



# Ordnance Survey Linked Data

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# Ordnance Survey today

- Ordnance Survey is 222 years old
- Civilian organisation since 1983; 1100 staff
- Independent Government Department and Executive Agency reporting directly to a Government Minister
- Trading Fund since April 1999
- Southampton headquarters with 26 field offices in Great Britain



# Role as national mapping authority

- Creates and maintains the ‘master map’ of Great Britain from which others derive benefit
- Manages complete national large scale digital data down to building level detail
- Maintains a database of 460 million features with over 10 000 changes made daily
- **Topographic Layer**  
Over one million units of change per year.
- **Address Layer**  
27.5 million geocoded postal addresses, with 500 000 changes per year.
- **Transport Network Layer**  
5.37 million kms of roads—  
over 20 000 changes per month.

Provides the underpinning geographic framework for Great Britain

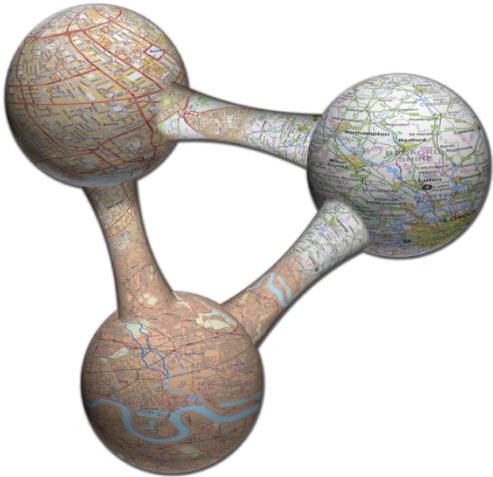
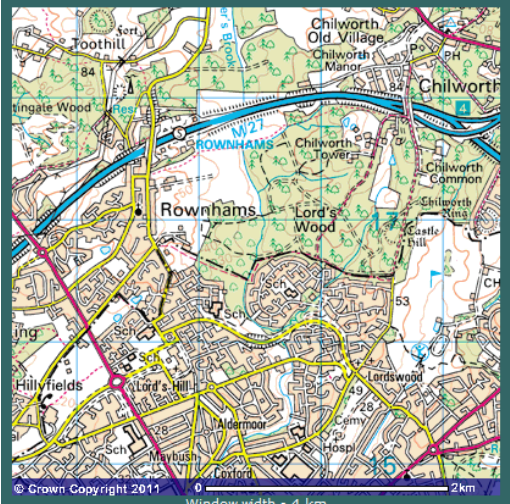


# Five stars of linked (open) data

- ☆ Available on the web (whatever format) (*but with an open licence, to be open data*)
- ☆ ☆ Available as machine-readable structured data (for example, Excel<sup>®</sup> instead of image scan of a table)
- ☆ ☆ ☆ As (2) plus non-proprietary format (for example, CSV instead of Excel)
- ☆ ☆ ☆ ☆ All the above plus, use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff
- ☆ ☆ ☆ ☆ ☆ All the above, plus: link your data to other people's data to provide context



