Minutes of the

International OGC, SIG 3D and TUM Workshop on Requirements for CityGML 3.0

20 – 21 June 2013

Venue:	Technische Universität München
	Chair of Geoinformatics
	Arcisstraße 21, 80333 München, Germany
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	Tatjana Kutzner, TUM
	Gerhard Gröger, Uni Bonn / SIG 3D
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	Egbert Casper, SIG 3D
	Carsten Roensdorf, Ordnance Survey / OGC CityGML SWG
	Claus Nagel, virtualcitySYSTEMS / OGC CityGML SWG
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Introductory Remarks

The Workshop Wiki is accessible at:

http://en.wiki.modeling.sig3d.de/index.php/Workshop_Munich_2013

All presentations can be downloaded from:

http://en.wiki.modeling.sig3d.de/index.php/Agenda_of_the_Workshop

Number of participants: 48

Countries of participants: Germany, England, France, The Netherlands, Italy,
                            Switzerland, USA, Singapore, Malaysia, China

1   Welcome Address

- Thomas H. Kolbe (Chair of Geoinformatics, Technische Universität München, Local Workshop Chairman)

  - Short presentation about TUM and the Chair of Geoinformatics

  - Statements on the aim of the workshop:

    - Provide a forum for the discussion about a major new version of CityGML
    - Ideas, comments and statements: modification and extension of CityGML
    - What should be touched, what should not be changed?

- Steve Smyth (Co-Chairman of the OGC CityGML SWG)

  - Statements on the aim of the workshop:
    - Discussion about problems in practice
    - Definition of a roadmap for CityGML 3.0

- Gerhard Gröger (Chairman of the modelling working group of SIG 3D)

  - Statements on the aim of the workshop:
    - Discussion about the LOD concept
    - New features for CityGML 3.0
    - Definitions of changes in the core module

2 Improved Support for Simulations and other Applications

2.1 Using CityGML as a platform for cascading simulations (Thomas H. Kolbe, Technische Universität München)

- Contents of presentation:

  - CityGML-dedicated projects with simulations:
    - Noise dispersion simulation for the entire state of North-Rhine Westphalia + Project „GDI Grid",
    - Disaster management („SIMKAS 3D"),
    - Energy simulation and strategic energy planning (EIT Climate KIC funded projects „Energy Atlas Berlin", „Neighbourhood Demonstrators", „City Systems Modelling")

  - Required Extensions/Modifications:
    - Definition of qualified attributes; metadata at attribute level (complex attributes):

      - Data types with more semantics (e.g. angle, height, count)
      - Type of measure (e.g. measured, estimated, default)
      - Data quality (e.g. standard deviation)
      - Dynamics:

        - Time-dependent model changes / model variations
        - Functional dependencies on time
        - Time-discrete representations (e.g. different attribute values or geometries for different time periods)

- Contents of discussion:

  - Demand for storing the results of simulations (shadow, thermal imagery)
  - Large demand in practice for time dependent attributes
  - How to deal with metadata on attributes changing over time?
  - Further development in consideration of aspects described in Ontology Definition Metamodel (OMG)

2.2 CityGML for Environmental Monitoring (Heino Rudolf, Volker Kraut, M.O.S.S.)

- Contents of presentation:

  - CityGML as a compact, generic, and flexible core for different applications (e.g. regularly conducted analyses of noise pollution); Core allows representation of features with a spatial representation
  - Use of CityGML in different projects:
    - Heat demand in urban areas („SimStadt")
    - Noise pollution
    - Solar potential assessment
    - Routing for disabled people („i-Scope")

  - Advantages of CityGML:
    - Representation of features with a spatial representation

- Possibility of extending CityGML (ADEs, generic objects and attributes, external references)
- CityGML as a central platform for semantic enrichment of objects

- Requirements for CityGML:
  - Representation of temporal aspects & processes (temperature, noise, solar radiation)
  - Representation of metadata at the level of attributes (e.g. algorithm used for simulation)
  - Support of simple and complex variables (e.g. single scalar value, time-series, composite scalar value (e.g. min, max, mean)
  - Use of modelling patterns according to ISO 19156
  - Topics like environmental monitoring and „non 3D" objects

- Contents of discussion:

  - Need for time-dependent variables especially in the fields of environmental monitoring

2.3 Usage of CityGML for Environmental Noise Propagation Simulation - Experiences and Issues (Hardy Stapelfeldt, Company Stapelfeldt)

- Contents of presentation:

  - Company uses CityGML for noise mapping
  - Additional attributes gained during data processing/data refinement
    - Origin of data
    - Time related information (start and termination time of objects)

  - Reasons for the use of CityGML:
    - Strict rules for classes, attributes, and content due to standard
    - Storage of project related information/results (generic attributes)
    - Possibility of Extension using ADEs

- Contents of discussion:

  - Demand for metadata at the level of a single object:
    - Origin of data
    - Units
    - Information measured/simulated

2.4 CityGML and FEM based simulations – Requirements and Challenges (Claus Nagel, virtualcitySYSTEMS)

- Content of presentation:

    - Project DETORBA:
        - CityGML used for simulations in the field of detonation scenarios in urban environments using Finite Element Method
        - Use of CityGML data in simulation software (ANSYS) requires conversion from GML -> CAD -> Finite Elements
        - Feeding back results of simulations into the city model
    - Demands:
        - Material properties for boundary surfaces, windows, etc.
        - Function-based property values (e.g. for elasticity, thermal expansion, thermal insulation)
        - Time-dependent property values (e.g. corrosion, fatigue, creep)
        - Solid volumes for FEM mesh decomposition

- Content of discussion:

    - Need for complex attributes
    - Need for dynamic attributes
    - How to combine BIM and CityGML?
    - Representation of physical properties in CityGML

2.5 CityGML based 3D modelling with Bentley MicroStation V8i & Bentley Map V8i (Michael Schönstein, Bentley Systems)

- Content of presentation:

    - Use of Bentley products in different fields of application
        - Terrain modelling / Point cloud 3D modelling
        - CAD applications
        - Noise simulation, solar analysis
        - 3D shadow analysis
        - Visualization
    - Presentation of different products (Bentley Map V8i, Bentley Geospatial Administrator V8i)
    - Full Support of CityGML
        - ADEs can be implemented

3   LOD Concept of CityGML

All presentations of this session are discussed at the end of the session.

**3.1   SID3D Proposal for an enhanced CityGML LOD Concept
         (Joachim Benner, KIT)**

- Introduction:

    - Current LOD concept mainly a marketing label, not an attribute with technical meaning
    - LOD concept and its implementation in CityGML has deficits

- Aim of LODs:

    - Concept of LODs commonly used for many 3D city models
    - Goal of defining LODs: partitioning a complex model into alternative models of different complexity
    - Information content, complexity, and quality of each alternative model are characterized by suited metadata

- Deficits of the actual LOD concept:

    - LOD definitions are informal and vague, allowing a lot of ambiguity
    - Actual LOD concept only determines a type of geometric representation and some degree of geometric correspondence between model and real object
    - LOD levels higher than or equal to 2 implies nothing about the actual semantic content of a Building or BuildingPart object
    - Features corresponding to the buildings exterior shell have different geometrical properties for LOD3 and LOD4, though there is no difference in modelling; increase of model complexity
    - Modelling of interior structures only possible when simultaneously the exterior shell is represented with highest geometrical accuracy
    - No possibility of modelling of interior structures of the building with different geometrical accuracy
    - Almost total lack of metadata addressing geometric accuracy and structural complexity, semantic meaning, and structural complexity
    - Use of the same LOD concept in (almost) all thematic modules
    - LOD concept in CityGML originally developed and defined for the Building module; transfer to other thematic modules incomplete and in some cases problematic (e.g. undefined meaning of geometrical LOD1 – LOD 4 for feature class LandUse; LOD4 interior representation for real objects with no relevant interior structures e.g. SolitaryVegetationObject, PlantCover, etc.)

- Proposals for an enhanced LOD concept:

    - Development of a modular LOD concept for the CityGML Building module to be transferred and adapted to other thematic areas
    - Representation of the actual LOD of a Building by suited metadata, which must be completed by additional LOD-independent metadata
    - Definition of a mapping between old and new LOD concept
    - Definition of a LOD specifying geometric and semantic LOD for exterior shell and building's interior:

- **LODG-E**: **g**eometric LOD for the building's **e**xterior shell (LODG-E0, LODG-E1, LODG-E2, LODG-E3)
- **LODS-E**: **s**emantic LOD for the building's **e**xterior shell (LODS-E0, LODS-E1, LODS-E2, LODS-E3)
- **LODG-I**: **g**eometric LOD for the building's **i**nterior (LODG-I0, LODG-I1, LODG-I2, LODG-I3)
- **LODS-I**: **s**emantic LOD for the building' **i**nterior (LODS-I0, LODS-I1, LODS-I2, LODS-I3)

- Representation of all features related with the exterior shell (Building, BuildingPart, BuildingInstallation, WallSurface, Door, etc.) with the same LODG-E
- Representation of all features related with the interior building structure (Room, IntBuildingInstallation, BuildingFurniture, etc.) with the same LODG-I; LODG-I and LODG-E might differ
- Definition of rules for the allowed combinations of interior and exterior LOD (open issue)

3.2   Towards an integrated definition of the concept of level of detail in 3D city modelling (Filip Biljecki, TU Delft)

- Current deficits of CityGML:

  - Modelling of the building interiors only possible in LOD4
  - Specifications of CityGML not fine enough; possibility of different datasets within the same LOD
  - Currently no possibility of a combination of different LOD of objects and LOD of parts

