



Overview of CityGML

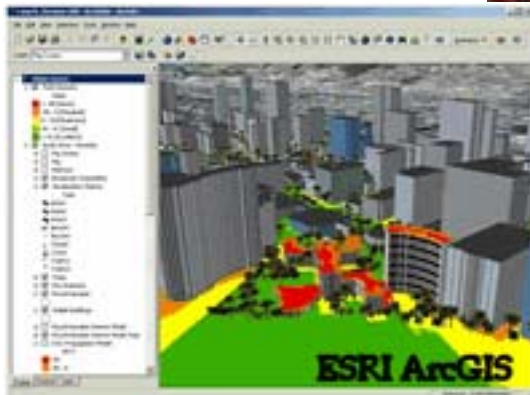
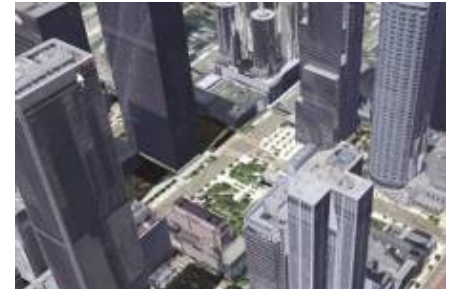
Dave Capstick, Ordnance Survey
Research Department

Introduction

- Why is cityGML necessary
- CityGML development – who is responsible?
- Ordnance Surveys interest
- 3D modelling – basic concepts
- CityGML – the basics
- CityGML in detail
 - Individual themes – buildings, DTMs
 - Other modelling concepts
- OGC Standards & Web Services
- Application Domain Extensions - ADE
- Example datasets
- Conclusions

Why is CityGML necessary?

- Increasing interest in 3D
- Research shown a definite need for 3D
- Standards led approach



Responsibility for CityGML

- Origins are with the Geodata Infrastructure North Rhine-Westphalia – 6 SIG WG
- Special Interest Group 3D (SIG3D)
 - Open group >70 members
 - Members range from industry, government, municipalities and academia
 - Participants from Germany, Austria, Switzerland and UK
 - Technical leads are Thomas Kolbe and Gerhard Gröger

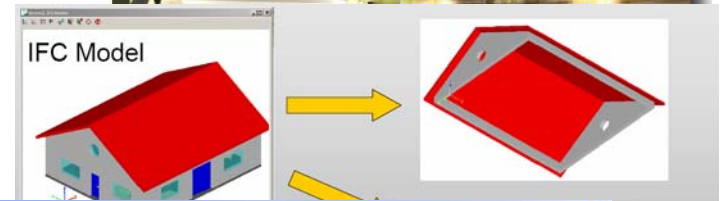
Why is Ordnance Survey interested in cityGML?

- OS have had an interest in 3D for a number of years
- Customer research – high level of interest
- OS competes with commercial organisations
- Thought leader
- Extensive research at OS
 - Requirements from customers
 - Requirement for a 3D standard