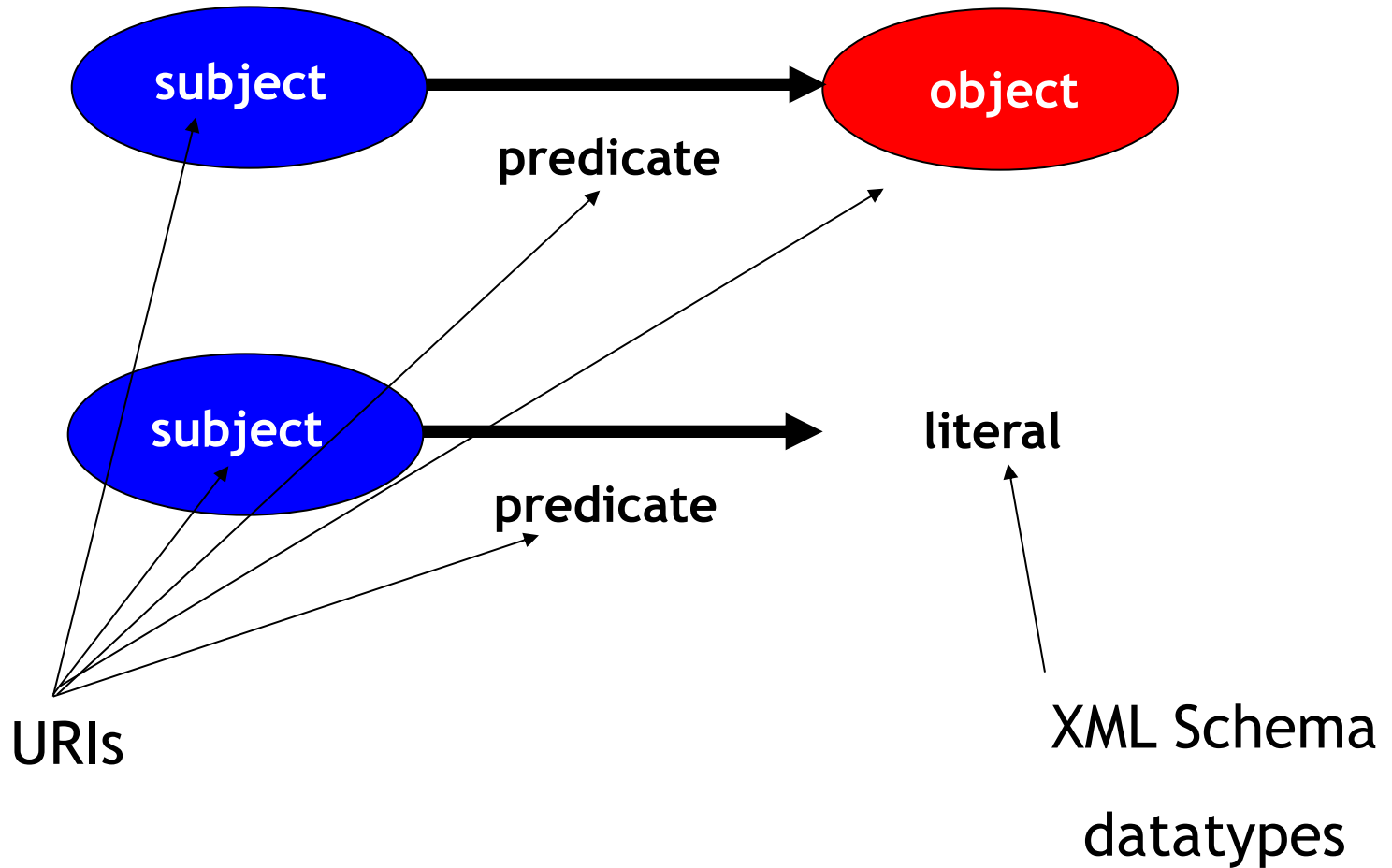
# Towards a web of linked data...



# RDF

- Resource Description Framework
- Been around for over 10 years
- W3C Standard
- Specialist databases – Triplestores
- SPARQL query language
- It is to the 'web of data' what HTML is to the 'web of documents'

# The Data Model



# Towards a URI for every 'place' in GB

The City of Southampton:

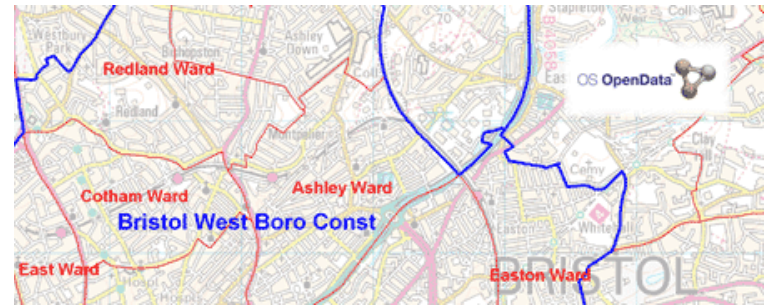
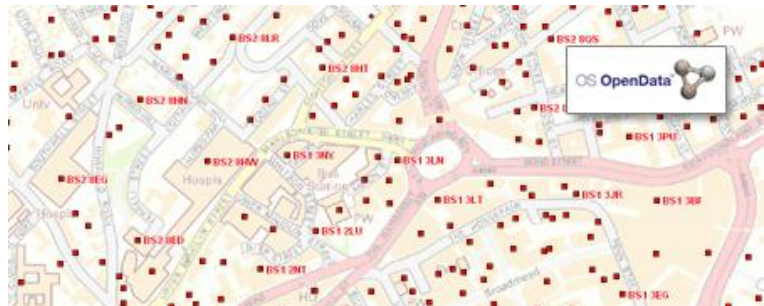
<http://data.ordnancesurvey.co.uk/id/7000000000037256>

Bevois:

<http://data.ordnancesurvey.co.uk/id/7000000000017707>

The postcode unit SO17 1DP:

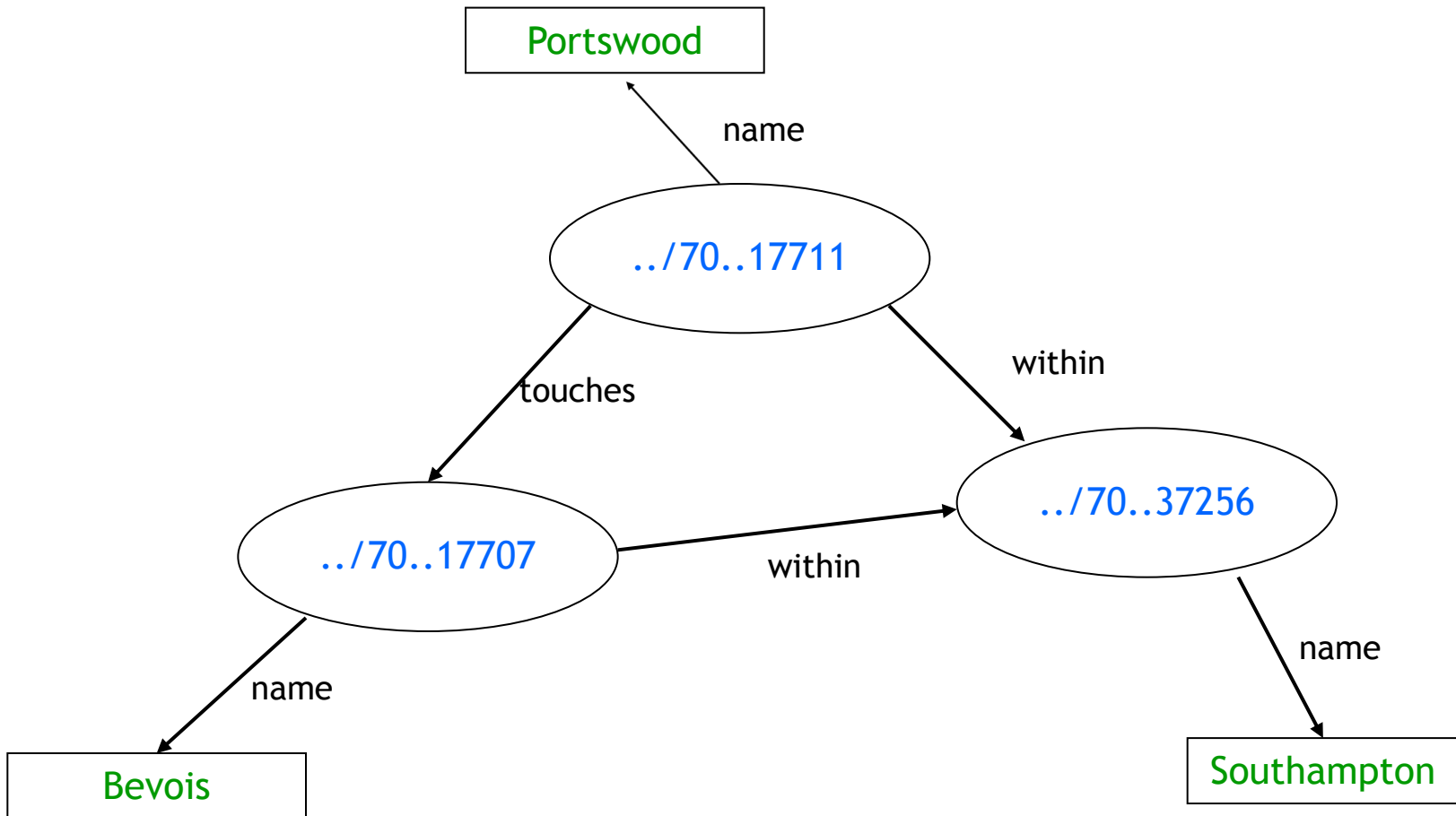
<http://data.ordnancesurvey.co.uk/id/postcodeunit/SO171DP>