- Proposals:

  - Definition of sub-LODS:
    - Exterior geometry LODs
    - Interior geometry LODs
    - LODs for appearance
    - LODs for semantics

  - Finer geometry definition: presence complexity, and dimensionality with the extension of types of geometric representations (0D: point, symbol; 1D: line, e.g. road river)
  - Definition of dataset-based and object-based constraints (interior -exterior; accuracy - geometric complexity)

3.3   Integrating LODs from different Sources – A practical View on the CityGML LOD concept (Claus Nagel, virtualcitySYSTEMS)

- Benefits of the CityGML LOD concept:

    - Currently common understanding of LOD
    - LOD affects both geometry and semantics
    - Manageable complexity

- Shortcomings:

    - No clear separation between LODs:
        - Geometry: only recommendations regarding accuracy and extent
        - Semantics: strict conformance requirements but no conclusion about semantic richness can be drawn from given LOD

    - Often project-specific definitions and extensions (e.g. "LOD 2.5")
    - Currently: specific LOD is requested, but it might be unclear what has to be delivered
    - LOD4 inconsistently used in different CityGML modules
    - LODs from different data sources:
        - City models often exist in multiple LODs; different data acquisition methods and processes; different data providers and software tools
        - LOD representations are kept and managed independently; separate XML-files; no central database; no linkage between city objects and their LOD representations
        - Major goal: integration of different LOD representations; Analysis, distribution, visualization of the same city object with regard to different degrees of resolution

    - Problems regarding identification of the same real world object in different data sources; different semantic and spatial representations for the same real world object

- Proposals:

    - Discussion and evaluation of current LOD concept should reflect market needs
    - Development of Modelling guidelines (or enforcements) for existing LODs rather than new LODs
    - Improvement of the interface to 2D data
    - Improvement of the interface to BIM

3.4 Thoughts about the CityGML LOD concept and its modification (Tatjana Kutzner, Technische Universität München)

- CityGML LOD concept used and referenced in many projects and places all over the world; Adoption of the concept by national (Germany, Netherlands) and international standards (INSPIRE)

- Pros:

    - Easy understanding and remembering
    - Geometric resolution and the maximal degrees of spatial and semantic structuring specified by just one number
    - Easy recognition whether interior building structures are intended to be represented

- Known shortcomings

    - Imprecision and vagueness; LOD number allows no precise conclusions regarding the actual degree of geometric and semantic structuring of a given dataset
    - No concept for multiple LODs of interior structures

- Different Proposals during the session "LOD Concept of CityGML":

    - Complementing the current concept by separate indoor LODs
    - Differentiation of the current LODs in semantic and geometric LODs
    - Extension of the LOD definition not only by semantics and geometry but also by topology and appearance
    - Introduction of more / less / continuous LOD levels
    - But: modifications cause fundamental changes to the current structure of CityGML

- Questions for discussion:

    - Which problems will the new LOD concepts solve?

        - Will the problem of imprecision / vagueness be solved unambiguously by the new LOD concept?

    - What impact will there be on existing CityGML data sets?

        - Is backwards compatibility guaranteed?
        - Will it be possible to map CityGML data unambiguously from the current LOD concept into the new LOD concept and vice versa?
        - Are the semantics maintained?

    - Which efforts are required to implement the new LOD concept?
    - To what extent are data providers and tool developers affected?

        - Do existing software tools have to be modified considerably?
        - What consequence does the new LOD concept have on software for façade reconstruction / generalisation tools which refer explicitly to individual LODs?
        - Will the acceptance of a new, more complex LOD concept given by the users?

3.5 Plenary discussion about the LOD concept of CityGML

- CityGML LOD concept used in many authorities and companies; Changes in the concept might cause large effort for revision of existing data sets
- Current LOD concept allows a simple and unambiguous identification of the level of detail (geometry, semantics)
- Shortcoming of having different LODs for exterior and interior: Possibility of inconsistencies, e.g. window in a room but not in the exterior shell
- LOD for geometric representation and LOD for semantic representation might be useful for some applications
- Revision of the LOD concept is indicated; but: risk of confusing the users
- Additional metadata required for a unambiguous description of LODs; maintenance of the current LOD concept and integration of further information into metadata
- Need for a LOD concept for interior structures of buildings
- Consideration of concepts from IndoorGML
- Need for an open discussion, thorough examination, and well-considered decisions

4   Extension of CityGML by new Objects

4.1   CityGML – UtilityNetworkADE topological concept (Thomas Becker, TU Berlin)

- Content of presentation:

  - Current tasks:

    - Creation of a common framework for multi-utility modelling including multi-utility network hierarchies
    - Integration of infrastructure into urban context (CityGML ADE)
    - 3D topography and functional modelling
    - Easy connectivity of different networks using network links (modelling neuralgic points)
    - Integration of topological network features (FeatureGraph, Net-workGraph)

