Ordnance Survey®

www.ordnancesurvey.co.uk

ArcGIS and Cartographic Production in a National Mapping Agency

John Dancy

Cartographic Production Development Manager

32nd ESRI User Conference 24th July 2012

Overview

- What is Ordnance Survey ?

  and what is “Cartographic Production” ?

- Five production examples of efficiencies introduced through the use of ArcGIS.

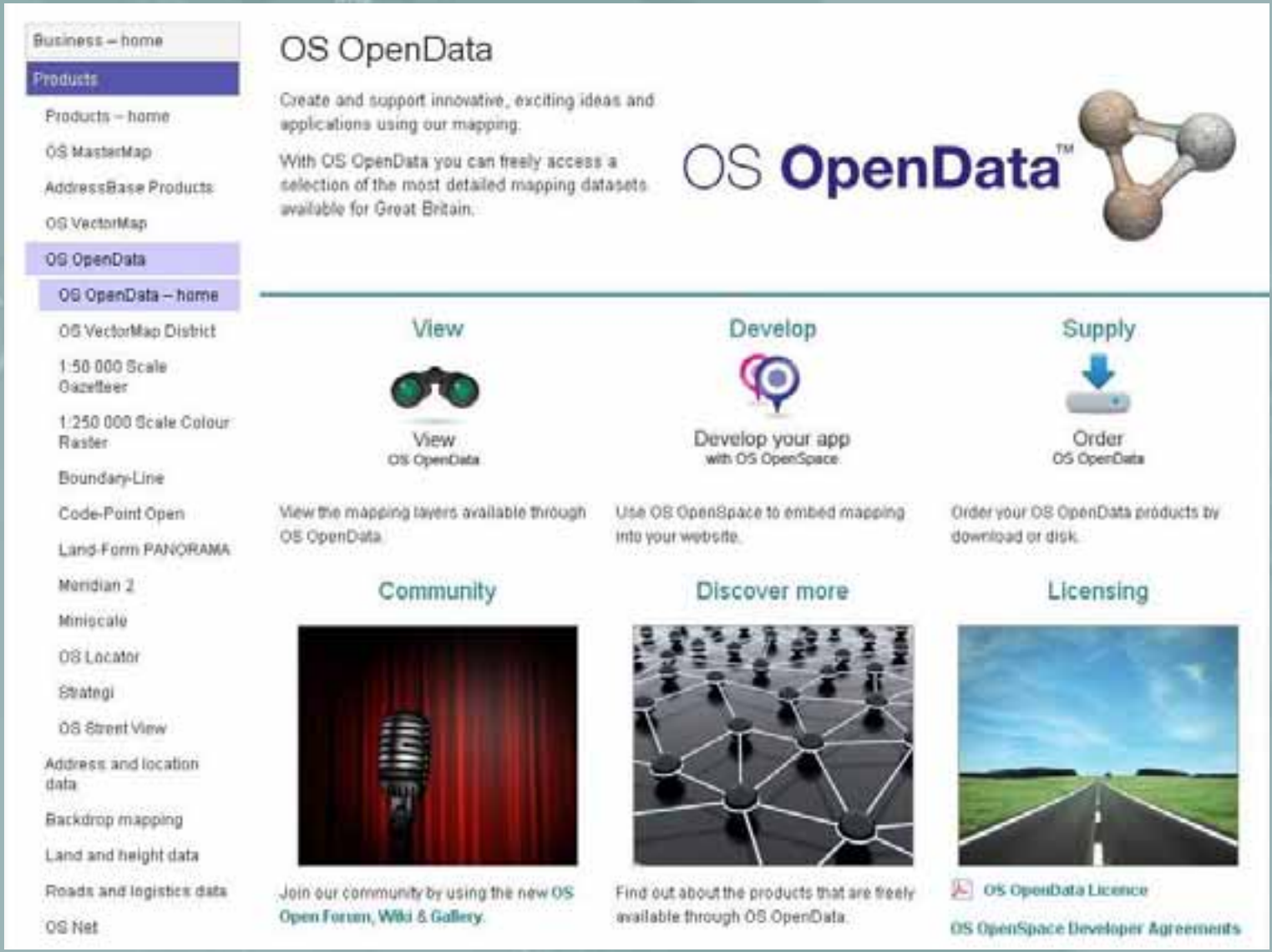
This will show ArcGIS, including v10, has helped