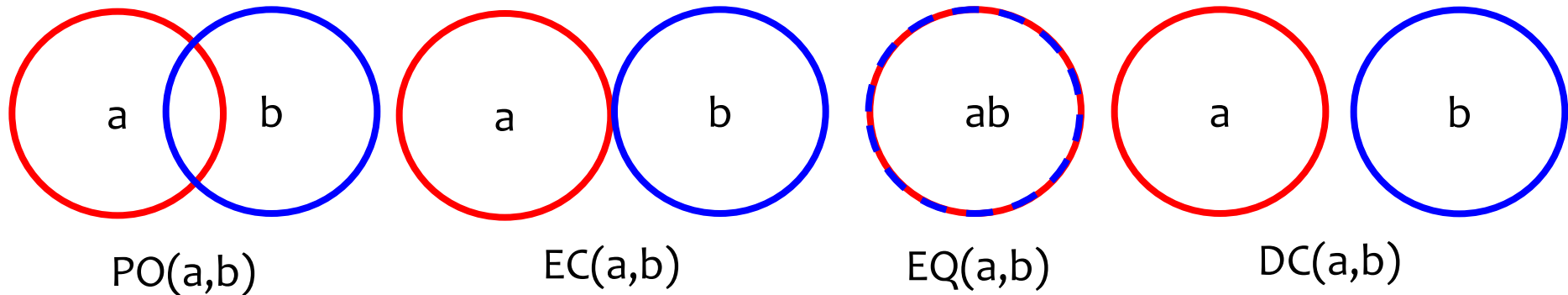


# Qualitative Spatial Relationships

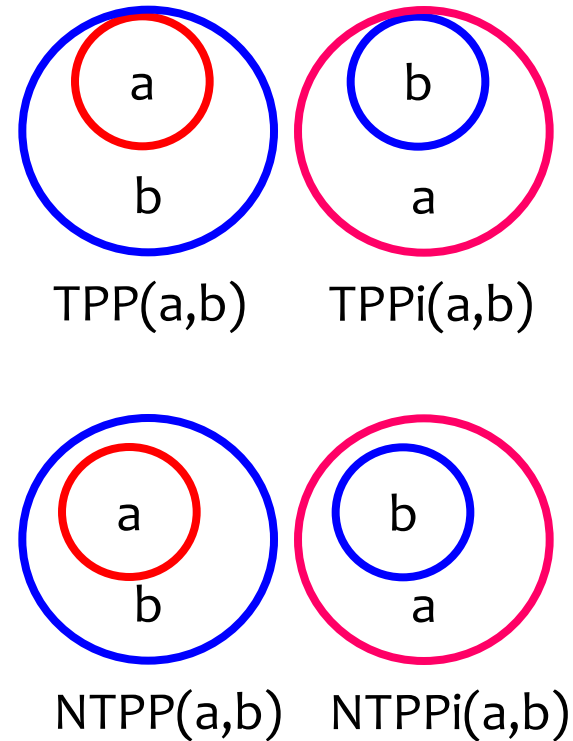
- Most semantic technologies are not geospatially enabled
- Some are, but implementations not that mature
- Qualitative spatial relationships