- Content of discussion:

  - Material types relevant e.g. for network pipes
  - Definition of attributes for CityGML network
  - CityGML currently only provides topographic representations; topology not represented by now
  - Consideration of functional elements e.g. streetlamp as city furniture and en-ergy consumer

4.2   Proposals of SIG3D and KIT for new features in the Building module (Joachim Benner, KIT)

- Content of presentation:

  - Proposed new features:

    - Storey: Class for representing the architectural concept of a storey; ex-plicit representation in 4 geometrical LODs

      - Proposed attributes:

        - name (text) and number (float)
        - class and usage (CodeList)
        - storeyHeight (Length)

      - Proposed relations (0..*):

        - Room
        - BuildingUnit
        - BoundarySurfaces (?)
        - BuildingInstallations (?)

    - BuildingUnit: Class for representing zoning and aggregations in the inte-rior of a building, e.g. to model apartments or temperature zones; explicit representation in 4 geometrical representations

      - Proposed attributes:

        - class and usage (CodeList)

- Proposed relations (0..*):

  - Address
  - Room
  - Storey
  - BuildingInstallation(?)

- OpeningSurface: Class for representing voids in interior or exterior boundary surfaces (KIT proposal); DoorSurface, WindowSurface, and VoidSurface

  - Currently no representation of volumetric building elements like walls or roofs in CityGML; only representation of outside and inside visible surfaces of these elements
  - In LOD4 models: two geometrically different surfaces representing the "voids" in the exterior shell (Feature WallSurface) and the room wall (Feature InteriorWallSurface), which both are related with the same opening (Door or Wall); the situation where a void in an interior or exterior wall is neither filled by a door nor by a window cannot be handled adequately
  - Inconsistency in nomenclature (WallSurface <-> Window), as well as frequently an inconsistency in modelling style:

    - Boundary Surface geometrically represented as surfaces, totally belonging either to a building's exterior or interior
    - Openings frequently modelled as complex geometric sets containing geometry parts belonging to the building's exterior and interior

- Content of discussion:

  - Proposal: representation of a building's exterior shell as volumetric object
  - Need for linking Indoor GML with CityGML
  - For BuildingUnits: Consideration of balconies and parking lots as external spaces
  - OpeningSurface could be replaced by ClosureSurface

4.3 Linking IndoorGML with CityGML
(Ki-Joune Li, Pusan National University)

- Need for linkage of IndoorGML and CityGML
- Issues:

  - Representation of geometry
  - n : 1 mapping
  - Virtual division
  - Synchronization

- Summary:

  - IndoorGML:

    - Graph model

- ▪ Provides a linkage with CityGML (and IFC as well) via external references (xlink)
  - ▪ Need for synchronization between CityGML and IndoorGML

4.4 Analysis of the Need for a new CityGML Extension: Other constructions (Marie-Lise Vautier, IGN France)

- ▪ Content of presentation:
  - ▪ Modelling of constructions that cannot be classified as Buildings (e.g. shed, bunker), BuildingParts or CityFurniture (e.g. pylons, dams)
  - ▪ Buildings in CityGML are not defined using specific characteristics (roofed, permanent, enclosed by walls, function, etc.)
  - ▪ Solutions for modelling other constructions:
    - ▪ GenericCityObject
    - ▪ CityFurniture and _AbstractBuilding
    - ▪ Definition of an ADE with defined structures and semantics
  - ▪ Proposal: a new Feature Class 'OtherConstructions' to represent those entities that are not covered by any of the other CityGML feature types for constructions
- ▪ Content of discussion:
  - ▪ Class OtherConstructions to unspecific
  - ▪ Catch-all objects for those objects that cannot be classified exactly?

4.5 Potential to store façade information in CityGML (Dorota Iwaszczuk, Technische Universität München)

- ▪ Content of presentation:
  - ▪ Need for merging of data from facades and thermal photography textures considering temporal changes:
    - ▪ Dynamic textures (e.g. winter/summer or sequence of observations every minute)
    - ▪ Changes in geometry (heat leakage changes shape)
  - ▪ Consideration of physical properties of the façade (especially the volume of walls; materials):
    - ▪ Need for new feature attributes (thermal conductivity, porosity, water absorption)
    - ▪ Consideration of different materials for one façade
  - ▪ Further ideas:
    - ▪ Introduction of a simple version of CityGML; "CityGML light"
    - ▪ Editing tools to edit the geometry and attributes at the same time
- ▪ Content of discussion:
  - ▪ Need for a division of the façade for every storey, which can alredy be done
  - ▪ Need for dynamic properties incl. thematic attributes and appearances
  - ▪ Need for complex attributes including metadata at attribute level

