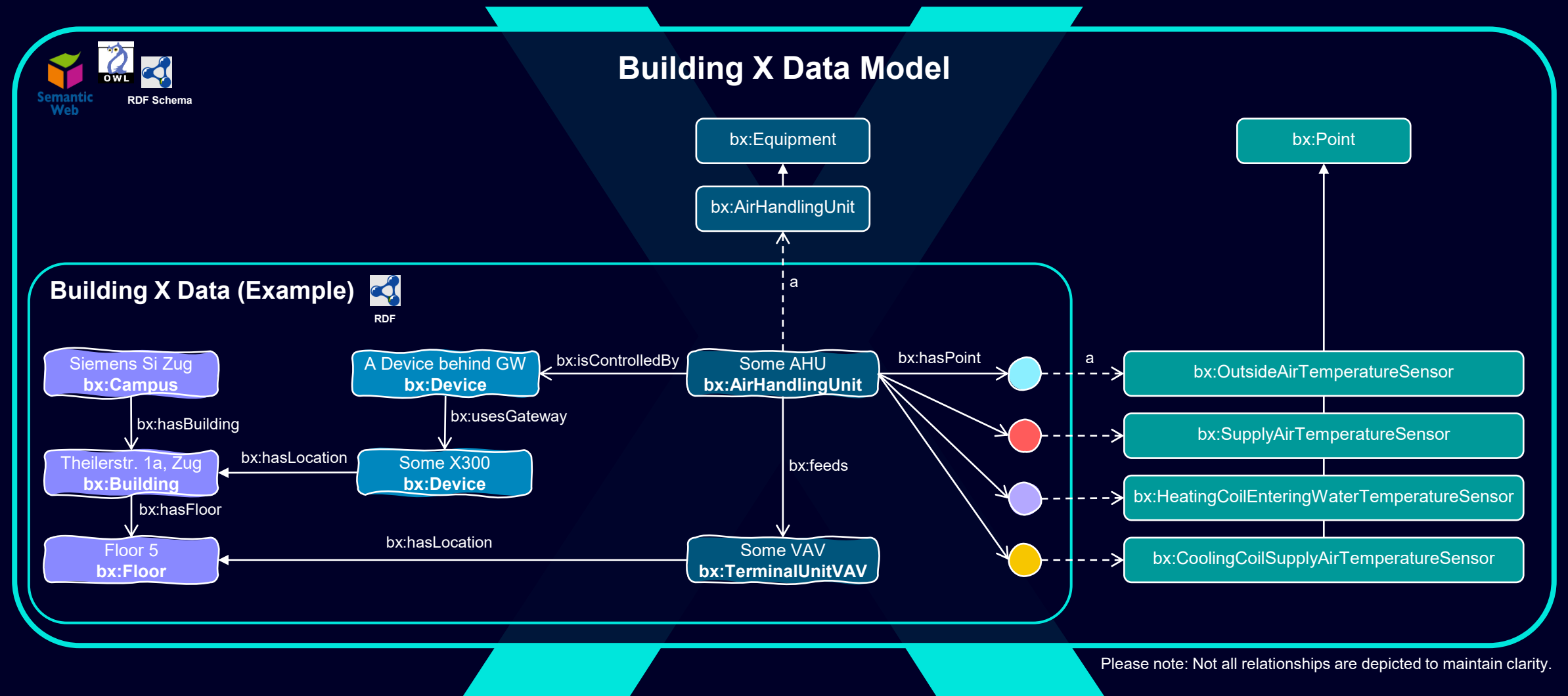
The Building X Data Model: A Harmonized Common Vocabulary for All Apps