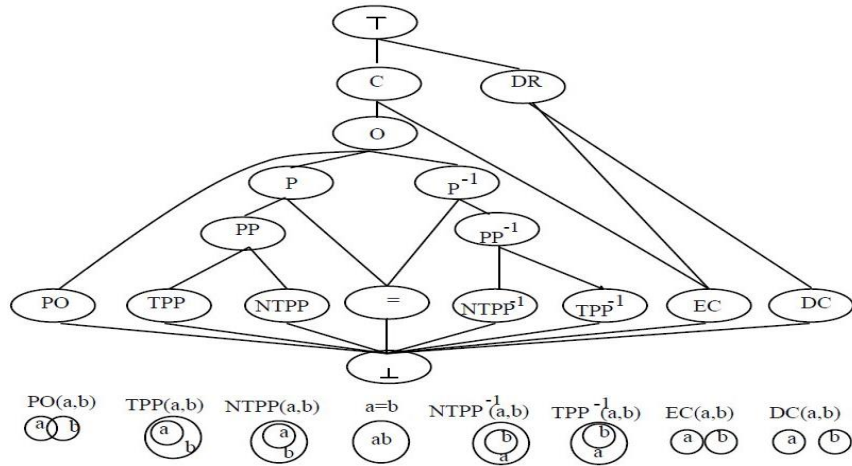
# Region Connection Calculus



disconnected (DC)  
 externally connected (EC)  
 equal (EQ)  
 partially overlapping (PO)  
 tangential proper part (TPP)  
 tangential proper part inverse (TPPi)  
 non-tangential proper part (NTPP)  
 non-tangential proper part inverse (NTPPi)



# Region Connection Calculus



- DC Disjoint
- EC Touches
- EQ Equal
- PO Partial overlaps
- TPP Within
- TPPi Contains
- NTPP Within
- NTPPi Contains

o	DC	EC	PO	TPP	NTPP	TPPi	NTPPi	EQ
DC	*	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC	DC	DC
EC	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPP,TPPi,EQ	DC,EC,PO,TPP,NTPP	EC,PO,TPP,NTPP	PO,TPP,NTPP	DC,EC	DC	EC
PO	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPPi,NTPPi	*	PO,TPP,NTPP	PO,TPP,NTPP	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPPi,NTPPi	PO
TPP	DC	DC,EC	DC,EC,PO,TPP,NTPP	TPP,NTPP	NTPP	DC,EC,PO,TPP,TPPi,EQ	DC,EC,PO,TPPi,NTPPi	TPP
NTPP	DC	DC	DC,EC,PO,TPP,NTPP	NTPP	NTPP	DC,EC,PO,TPP,NTPP	*	NTPP
TPPi	DC,EC,PO,TPPi,NTPPi	EC,PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPP,TPPi,EQ	PO,TPP,NTPP	TPPi,NTPPi	NTPPi	TPPi
NTPPi	DC,EC,PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPP,NTPP,TPPi,NTPPi,EQ	NTPPi	NTPPi	NTPPi
EQ	DC	EC	PO	TPP	NTPP	TPPi	NTPPi	EQ

# Spatial Relations Ontology

<http://data.ordnancesurvey.co.uk/ontology/spatialrelations>

6 spatial predicates:

- touches (EC)
- partially overlaps (PO)
- within (TPP  $\sqcup$  NTPP)
- contains (TPPi  $\sqcup$  NTPP)
- spatially equals (EQ)
- disjoint (DC)



# RCC8 semantics in OWL2?

Spatial Relations	Characteristics
disjoint	symmetric
touches	symmetric
partiallyOverlaps	symmetric
equals	symmetric, transitive, reflexive
contains	transitive
within	transitive

Rules
<b>hasSpatialPart(?x, ?y), spatialPartOf(?x, ?y) -&gt; equals(?x, ?y)</b>
<b>disjoint(?x, ?y), touches(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>DR(?x, ?y), connected(?x, ?y) -&gt; touches(?x, ?y)</b>
<b>overlaps(?x, ?y), touches(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>partiallyOverlaps(?x, ?y), spatialPartOf(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>equals(?x, ?y), within(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>DR(?x, ?y), overlaps(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>contains(?x, ?y), equals(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>hasSpatialPart(?x, ?y), partiallyOverlaps(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>
<b>contains(?x, ?y), within(?x, ?y) -&gt; inconsistentWith(?x, ?y)</b>

*property* o equals → *property*

equals o *property* → *property*

within o disjoint → disjoint

disjoint o contains → disjoint

partiallyOverlaps o within → overlaps

contains o touches → connected

Etc...