Ordnance Survey - Overview

- Great Britain's National Mapping Agency
- Founded 1791, we are an Executive Agency within a Government Department
- Annual operating turnover (to 1/4/2012) of $202 million, with a profit of $37.6 million
- 1180 staff (1450 in 2007)
- Based in Southampton – with a team of surveyors spread around the country

Cartographic Production

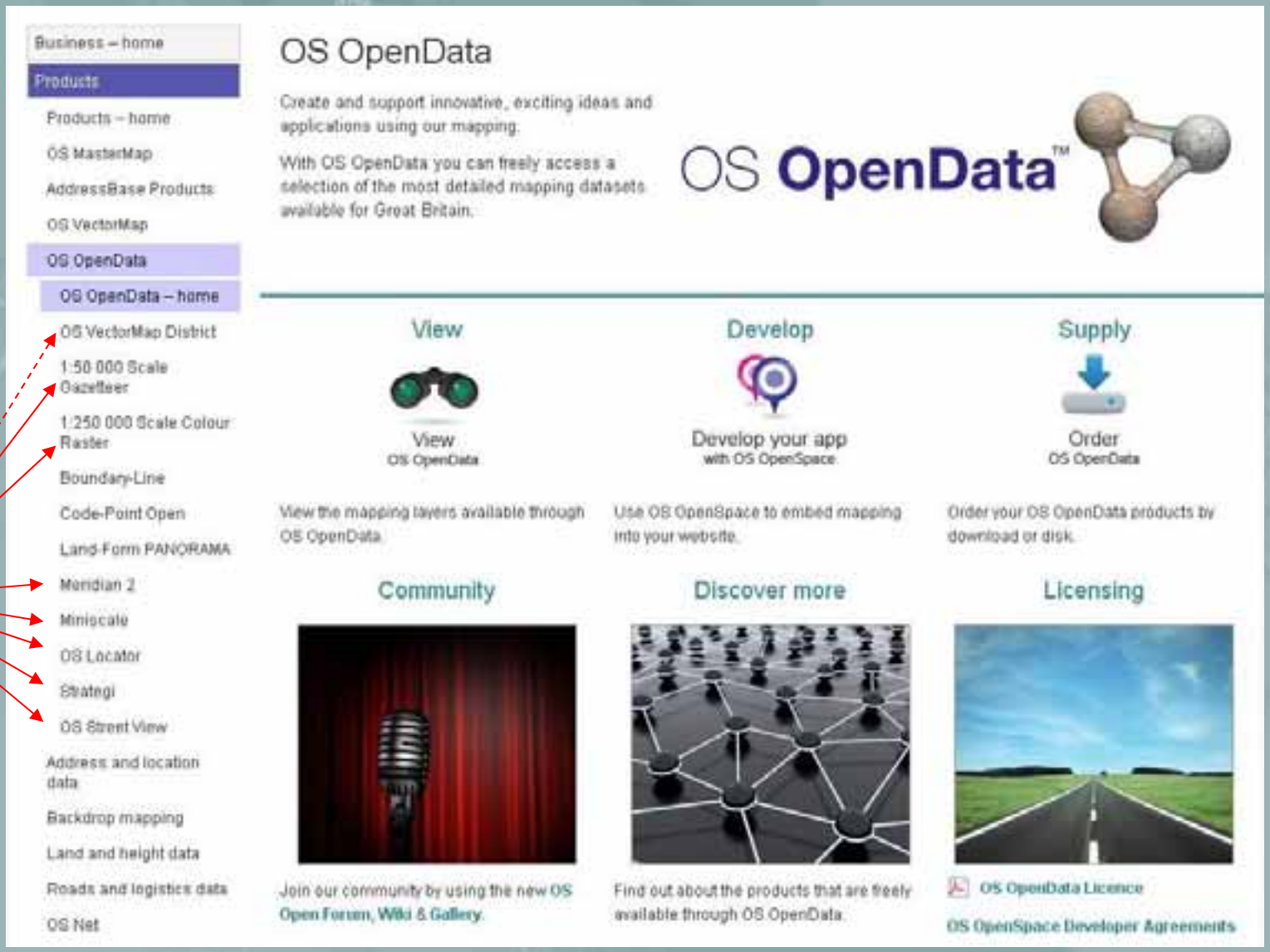
- All graphic products = and <1:10 000 scale
- All derived vector data products
- 43 graphic and data products
- 67 staff



Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk



Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk

Five examples of how we use ArcGIS to help us become more efficient.