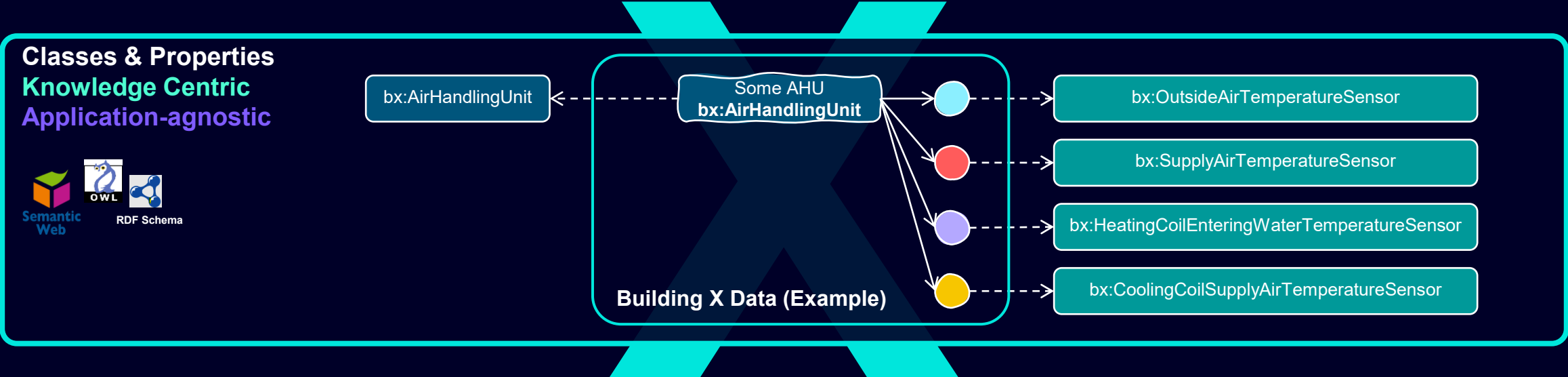
The Building X Data Model: The Unified Common Semantic Language



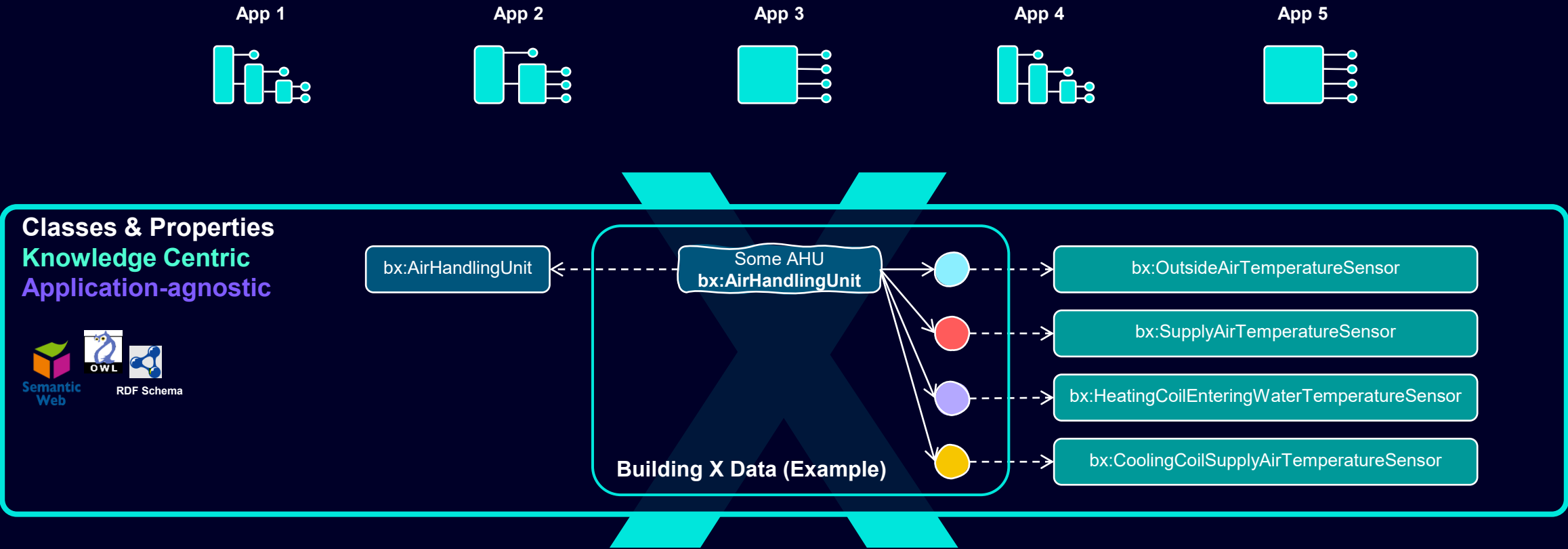
The Building X Data: A Simple Building X Data Model Instantiation Example