4.6 Harmonization between CityGML and INSPIRE Buildings (Gerhard Gröger, University of Bonn)

- Content of presentation:

  - Great influence of CityGML on INSPIRE:
    - 2D profiles: patterns (Building/BuildingPart, …), attributes (externalReference, roofType, …)
    - 3D profiles: in addition LOD1-LOD4 geometries, TerrainIntersection-Curve

  - INSPIRE: additional concepts not contained in CityGML; extensions worth to be included in CityGML
  - Representation of relative height:
    - CityGML: number with unit of measure
    - INSPIRE: complex data type:

      - Height: number with unit of measure
      - Explicit representation of lower reference level (low reference) and upper reference level (high reference)

    - Need for metadata about geometries (LOD1 – LOD4) including accuracies (x, y, and z)

  - Representation of LOD1 box
    - INSPIRE: footprint, roofEdge, and aboveGroundEnvelope
    - Need for metadata about geometries (LOD1 – LOD4) including accuracies (x, y, and z)

  - Need for further extensions:
    - BuildingUnits (presentation Häfele, Benner)
    - OtherConstructions (presentation Vautier)
    - 2.5D geometry: non-vertical base surfaces in contrast to CityGML LOD0: horizontal surfaces (2D block)
    - No BuildingParts of BuildingParts
    - Metadata in application schema (no ISO 19115 metadata)
    - Multifaceted attributes (energy, heating system, materials of façade/roof/etc.)

- Content of discussion:

  - Need for introduction of voidable attributes in CityGML?
  - How to represent height below ground?

4.7 Separate Conceptual Model and Encoding (Carl Stephen Smyth, Open Site Plan)

- Content of presentation:

  - Proposals:
    - The underlying conceptual model should be defined in a way that is independent of any specific encoded realization (e.g. using UML)

- - - Implementations of the conceptual model should have internal representations that are equivalent to those of the conceptual model
    - Implementations of the conceptual model should have serialization/deserialization methods that produce or consume encodings according to encoding specifications that relate constructs in the conceptual model to constructs in each supported encoding (e.g. JSON, GeoPackage, GML).
  - Background:
    - Definition of the CityGML conceptual model is shared between a set of XML Schema Language (XSD) files and UML model diagrams
    - The superiority of one or the other of the XSD and XML definitions is not clear and some adopters of CityGML have picked one as fundamental and some have chosen the other
    - A strong argument can be made that there should be one fundamental definition, that it should not be expressed in terms of a particular encoding, and that there are significant advantages to a separation of the conceptual model from its realization in specific encodings
- Content of discussion:

  - CityGML is more than an exchange format for 3D City models
  - Need for mapping to different databases/exchange formats
  - Need for model driven architecture process
  - Possibility of standardization of a conceptual data model? OGC Standard now consist of conceptual data model and encoding in GML

4.8 CityGML IMGeo ADE – Clearer guidelines for extending CityGML (Linda van den Brink, GEONOVUM)

- Content of presentation:

  - IMGeo:
    - Dutch large scale topography standard
    - Based on CityGML and modelled in UML as an ADE
  - Problems with creating ADE:
    - No guidelines how to create ADE for UML
    - No equivalent of the way CityGML adds properties in XML schema in UML
  - Alternatives for ADE:
    - Use of the extension possibilities of GenericCityObject and _genericAttribute:

      - Pro: no extra modelling work
      - Con: no formal definition of the extension

    - Adding properties to the CityGML classes directly in the CityGML package:

      - Pro: no necessity of subclass definition

- ▪ Con: packages reflect governance

- ▪ Adding properties in a subclass in the ADE package but suppressing this subclass from the generated XML schema:

    - ▪ Pro: no violation of UML, ISO 19100, and OGC rules
    - ▪ Con: inheritance not intended in this case

- ▪ Definition of a ADE hook '_GenericAppliucationPropertyOf…' as a class associated to the CityGML class:

    - ▪ Pro: clear distinction between the concept of subtyping a CityGML class and extending a CityGML class with properties
    - ▪ Con: less clear than subtyping the CityGML class; not in line with the ISO 19109 General Feature Model; no concept of attribute substitution

- ▪ Adding properties in an abstract superclass:

    - ▪ Pro: Avoidance of the problem of using a subclass while not intending inheritance of properties
    - ▪ Con: Adding of the generalization relationships to CityGML violates basic UML and XML namespace governance rules

- ▪ Definition of a general type ADEPropertyType and extendsType; types outside the UML in a registry:

    - ▪ Pro: no violation of UML rules and the ISO 19109
    - ▪ Con: maintenance of added features properties outside the UML; ADE extensions not completely modelled in UML

- ▪ For further information see OGC CR 12-066 (#11-101)
- ▪ Content of discussion:

    - ▪ Great importance that conceptual data model is compliant with ISO standards for further development and ADEs