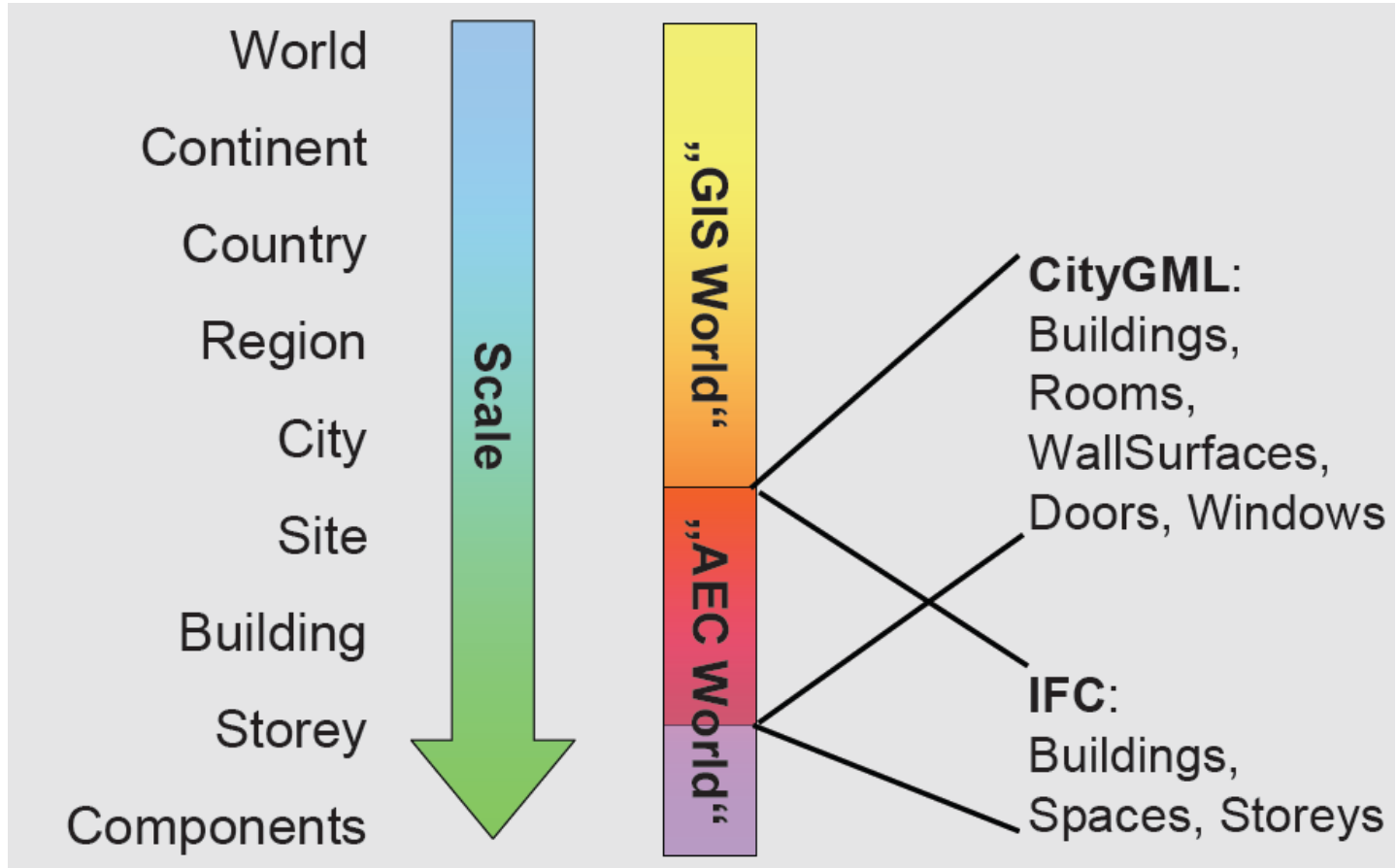
3D modelling – an introduction

- 3D Modelling can be applied to several different domains/industries

- Computer graphics - visualisation
- CAD/BIM (IFC)
- GIS



CityGML and BIM / IFC



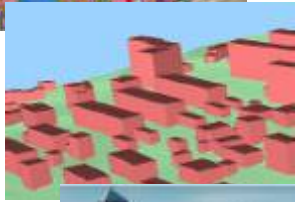
CityGML – the basics

- Application independent topographic information model for virtual 3D city models
- Comprises different themes – buildings, terrain, etc
- Data model (UML) ISO 191xx standard family
- Exchange format
- Realised as a GML3 application schema
- August 2008 – cityGML version 1.0.0 accepted as an official OGC standard
- Represents 4 important aspects of virtual 3D city models
 - Geometry
 - Topology (Optional)
 - Semantics
 - Appearance (Optional)