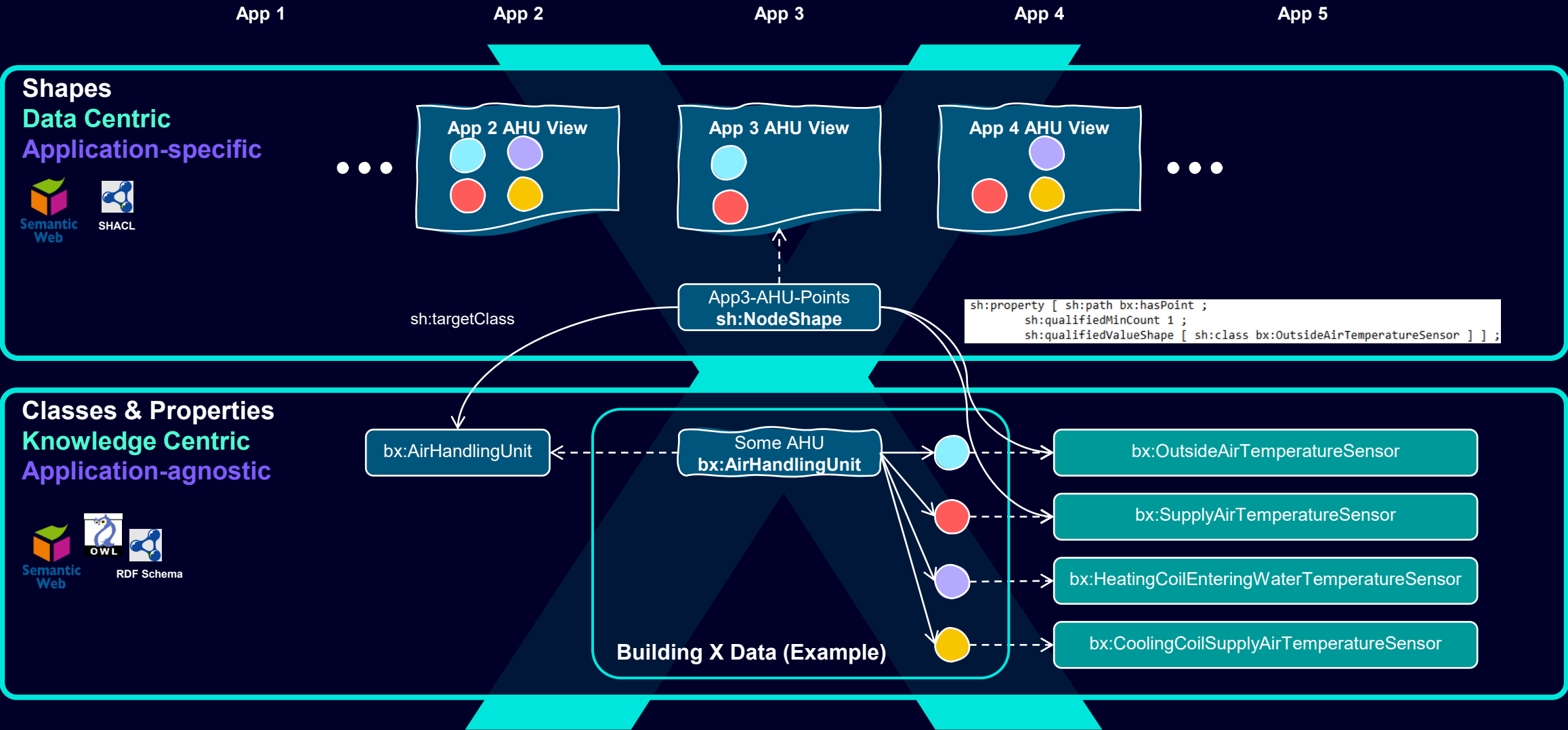
Building X Data: Focused AHU has Data Points Example