32nd ESRI User Conference 24th July 2012

Problem 1:

We had an old and unsupported production system

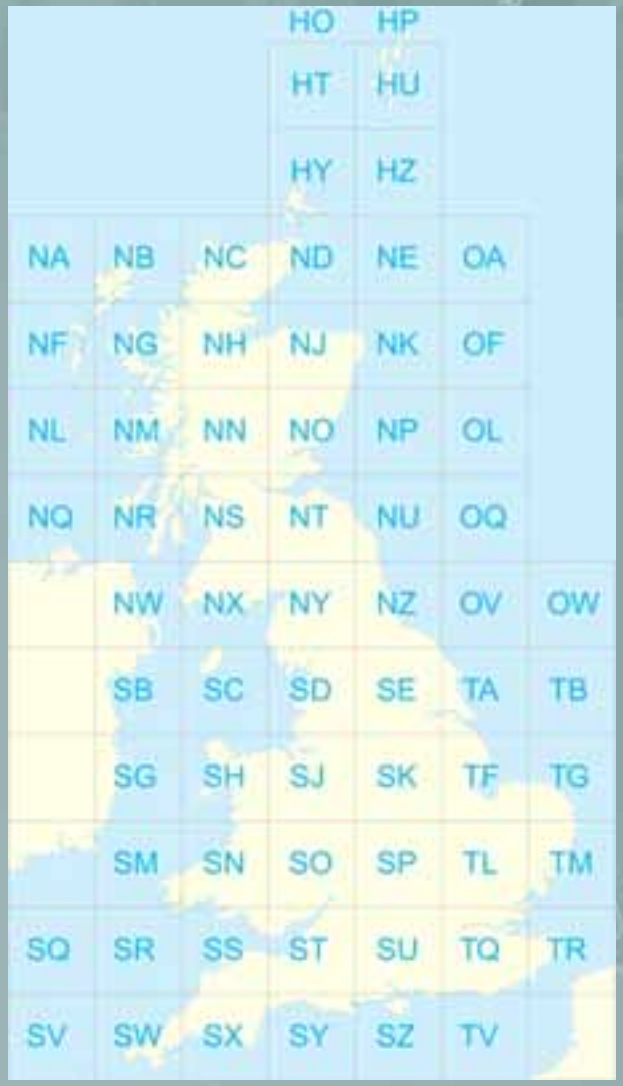
Old Equipment

Not exactly WYSIWYG

~~Software Support~~ – finished April 2006

Hardware Support – E-Bay etc

(but it might not work)



Data for each database was held in up to 55 tiles

And

It was Spaghetti data

Translation of data

1. Analysed existing feature classification

251 relevant feature codes comprising:

45 contours

86 line codes

78 point codes

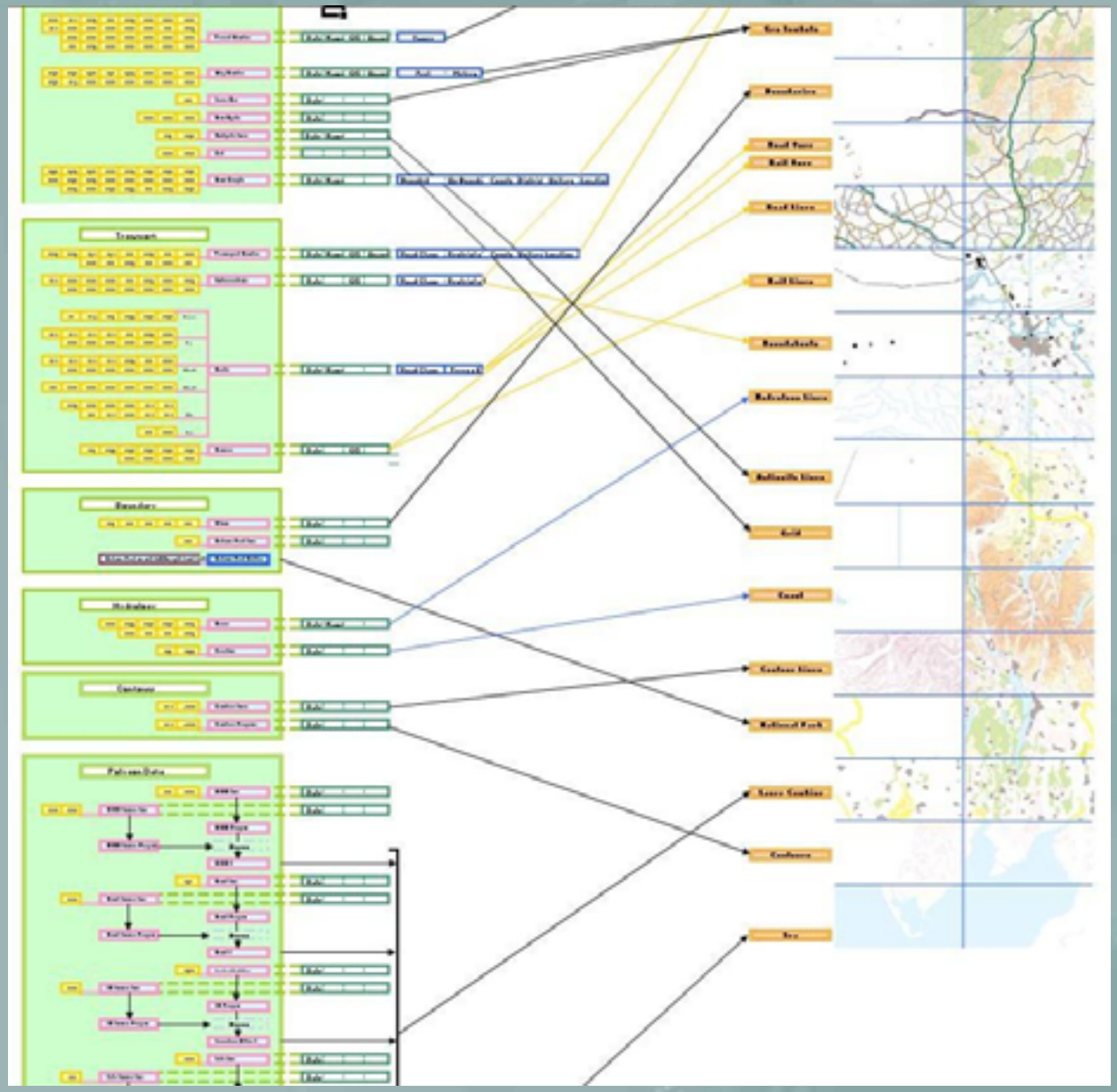
11 polygon codes

31 text features

2. Identify the database structure

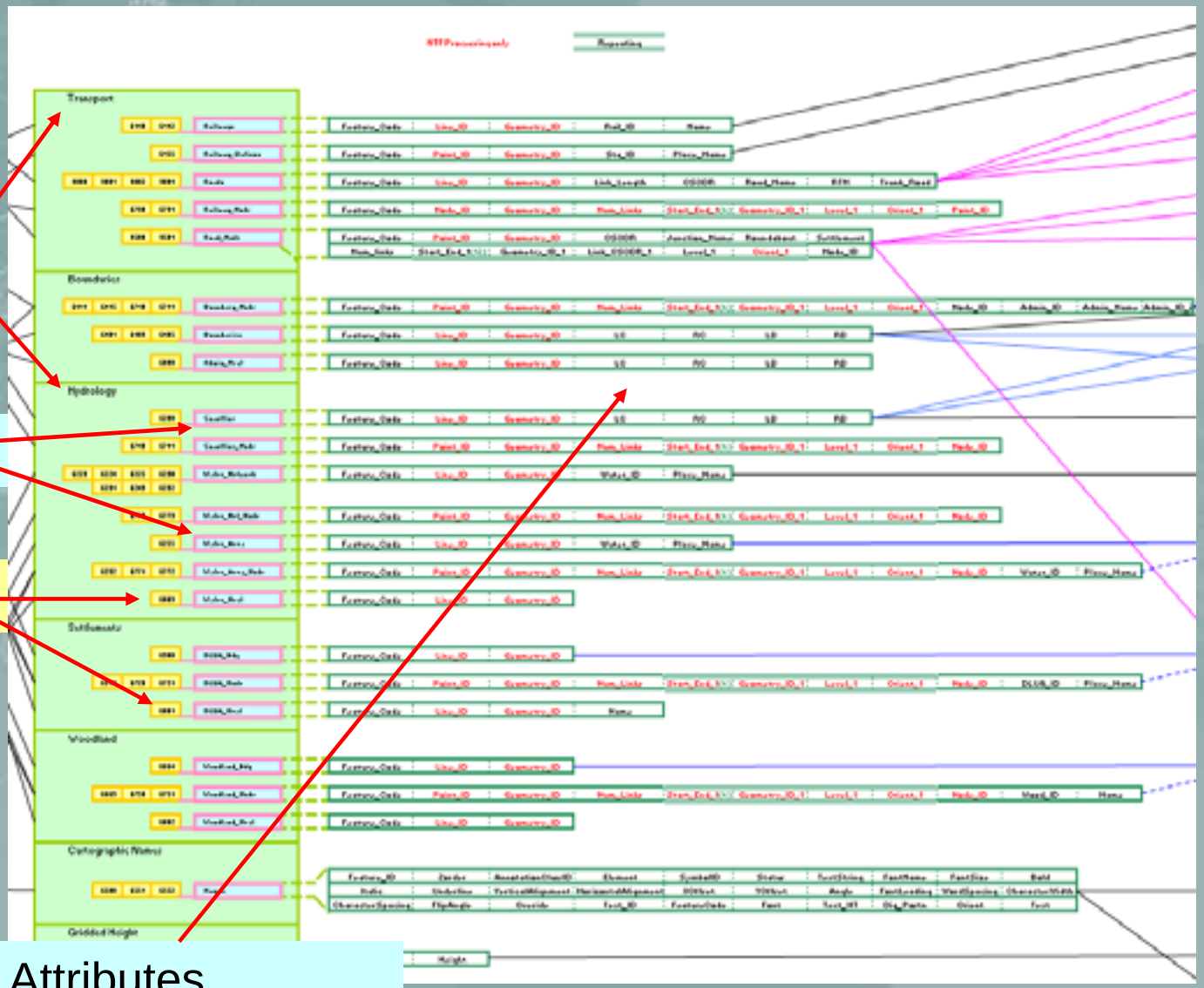
Using the Digest and EuroRegionalMap specifications:

- created 7 themes (databases) and 52 feature classes
- allocated lines, points and polygons to these feature classes
- drew up a diagram of how they all fitted together



Using the databases:

Built the Map



Themes

Feature Classes

Feature Codes

Attributes

Ordnance Survey

32nd ESRI User Conference 24th July 2012

Using ArcGIS we created a transfer process that automatically transfered the data into these feature classes.

This allowed us to continue updating the original data whilst we were building the system.

3. Issues with spaghetti data on translation.

Lines can transfer as lines or polygons

because lines can go round in a loop

Polygons can transfer as lines

Because the sides might not be closed

Features do not meet at tile edges

A 962,000 meter contour had a 14 meter gap at the end

Also:

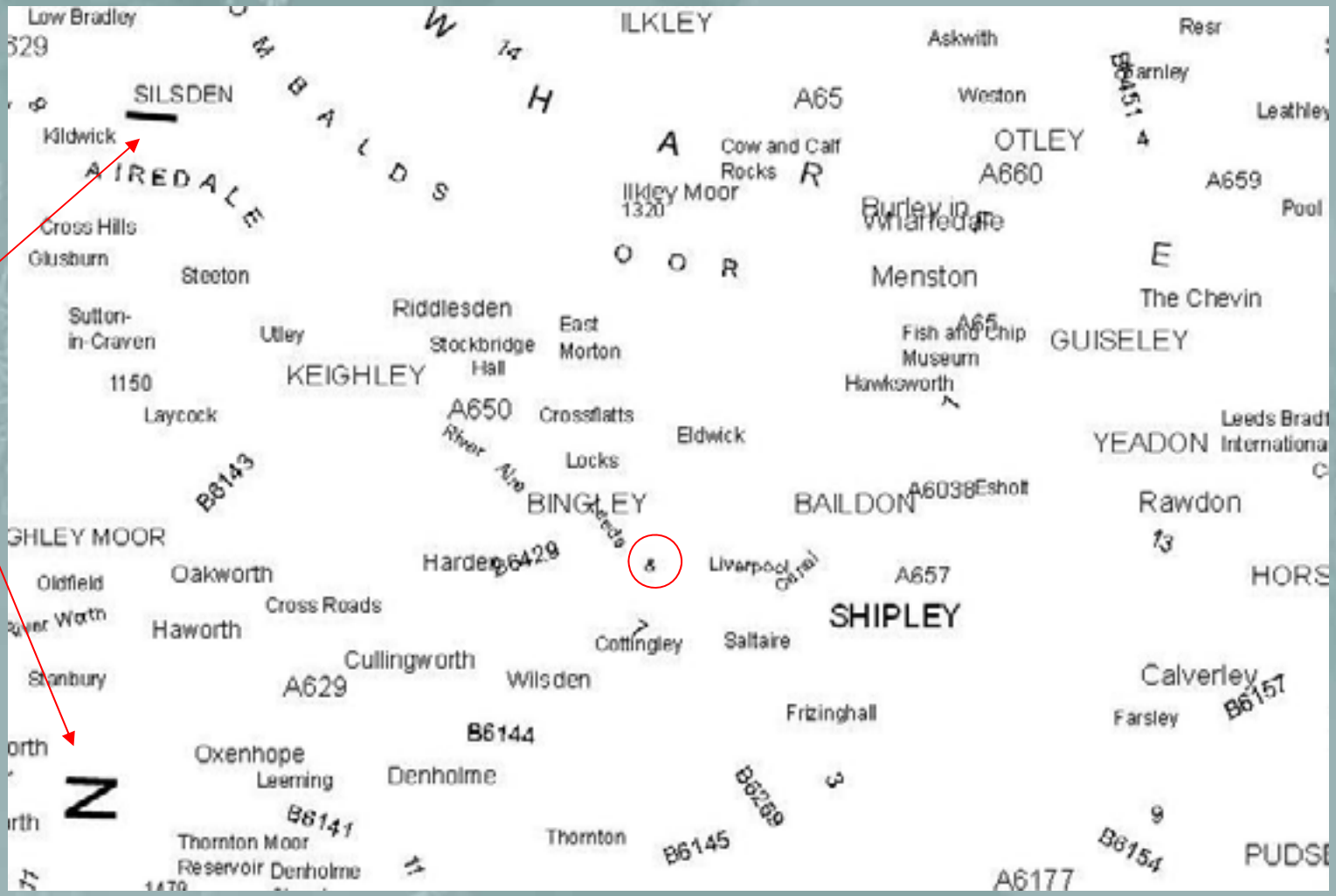
Symbols were out of position

- *Stations not always on railway lines*
- *Roundabouts not always on road junctions*

Text was as it appeared on the map

Sometimes as individual letters

PENNINES



32nd ESRI User Conference 24th July 2012

Benefits

1. Topologically structured database
- Improved geometrical integrity
- Holes in polygons, not two types of feature
2. Improved attribution
- Lack of support for the old system meant no changes had been allowed
3. Allows increased process automation
- Reducing manual effort required
4. Better database utilisation

Which leads to Problem 2.

Problem 2:

We were having to make the same update to data in different datasets.

1:250k Core Data

Road Map Series

Data for Customers

1:250k Core Data

Road Map Series

Data for Customers

1:250k CAA Database

ICAO Aeronautical Charts

1:250k Core Data

Road Map Series

Data for Customers

1:250k CAA Database

ICAO Aeronautical Charts

1:250k Core Data

Road Map Series

Data for Customers

1:250k CAA Database

ICAO Aeronautical Charts

/10

1:500k CAA Database

ICAO Aeronautical Charts

1:250k Core Data

Road Map Series

Data for Customers

x 2

Tour Map Data

1:250k CAA Database

ICAO Aeronautical Charts

/10

1:500k CAA Database

ICAO Aeronautical Charts

1:250k Core Data

Admin Boundary Maps

Road Map Series (as raster)