CityGML – goals

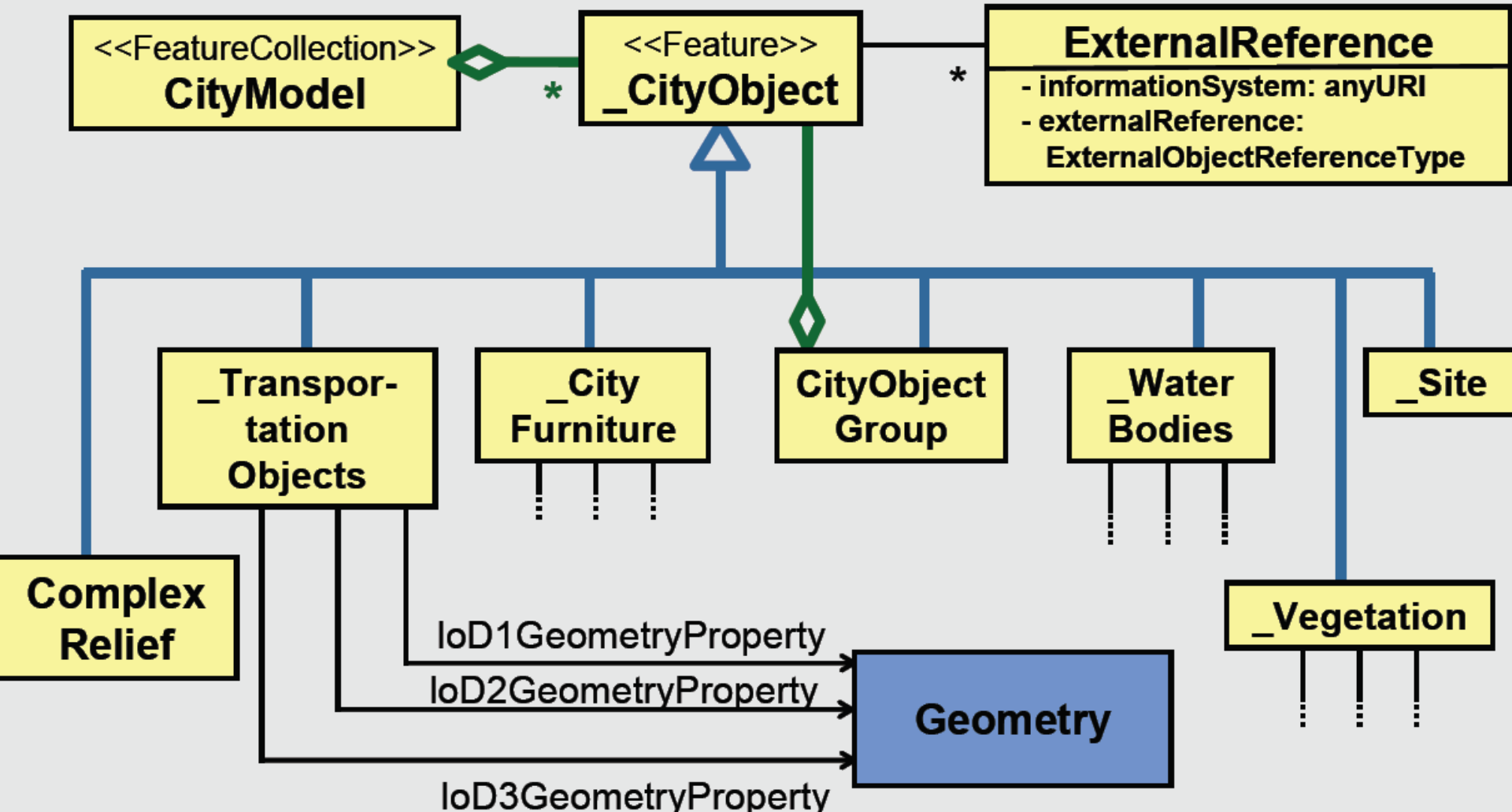
- Establish a high degree of semantic interoperability
 - Enable multifunctional usage of 3D models
 - Definition of a common information model
 - Potential for 3D geo database (similar to more traditional 2D)
- Representation of observed 3D topography
 - Explicit 3D shapes – surfaces and volumes
 - Identification of most relevant feature types – useful for variety of applications
- Suitable for use in SDI
- Simple to use

Multi-scale modelling - Level of Detail



- **LOD 0 — Regional Model**
2.5D Digital Terrain Model
- **LOD 1 — City model**
block model, no roof structures
- **LOD 2 — City model**
roof structures, optional textures
- **LOD 3 — Site model**
detailed architectural model
- **LOD 4 — Interior model**
Walkable interior spaces

More detail – Thematic modelling



The building model

- Coherent aggregation of spatial and semantical components
 - (recursive) composition of building parts
 - Thematic surfaces – roofs, wall etc
 - Building installations – dormers, stairs, balconies (from LOD2)
 - Openings – doors, windows (from LOD3)
 - Rooms and furniture (only LOD4)
- Components contain relevant thematic attributes
 - Name, class, function, usage (dates, roof type, address)
 - Number of storeys above/below ground
- Surface appearance – textures and colours

The building model

3D-Modell: Stadt Coburg



BuildingInstallation
(Dormer)