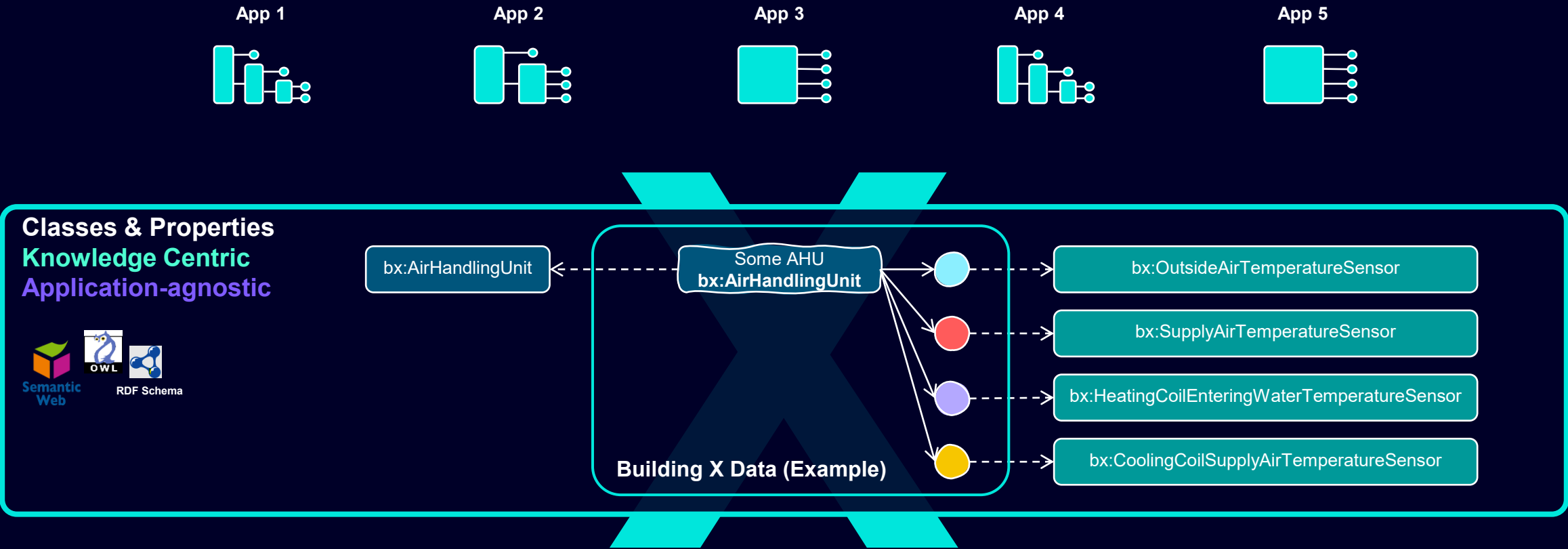
One AHU Twin, Many Perspectives: Supporting Varied AHU Information Needs from Apps