# GeoSPARQL

<http://www.opengeospatial.org/standards/geosparql>

- OGC Standard

## Simple Features Topological Relations

Relation Name	Relation URI	Domain/Range	Applies To Geometry Types	DE-9IM Intersection Pattern
equals	geo:sfEquals	geo:SpatialObject	All	(TFFFTFFFT)
disjoint	geo:sfDisjoint	geo:SpatialObject	All	(FF*FF****)
intersects	geo:sfIntersects	geo:SpatialObject	All	(T***** *T***** ***T***** ****T****)
touches	geo:sfTouches	geo:SpatialObject	All except P/P	(FT***** F**T***** F***T****)
within	geo:sfWithin	geo:SpatialObject	All	(T**F**F****)
contains	geo:sfContains	geo:SpatialObject	All	(T*****FF*)
overlaps	geo:sfOverlaps	geo:SpatialObject	A/A, P/P, L/L	(T*T***T**) for A/A, P/P; (1*T***T**) for L/L
crosses	geo:sfCrosses	geo:SpatialObject	P/L, P/A, L/A, L/L	(T*T***T**) for P/L, P/A, L/A; (0*****) for L/L

## Egenhofer Topological Relations

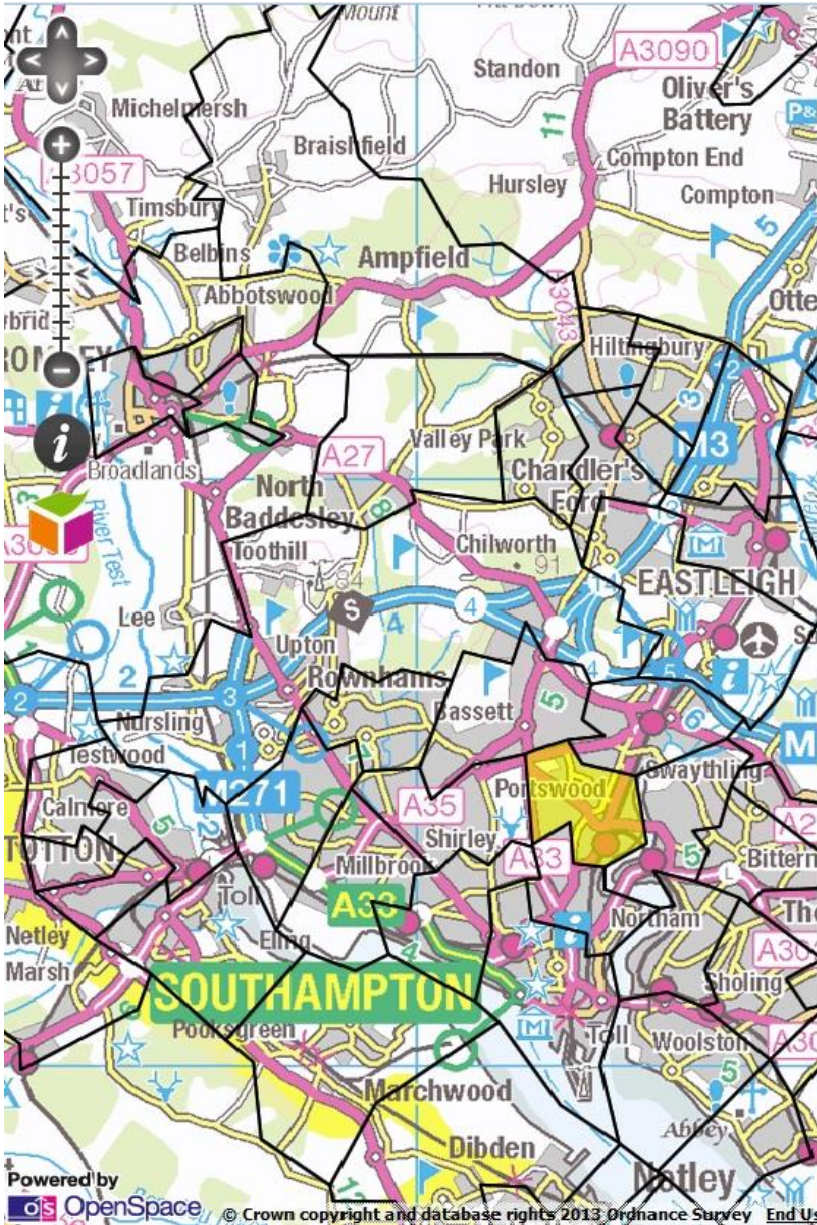
Relation Name	Relation URI	Domain/Range	Applies to Geometry Types	DE-9IM Intersection Pattern
equals	geo:ehEquals	geo:SpatialObject	All	(TFFFTFFFT)
disjoint	geo:ehDisjoint	geo:SpatialObject	All	(FF*FF****)
meet	geo:ehMeet	geo:SpatialObject	All except P/P	(FT***** F**T***** F***T****)
overlap	geo:ehOverlap	geo:SpatialObject	All	(T*T****T**)
covers	geo:ehCovers	geo:SpatialObject	A/A, A/L, L/L	(T*TFT*FF*)
covered by	geo:ehCoveredBy	geo:SpatialObject	A/A, L/A, L/L	(TFF*TFT**)
inside	geo:ehInside	geo:SpatialObject	All	(TFF*FFT**)
contains	geo:ehContains	geo:SpatialObject	All	(T*TFF*FF*)