BuildingPart

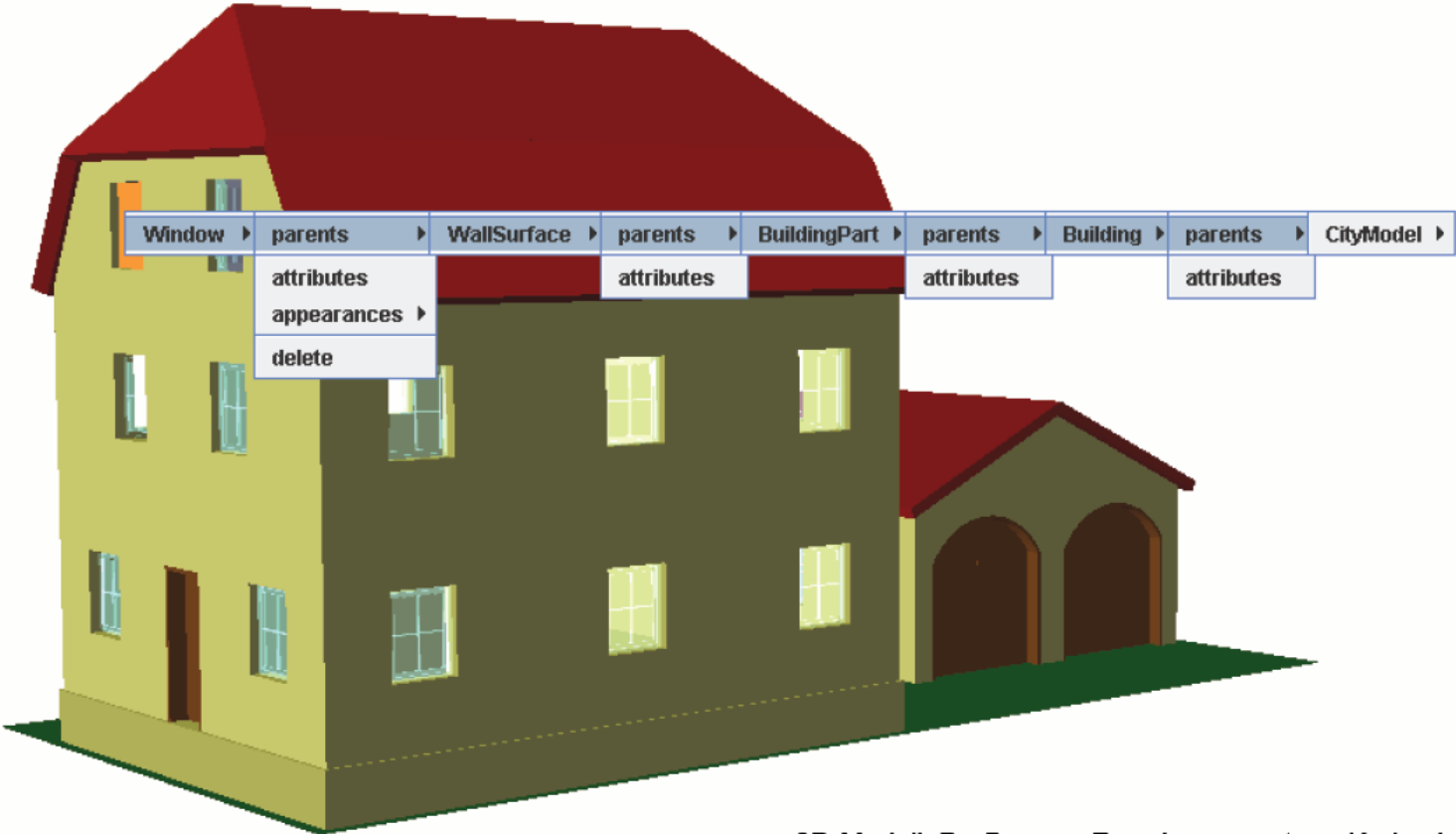
Building

BuildingPart

Building surface
(WallSurface)