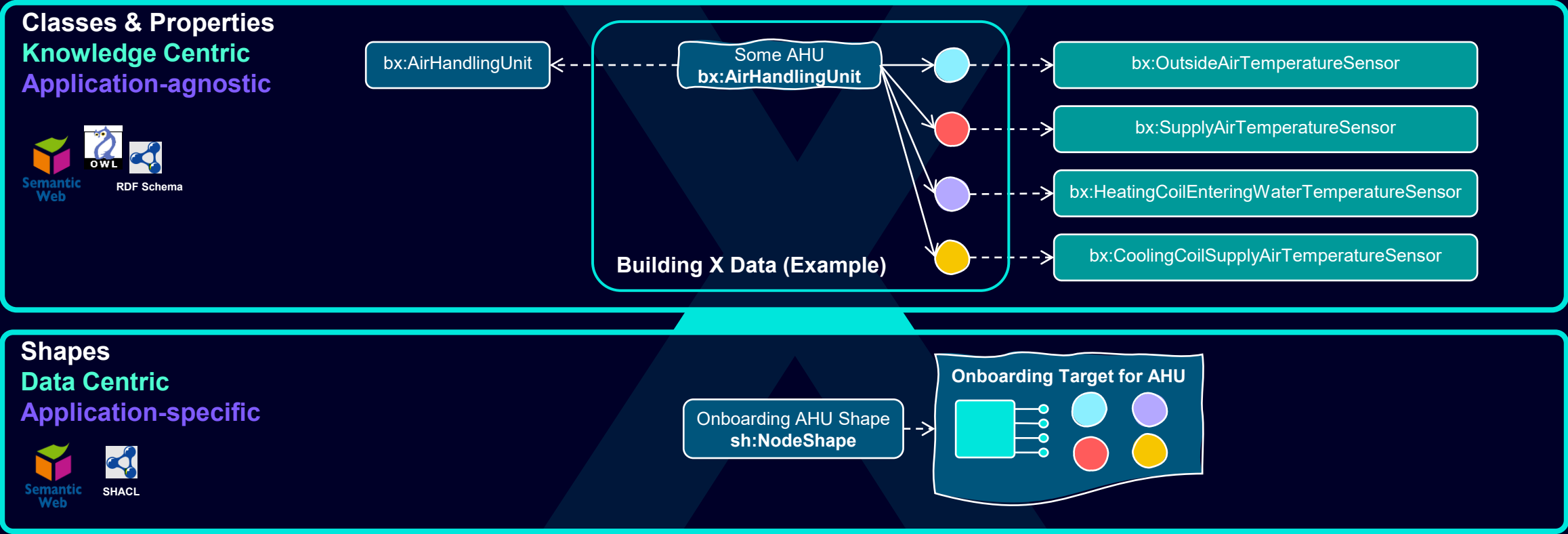
Application-Specific Views: Defined through App-Specific SHACL Shapes



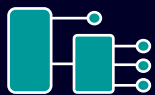
The South-Bound Challenge: Unifying Disparate Data Sources



The Building X Onboarding: Bring Disparate Data into Shape!