4.9 Reorganization of Conformance Requirements (Detlev Wagner, Hochschule für Technik Stuttgart)

- ▪ Project Citydoctor as a tool for quality control of CityGML 3D city models:
- ▪ Quality aspects in context with CityGML:

    - ▪ Compliance with XML schema
    - ▪ Correctness of geometry and topology
    - ▪ Correctness of semantics
    - ▪ Ensuring spatio-semantic coherence

5   Stronger Harmonisation with 2D Cadastre and Models

**5.1   Integration of 3D cadastre, addressing and topography
(Carsten Rönsdorf, Ordnance Survey UK)**

- Content of presentation:

  - Need for a decomposition of buildings into storey and even more detailed into apartments and single rooms
  - Proposals:
    - Address/POI:
      - Two new modules 3D cadastre and address/POI
      - Possibility of referencing location within a building
    - 3D cadastre:
      - Need for referencing property within a building in 3D
  - Requirements for indoor representations:
    - Storeys:
      - Multiple LODs of storeys? (e.g. floor plan, block, generalized spaces, detailed spaces)
      - Storeys being abled to stand un its own without exterior representation
      - Storeys as implicit geometric representations of the outer shell
      - Relationship between storeys and functional units
    - Functional/addressable units (building units)
    - Connectors (stairs, escalators, etc.)
    - Floor plans
    - Assets within buildings (building installations already there)
- Content of discussion:

  - Need of being able to reference indoor and outdoor in an integrated way
  - Need of an integration of floor plan cadastre and addresses into buildings

**5.2   The national CityGML standard in the Netherlands: explanation, experiences and requests for stronger harmonisation with 2D models
(Jantien Stoter, Kadaster NL/TU Delft)**

- 3D Pilot:

  - Phase 1:
    - National vision for 3D developments by collaboration with many stakeholders in a test area and on use cases
    - Integration of:
      - 2D Information Model Geography (IMGeo):
        - Roads water,
        - Land use/land cover,
        - Bridges, tunnels

- CityGML:
  - Not only an exchange format, also an information model
  - Not limited to cities
- IMGeo ADE for CityGML:
  - Modelling of every IMGeo class as a CityGML class; Requirement for a remodelling of IMGeo
  - Problem: not for all classes equivalent CityGML classes could be found
- Phase II:
  - Development of implementation tools for IMGeo-CityGML
- Experiences with CityGML for harmonisation with 2D:
  - Linking to 2D makes 3D feasible
  - Standard provides solid base for developments
  - Problems with structuring data according to CityGML
  - Problems:
    - Inheritance of multiplicity of attributes from CityGML classes (e.g. function/usage)
    - Geometry not as attribute
- Presentation of different change requests
- Proposals:
  - Need for interoperability experiments on 3D validation and automated reparation
  - Considerations to better harmonize with 2D
    - 11-102: LOD footprints for all CityGML classes
    - 13-025: allow non-horizontal LOD0 footprint
    - 13-028: Enforce LOD1 and LOD2 buildings as solid
    - Modelling method ADE in standard
    - Adding of class OtherConstructions
    - Address issues if one only wants to work with the ADE

5.3 Support Parameterized Implicit geometries (Carl Steven Smyth, Open Site Plan)

- Content of presentation:

  - Proposal: Use of implicit geometries in CityGML:
    - Reuse of geometry by instances transformed by a 4 x 4 transformation matrix
    - High efficiency in storage, rendering, and analysis (e.g. trees)
    - Definition of key-value pairs to define parameters to further customize individual instances (e.g. for trees: species, diameter at breast height, height, condition;

- Content of discussion:

    - Attributes needed for an implicit geometrical representation are already available in CityGML
    - Extension of CityGML by implicit geometries useful for different objects (pipes, vegetation, etc.)

6 Summary, plenary discussion and workshop conclusions

- Suggestions/proposals to be examined further in the future

    - Demand for parametric object representation; Library of objects (trees, pipes etc.)
    - Demand for Material properties/physics (?)/libraries/composed materials
    - Need for representation of object specific behaviour
    - General space concept
    - Consolidation of construction modules (buildings, bridges, tunnels, other constructions)
    - Demand for Indoor LODs
    - Requirement of specifying geometric and semantic LODs
    - Extension of the building module (storeys, building units, openings, volumetric components, INSPIRE)
    - Definition of "CityGML light" profile as a CityGML Primer
    - Augmentation of thematic surfaces by "damages", "leakages"
    - Consideration of dynamic properties incl. attributes or appearances
    - Need for complex attributes (including metadata at attribute level)
    - Separation of conceptual model from CityGML encoding incl. UML extensions for the definition of ADEs / separation of conformance requirements
    - Requirement of stable Object IDs over the object's lifetime
    - Importance of conformity with ISO standards