Building

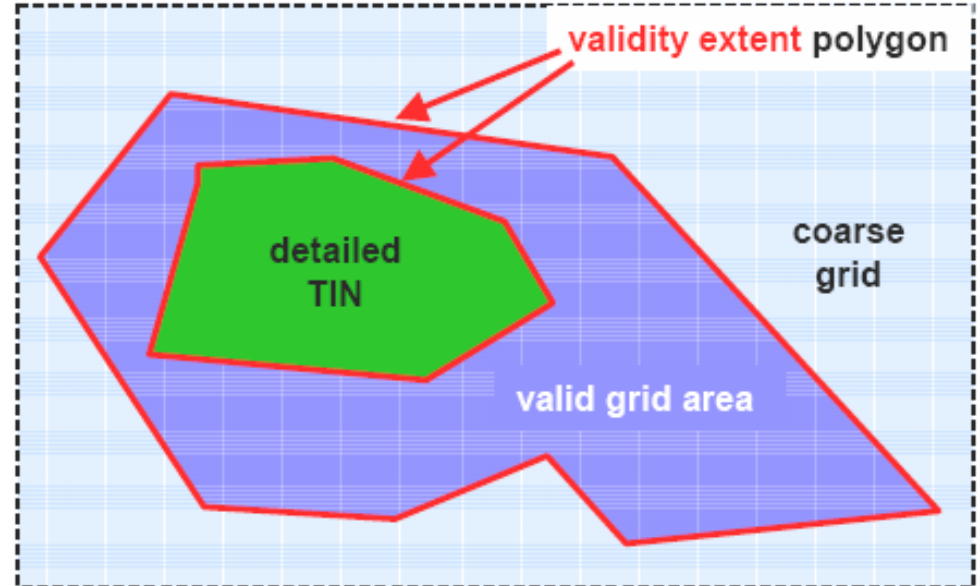
Example – Building model at LOD3



Digital terrain models

DTM at each LOD can be composed of –

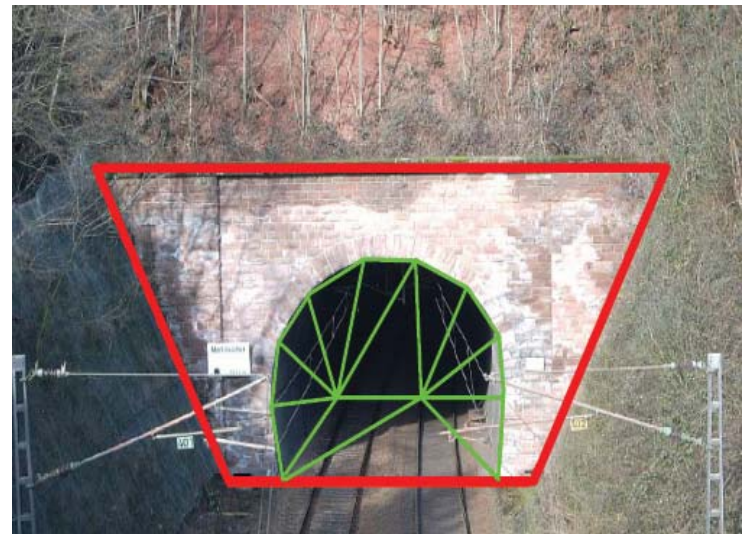
- Triangulated Irregular Network (TIN), grids, 3D breaklines and 3D Mass points
- Each DTM component can be restricted to be valid in a specific region – validity extent polygon
 - Nested DTMs



Other concepts - Support for spatial homogenisation - Terrain Intersection Curve

Often a poor correspondence between terrain and features on the terrain

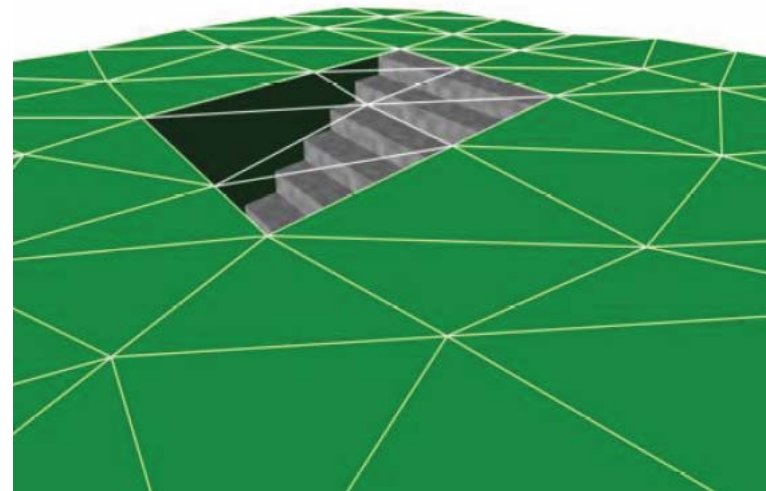
- Leads to features floating/sinking below terrain surface
- Terrain Intersection Curve, TIC, ensures matching
- DTM may be locally warped to fit the TIC



Other concepts - Closure surfaces

Open ended objects may exist – buildings, terrain

- Closure surface concept – seals 3D objects
- Allows computation of volumes

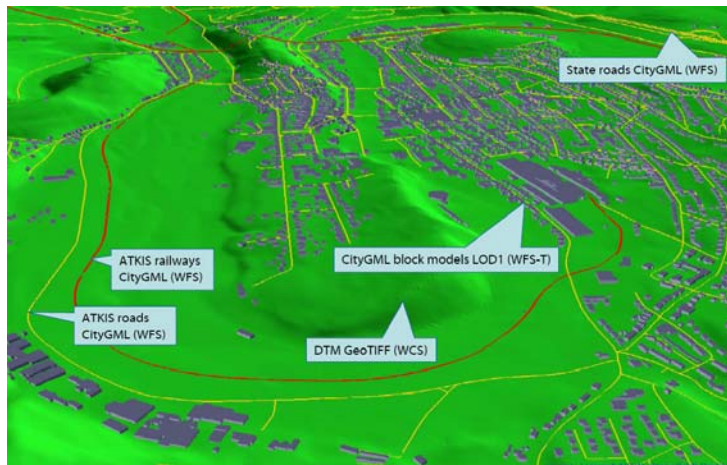


Other concepts

- Explicit linking – every citygml object can have an arbitrary number of links to external resources
- Topology
 - Do not use complex topology that exists in GML3
 - Explicit modelling – sharing of geometry between features
 - Xlinks - geometries have Ids – referenced using href attribute
- Appearance model – based on X3D, Collada
 - Models textures and colours