Source 1



Source 2



Source 3

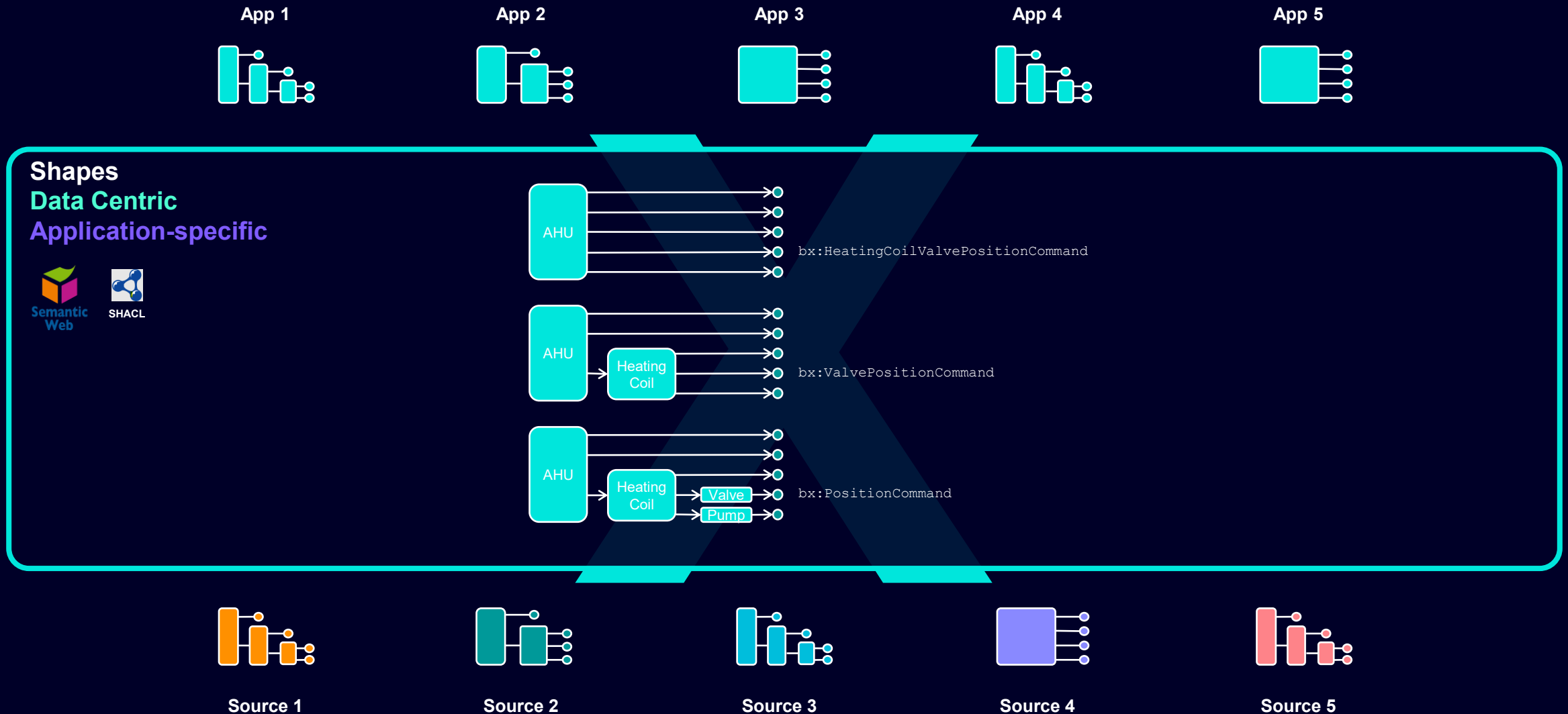


Source 4



Source 5

Building X Guided Onboarding: Leveraging SHACL Shapes to Define Target



The Building X Semantic Interoperability: Graph-to-Graph Transformations using SPARQL

SPARQL Queries

Data Centric

Application-specific

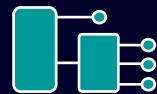


Building X Bridge Ontology Example

```
bx:CreateBxBuildingNode rdf:type sh:SPARQLRule ;
sh:construct """
    CONSTRUCT {
      $this rdf:type bx:Building ;
      rdfs:label ?buildingTitle .
    }
    WHERE {
      $this rdf:type rec:Building.
      # Get title from td:title (preferred) or dcterms:title (fallback)
      OPTIONAL { $this td:title ?tdTitle . }
      OPTIONAL { $this dcterms:title ?dctermsTitle . }
      BIND(COALESCE(?tdTitle, ?dctermsTitle) AS ?buildingTitle)
    }
  """
.
```