Agenda of the Workshop

From SIG3D Modeling Wiki EN

**This agenda will dynamically evolve in the next two weeks as we receive and accept presentation proposals. Therefore, please check back again soon.
If you want to contribute to the workshop please contact kutzner@tum.de (mailto:kutzner@tum.de) .**

Contents

THURSDAY, 20 June 2013

Topics

- **Improved Support for Simulations and other Applications**, e.g.
  - Coupling of CityGML with different types of simulations; time varying feature properties (spatial and thematic, e.g. energy demand or production potential for a building along the course of the day / week / year)
  - Qualified attributes (metadata at individual attribute level like lineage, accuracy, unit of measure, date of acquisition etc.)
- **LOD Concept of CityGML**, e.g.
  - semantic and geometric LODs
  - definition of separate indoor LODs; floorplans
  - more / less / continuous LOD levels

(A more detailed explanation of the topics can be found here: Workshop Topics)

Agenda

Time	Topic	Presenters
10:00-10:20	Welcome address from the organizers	- Thomas H. Kolbe (Chair of Geoinformatics, TU München) - Steve Smyth or Carsten Roensdorf (Chair of OGC CityGML SWG) - Gerhard Groeger (Chair of Modelling Group of SIG 3D)
10:20-12:30	Improved Support for Simulations and other Applications	- Thomas H. Kolbe (TU München): Using CityGML as a platform for cascading simulations - Heino Rudolf, Volker Kraut (M.O.S.S.): CityGML for Environmental Monitoring - Hardy Stapelfeldt (Stapelfeldt GmbH): Usage of CityGML for Environmental Noise Propagation Simulation - Experiences and Issues - Claus Nagel (virtualcitySYSTEMS): CityGML and Finite Element Method (FEM) based simulations - Requirements and Challenges - Michael Schönstein (Bentley): CityGML based 3D modeling with Bentley MicroStation & Map V8i
12:30-13:30	Lunch break	
13:30-15:00	LOD Concept of CityGML	- Joachim Benner (Karlsruhe Institute of Technology): SIG3D Proposal for an enhanced CityGML LOD Concept - Filip Biljecki, John Zhao, Jantien Stoter, Hugo Ledoux (TU Delft): Towards an integrated definition of the concept of LoDs in 3D city modelling [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/IntegratedDefinitionOfTheLoDConceptIn3DCityModelling_BiljeckiZhaoStoterLedoux.pdf)]
15:00-15:30	Coffee break	
15:30-17:00	LOD Concept of CityGML	- Claus Nagel (virtualcitySYSTEMS): Integrating LODs from different data sources - A practical view on the CityGML LOD concept - Tatjana Kutzner (TU München): Thoughts about the CityGML LOD concept and its modification
18:00-22:00	Social Event in a Munich beer garden or cellar <<< New - The directions: [Augustinerkeller (http://en.wiki.modeling.sig3d.de/images/upload/Augustinerkeller.pdf)] >>>	

FRIDAY, 21 June 2013

Topics

- **Extension of CityGML by new Objects**, e.g.
  - Support for other types of constructions like walls, fences etc.
  - Utility networks (e.g. UtilityNetworkADE)
- **Stronger Harmonisation with 2D Cadastre and Models**, e.g.
  - Admissibility of 2D geometries, definition of LOD0

(A more detailed explanation of the topics can be found here: Workshop Topics)

Agenda

Time	Topic	Presenters
09:00-10:30	Extension of CityGML by new Objects	- Thomas Becker (TU Berlin): Extending CityGML for Utility Networks - Joachim Benner (Karlsruhe Institute of Technology): Proposals of SIG3D and KIT for new features in the Building module - Ki-Joune Li (Pusan National University): Linking IndoorGML with CityGML - Linda van den Brink (Geonovum), Marie-Lise Vautier (IGN): Extending CityGML for other constructions [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/ExtendingCityGMLForOtherConstructions_VanDenBrinkVautier.pdf)] - Dorota Iwaszczuk, Ludwig Hoegner, Silvia Beer, Susanne Casper, Uwe Stilla (TU München): Potential to store façade information in CityGML
10:30-11:00	Coffee break	
11:00-12:30	Extension of CityGML by new Objects	- Gerhard Gröger (Universität Bonn): Harmonization between CityGML and INSPIRE Buildings - Carl Steven Smyth (Open Site Plan): Separate the Conceptual Model from the CityGML Encoding [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/SeparateTheConceptualModelFromTheCityGMLEncoding_Smyth.pdf)] - Linda van den Brink (Geonovum): UML-Based Approach to model Application Domain Extensions of CityGML [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/UMLBasedApproachToModelADEsOfCityGML_vanDenBrink.pdf)] - Detlev Wagner (Hochschule für Technik Stuttgart): Reorganization of Conformance Requirements [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/ReorganizationOfConformanceRequirements_Wagner.pdf)]
12:30-13:30	Lunch break	
13:30-15:00	Stronger Harmonisation with 2D Cadastre and Models	- Carsten Roensdorf (Ordnance Survey): Integration of 3D cadaster, addressing and topography - Jantien Stoter (TU Delft): The national CityGML standard in The Netherlands: explanation, experiences and requests for stronger harmonisation with 2D models [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/TheNationalCityGMLStandardInTheNetherlands_Stoter.pdf)] - Carl Steven Smyth (Open Site Plan): Add Support for Parameterized Implicit Geometries [Abstract (http://en.wiki.modeling.sig3d.de/images/upload/AddSupportForParameterizedImplicitGeometries_Smyth.pdf)]
For members of OGC CityGML SWG only:		
15:30-17:00 (17:30)	OGC CityGML SWG Meeting	