## RCC8 Topological Relations

Relation Name	Relation URI	Domain/Range	Applies to Geometry Types	DE-9IM Intersection Pattern
equals	geo:rcc8eq	geo:SpatialObject	A/A	(TFFFTEFFT)
disconnected	geo:rcc8dc	geo:SpatialObject	A/A	(FFTFETTTT)
externally connected	geo:rcc8ec	geo:SpatialObject	A/A	(FFTFETTTT)
partially overlapping	geo:rcc8po	geo:SpatialObject	A/A	(TTTTTTTTT)
tangential proper part inverse	geo:rcc8tppi	geo:SpatialObject	A/A	(TTTFTEFFT)
tangential proper part	geo:rcc8tpp	geo:SpatialObject	A/A	(TFFTFETTT)
non-tangential proper part	geo:rcc8ntpp	geo:SpatialObject	A/A	(TFFTFETTT)
non-tangential proper part inverse	geo:rcc8ntppi	geo:SpatialObject	A/A	(TTTFTEFFT)



Simple Features	RCC8	Egenhofer
equals	equals	equal
disjoint	disconnected	disjoint
intersects	$\neg$ disconnected	$\neg$ disjoint
touches	externally connected	meet
within	non-tangential proper part + tangential proper part	inside + coveredBy
contains	non-tangential proper part inverse + tangential proper part inverse	contains + covers
overlaps	partially overlapping	overlap



See UK :: All crime (normalised by Population) at Ward level

Visualise

All crime

Search by [postcode](#)...

normalised

- by Population
- by Area
- actual values

zoom

- Ward
- County
- Region

Portsmouth :: 10 crimes per 1000 people



The picture is centred on Portsmouth, and the circles get further away. Colour indicates the "worst" (red) and "best" (green) areas from those shown. Things can be viewed as a raw value, or normalised by population or area. You can also view how these figures have changed over time.

Sorry that many of the datasets lack data outside England and Wales - when it is published, we will be pleased to include it

[Find out more about this visualisation](#)



# Navigating the Spatial Graph