Source 1



Source 2



Source 3

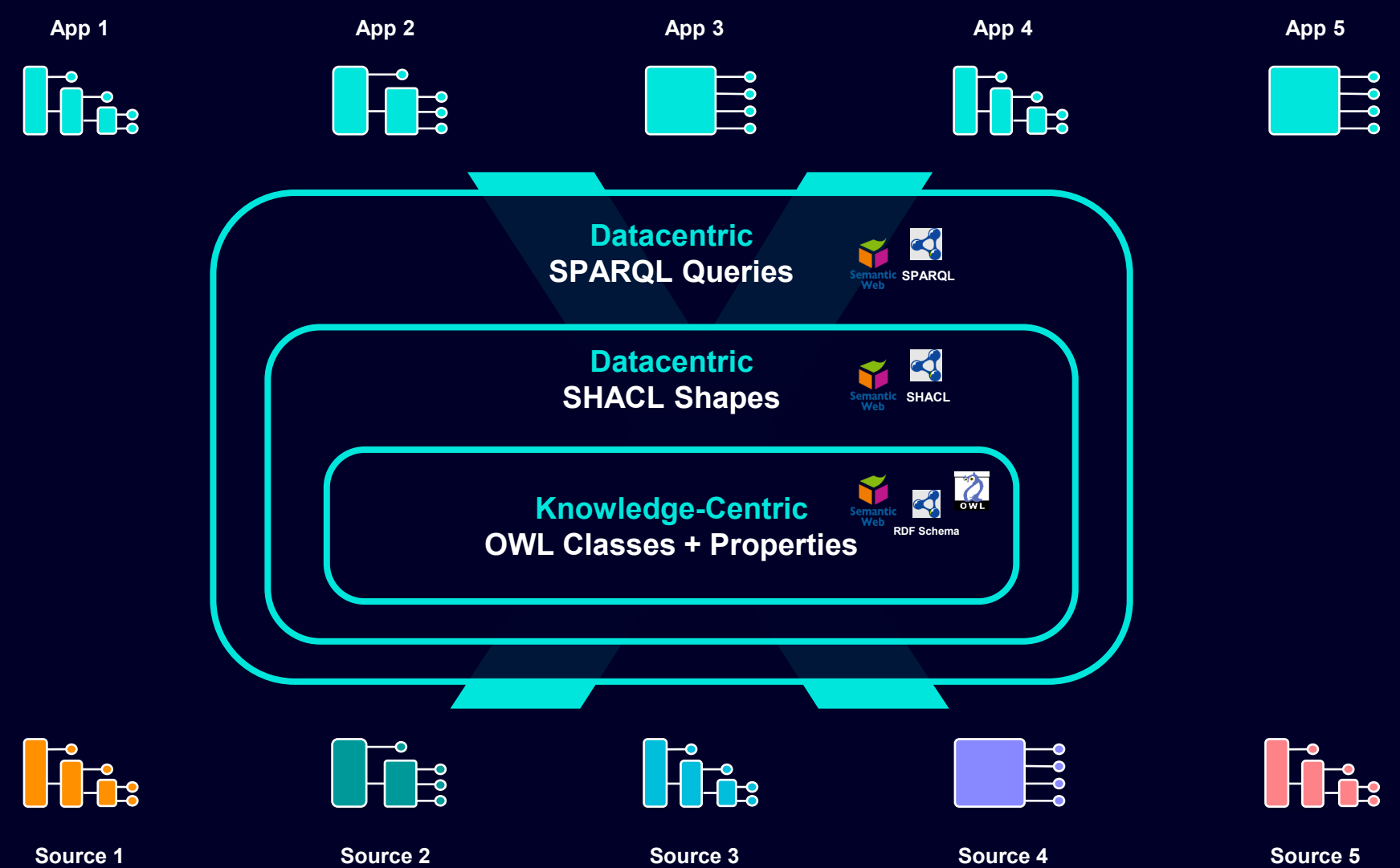


Source 4



Source 5

Building X Data Model: Interoperability, AI Readiness, and Low Touch Digital Twin Onboarding



Contact

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