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BIM and FM:

The Portal to Lifecycle Facility Management

Interoperability on a Large Scale

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BEFORE FACILITY, GEOSPATIAL AND EMERGENCY DATA WERE able to interoperate on a large scale, emergencies were typically reported by phone, including only the location and type of emergency. Today, smart buildings can report situations earlier and in more detail—but there is a disconnect between the standards needed for effective interoperability. The Open Floor Plan Display / Exchange Project is a response to this need.

Open Floor Plan Display (OFPD) is a Requirements Prototyping effort to create a lightweight graphical interface for web browsers. **FIGURE 1** is a demo, available at http://comopview.org/ofpdemo/.

Open Floor Plan Exchange (OFPX) is a Standards Harmonization effort to provide diverse communication systems with a common understanding. Both the display and exchange will be maintained by the Building Information Service Ontology, currently in development. Data models and reasoning support keep OFPD/X specifications interoperable with related standards.

Together, OFPD/X supports emergency situation awareness by addressing three key questions (**FIGURE 2**):

1. Where is the problem? (location)
2. What surrounds the problem area? (environment)
3. What is contained in the problem area? (content)

Answers to these three questions provide a framework for real-time understanding of emergencies. The level of detail is determined by first responder needs and facility access policies. Maintaining the integrity of facility data is critical because if information is not current, first responders' understanding will be faulty. Incorrect information costs lives and increases property damage. The Building Information Service Ontology will specify the required data types and associations with specific buildings. Required data must be maintained throughout a building's lifecycle with minimal effort by owners or local jurisdictions. Preliminary research indicates the following standards are useful:

1. Identify: OmniClass Facility and Space Types Tables 11 to 14 and Properties Table 49; National Association of Electrical Manufacturers (NEMA) SB30 Fire Service Annunciator and Interface.
2. Format: OGC CityGML, National Information Exchange Model (NIEM) Information Exchange Package Documentation (IEPD), OASIS Emergency Data Exchange Language (EDXL), Common Alerting Protocol (CAP).
3. Track: Construction Operations Building Information Exchange (COBie2), Building Information Services and Access Control System (BISACS) and Disaster Management Open Platform for Emergency Networks (DM-OPEN).
4. Display: W3C Scalable Vector Graphics (SVG), JavaScript, AJAX, CityGML.
5. Maintain: COBie2, IFD/IFC, CityGML, OFPD/X.

REFERENCING ACROSS STANDARDS

Many standards include references. The CityGML Building Schema is at http://schemas.opengis.net/citygml/building/1.0/building.xsd. Next is an important snippet:

```
<xs:simpleTypename="BuildingClassType">
    <xs:annotation>
       <xs:documentation> Class of a build
       ing. The values of this type are de
       fined in the XML file BuildingClassType.
       xml, according to the dictionary concept
       of GML3.</xs:documentation>
    </xs:annotation>
    <xs:restriction base="xs:string"/>
  </xs:simpleType>
```

The BuildingClassType.xml file, located at http://schemas.opengis.net/citygml/codelists/BuildingClassType.xml, contains 19 types:

```
1000 habitation
1010 sanitation
1020 administration
1030 business, trade
1040 catering
```

Figure 1. Image courtesy of David Coggeshall.

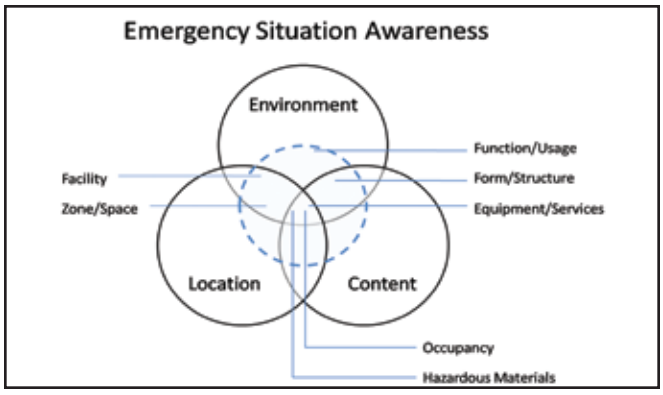


Figure 2. Data Integration Scope for Emergency Situation Awareness. Image courtesy of Michelle A. Raymond.

```
1050 recreation
1060 sport
1070 culture
1080 church institution
1090 agriculture, forestry
1100 schools, education, research
1110 maintenance and waste management
1120 healthcare
1130 communications
1140 security
1150 storage
1160 industry
1170 traffic
1180 function
```