Web Services

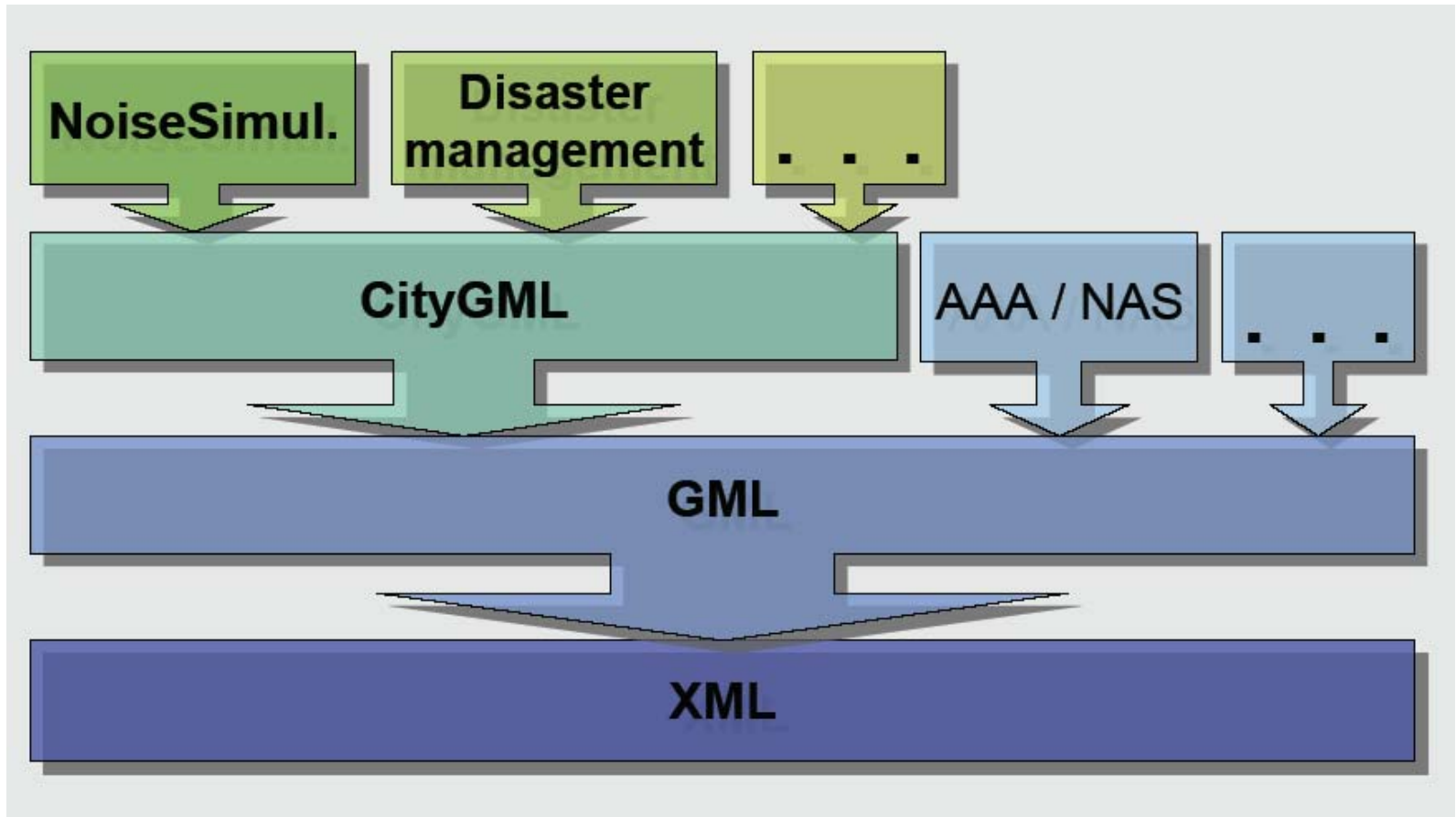
- CityGML based on GML3 – combines with other OGC standards
 - WFS, CS-W, WCTS and WPS especially
- Examples
 - OGC Web Services – 4 (OWS-4) Testbed – showed how cityGML/IFC 3D data can be used in disaster management
 - Statewide 3D SDI with cityGML – NRW. Noise modelling
 - SDI Berlin – city urban planning, civic participation etc