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- This page was last modified on 18 June 2013, at 13:07.

Workshop Topics

From SIG3D Modeling Wiki EN

In various meetings and discussions SIG 3D, OGC CityGML SWG and TUM have collected several topics which are important for the further development of the CityGML standard. However, before starting with the development of a new major version of CityGML, it was regarded as useful to first discuss these topics in a workshop with a broader audience. In the following paragraphs we describe each topic in more detail and indicate why the topic is important.

Contents

- 1 Improved Support for Simulations and other Applications
- 2 LOD Concept of CityGML
- 3 Extension of CityGML by new objects
- 4 Stronger Harmonisation with 2D Cadastre and Models

Improved Support for Simulations and other Applications

On the one hand CityGML is a very useful and important source of information for different types of simulations, whereas on the other hand the results of simulations can be fed back to the original CityGML data for thematic enrichment and data fusion. Therefore, semantic 3D city models and simulations should become tighter coupled in the future.

In most simulations time plays an important role, i.e. dynamic / time-varying feature properties (spatial and thematic, e.g. electrical energy demand or production potential for a building along the course of the day / week / year), which are not yet supported in CityGML.

Furthermore the quality of individual attributes needs to be represented and propagated when different attributes are combined (e.g. multiplied). This requires the definition of qualified attributes (metadata at individual attribute level like lineage, accuracy, unit of measure, date of acquisition etc.) This concept is similar to the INSPIRE complex attributes but the definition should be done in a more systematic way.

LOD Concept of CityGML

Currently the CityGML specification defines five LODs. However, several works exist which suggest modifications or even a replacement of the current LOD concept. These include the separation of the current LODs into semantic and geometric LODs, complementing the current concept by separate indoor LODs, or introducing more / less / continuous LOD levels.

This topic induces a fundamental change to the current structure of CityGML and thus needs to be discussed thoroughly in a larger round of developers, users and data providers before any decision will be made. The alternative suggestions have to be analysed and their advantages and disadvantages over the current concept have to be identified. Only afterwards it will be possible to decide whether the current LOD concept should be kept or modified. This decision has also to take into account the opinion of the users of CityGML, i.e. if

the acceptance of a new LOD concept will be given by them, if the new concept will be easy to understand and if the investments for implementing the new concept are bearable.

Extension of CityGML by new objects

CityGML only provides some basic objects and attributes. If for a certain application more specific objects and attributes are required, they can be added to CityGML by means of an ADE or by generics. However, it has been proposed to add permanent support for other types of constructions like walls, fences etc., by defining specific feature types for these objects. Furthermore, suggestions have been made to extend the Buildings module by Storeys, BuildingUnits, building components and further attributes. These concepts exist in the INSPIRE Buildings theme and they have also been requested by several CityGML users. Other possible extensions might be utility networks (e.g. UtilityNetworkADE) and metadata at dataset level. Another important topic is the extension of CityGML by BIM/IFC concepts. CityGML and BIM represent similar but not identical concepts. To support a smoother conversion between the two concepts, the CityGML Buildings module needs to be extended by relevant BIM concepts such as volumetric elements. However, due to the extensiveness of this topic we want to delay the discussion to a later workshop in about seven to nine months or even to organise a workshop dealing specifically with this topic only and addressing primarily the BIM community.

Stronger Harmonisation with 2D Cadastre and Models

CityGML currently does not allow 2D geometries to be added to the data. Furthermore, buildings cannot be represented by 3D points and 2,5D geometries always have to be defined with a constant z value. Due to the increasing importance of INSPIRE and the migration of national frameworks to 3D, where these geometries are admissible, it needs to be discussed whether 2D geometries are to be allowed in CityGML as well and whether the definition of LOD0 should be modified to allow unique z values and 3D points.

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International OGC, SIG 3D and TUM Workshop
on Requirements for CityGML 3.0

Social Event: 20 June 2013, 18:00-22:00

Source: www.augustinerkeller.de

Venue: Augustiner-Keller
           Arnulfstr. 52
           80335 München
           www.augustinerkeller.de

Source: maps.google.de/