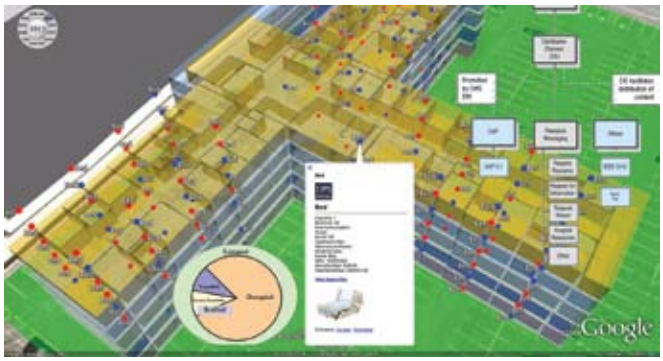
To increase functionality, this list could be replaced by Omniclass Table 11 Construction Entities by Function. These have been harmonized with other space classification standards and aligns to the International Building Code (IBC) Occupancy Classifications. OFPD/X also incorporates Omniclass Space Types and Properties. Information codified in Omniclass can be searched in OFPD/X as displayed terms or semantically equivalent synonyms. Building owners can use standard designations or their own lists. For the latter, maps will be needed to standard code lists for correct interpretation when terminology differs.

Building owners maintain control over their data. Sensor and annunciator panel specifications distinguish between fire, security, HVAC and other systems. The ontology will help package information appropriately based on owner and public safety requirements for distributing and tracking information flow before, during and after emergencies. Therefore, emergency messaging will need to comply with open standards for building information modeling (BIM), such as the International Framework for Dictionaries (IFD).

GEOMETRY AND SEMANTICS

Names and shapes are fundamentally different types of information. Semantic information is easier to work with and exchange than geometry. But lists and tables are not enough for first responders, they need drawings to provide context. Building data needs to be organized in logical levels to unfold and be displayed for both geometric and semantic exchange.

CityGML is an excellent candidate to accomplish these tasks, as are predefined IEPD exchanges specified in NIEM. However, the CityGML and NIEM schemas for "building" differ. The more schemas that can be harmonized or reference the same namespaces, the more interoperability improves.



A VA Center and hospital bed popup. The Emergency Data Exchange Language (EDXL) suite and hospital bed graph is courtesy of OASIS. Image courtesy of Kimon Onuma, Onuma Planning Systems.

Graphics and labels need to be encoded for communication with diverse end users. Graphics require shapes, locations and relationships to other elements. Shapes and locations can be polygons or points. Relationships are available as object types (with or without shape and location) within standardized hierarchies being developed to cross-cut relevant domains.

When a sensor detects fire within a space, the component raising the alarm may be designated by an arbitrary number with little meaning to a first responder. However, spaces containing sensors have a shape and location to provide context. Sensors and spaces need to stay linked regardless of whether geometry, semantics, or both, are used. Space boundaries need to be put through explicit transforms for building and geospatial coordinate systems to work together in response to emergencies.

OFPD used Scalable Vector Graphics (SVG), JavaScript, and AJAX to create W3C-compliant, web-based components to render basic building geometry and semantic information. Modular architecture facilitates integration with Google Maps and common operating pictures.

CASE STUDIES

VectorWorks was used to create open floor plans for two buildings at Carnegie Mellon University, Silicon Valley. One started with a raster image, another a .dwg file. Build Hospital Live by Onuma Planning System included detailed .ifc and COBie structured data available to classify spaces.

Regardless of the starting format or completeness of building documentation, the same end point is needed for successful exchange. Reaching that end point in a standardized, easy to implement manner is the key to effective Open Floor Plan Display and Exchange. A future goal is to extend the Build Hospital Live model to the Hospital AVailability Exchange specification (EDXL-HAVE), where the first information needed is the number of beds, whether the hospital is operational, and similar data hospitals previously reported ad hoc. Assigning full-time staff members to keep it up-to-date, is key. By standardizing the data fields, reports can now be sent with a few clicks.

The next steps are to agree on data types and elements that need to be expressed through software and web services, such as wall locations, fire rating and construction types. Next would be to build up that capability across all of the standards needed to display and exchange open floor plans. A concept development plan is forthcoming, including the role of 3D versus 2D. An energy domain application of OFPD/X is also in the queue. We will continue to work with OGC, the buildingSMART alliance™, NIEM and OASIS to include voices from geospatial, facility and emergency management domains in advancing interoperability on a large scale. ■

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