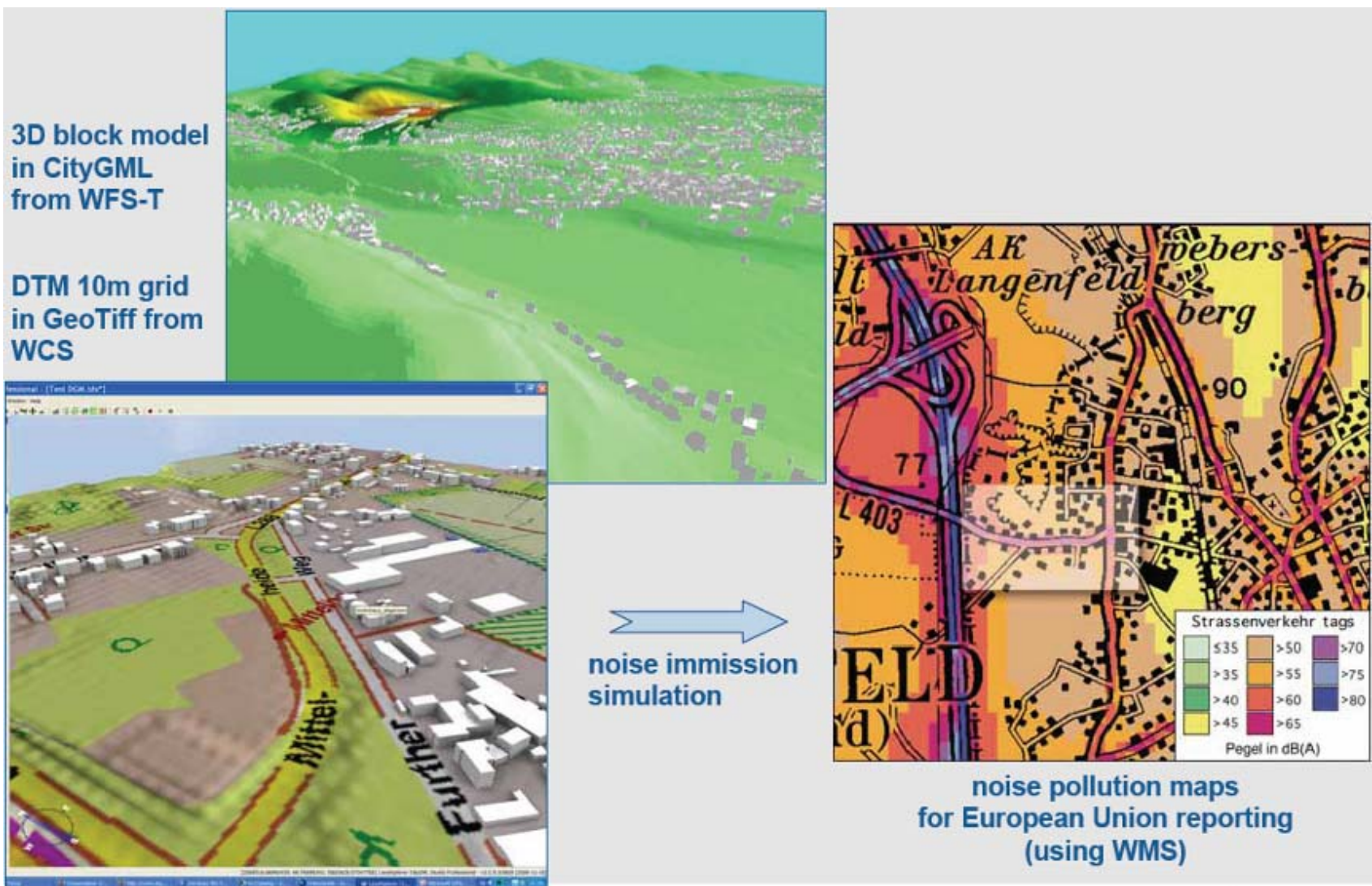
Application Domain Extensions

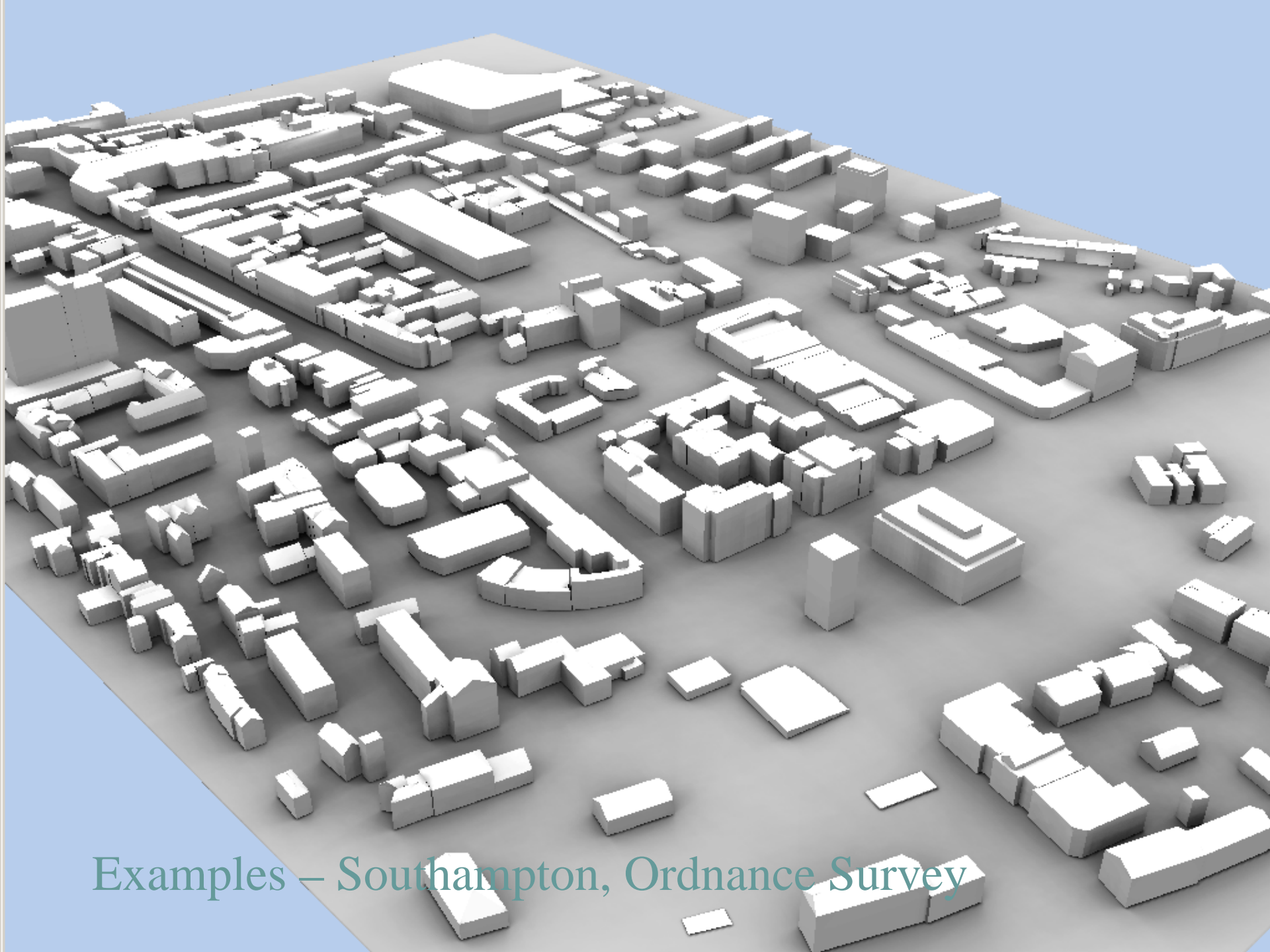
- CityGML – Base information model. Specific applications need extra information. E.g. Environmental simulations, Utility networks, etc
- Types of domain extension
 - Extend existing cityGML feature types
 - Extra spatial/non spatial attributes
 - Extra relations/associations
 - Definition of new feature types
 - Preferably based on cityGML base class CityObject

Application Domain Extensions



Examples - Noise simulation using Noise ADE





Examples – Southampton, Ordnance Survey



Berlin

**Large models:
55 000 detailed buildings**

(>50km²)

Image: Reality maps, Berlin 3D

Conclusions

- CityGML is a Geospatial Information model (based on ISO191xx), which can be mapped to a database environment
- Exchange format for virtual 3D city and regional models (realised as a GML3 Application schema)
- CityGML represents geometry, topology, **semantics** (esp. important) and appearance
- Can be considered as a rich 3D information source for generation of 3D visualisations
- Not just a tool for visualisations – semantics
- Model contains most important core concepts – these can be extended for particular applications
- Recently accepted as OGC standard and is creating high level of interest – software being developed, applications etc

Any questions?

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