Data for Customers

x 2

Tour Map Data

1:250k CAA Database

ICAO Aeronautical Charts

AIDU Low Flying Charts

/10

1:500k CAA Database

ICAO Aeronautical Charts

AIDU Low Flying Charts

1:625k CAA Database

Route Map Series

Historical Maps

Admin Boundary Maps

Strategi™

(4 data formats)

EuroRegional Map

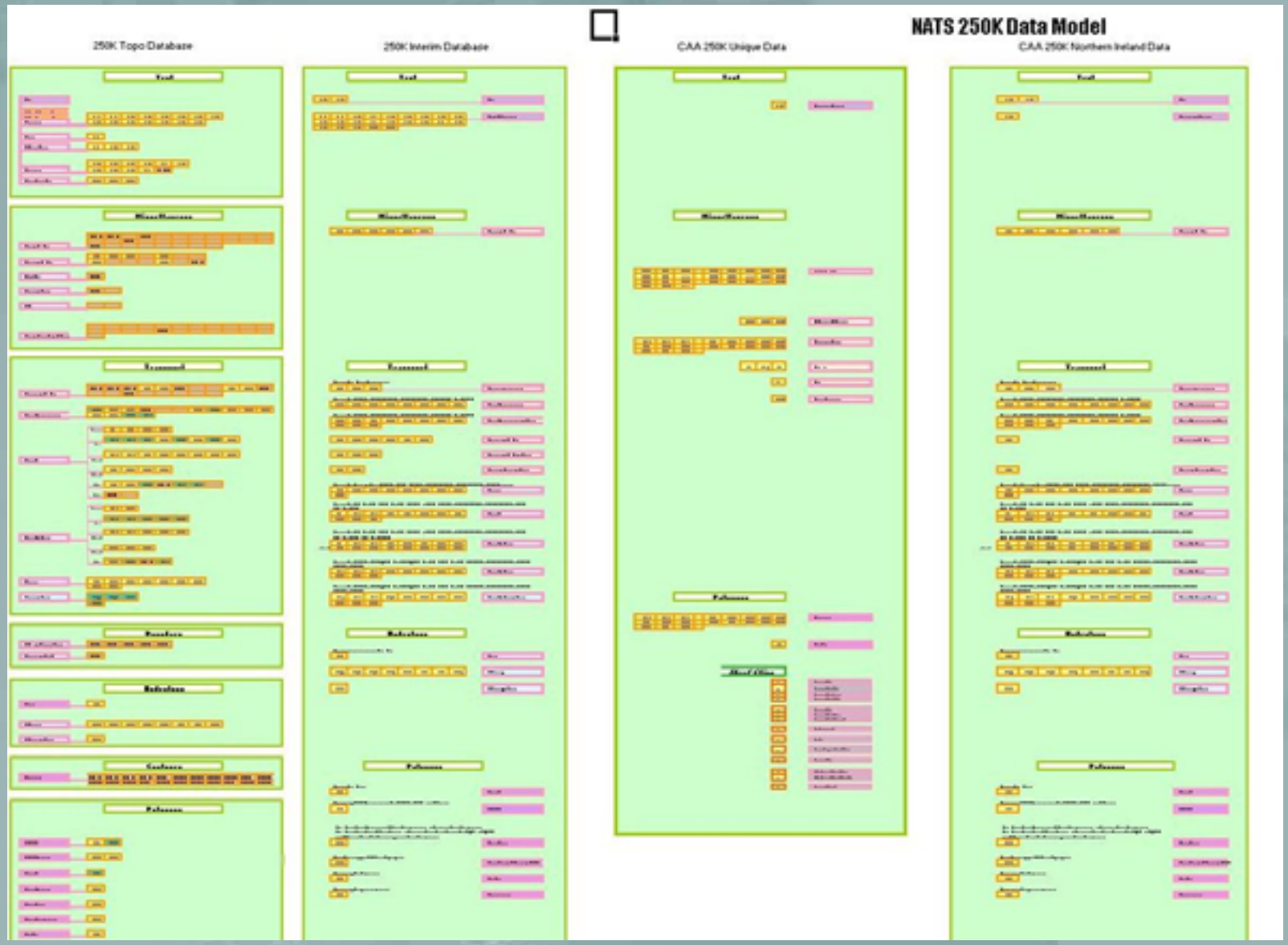
EuroGlobal Map

Not including marginalia

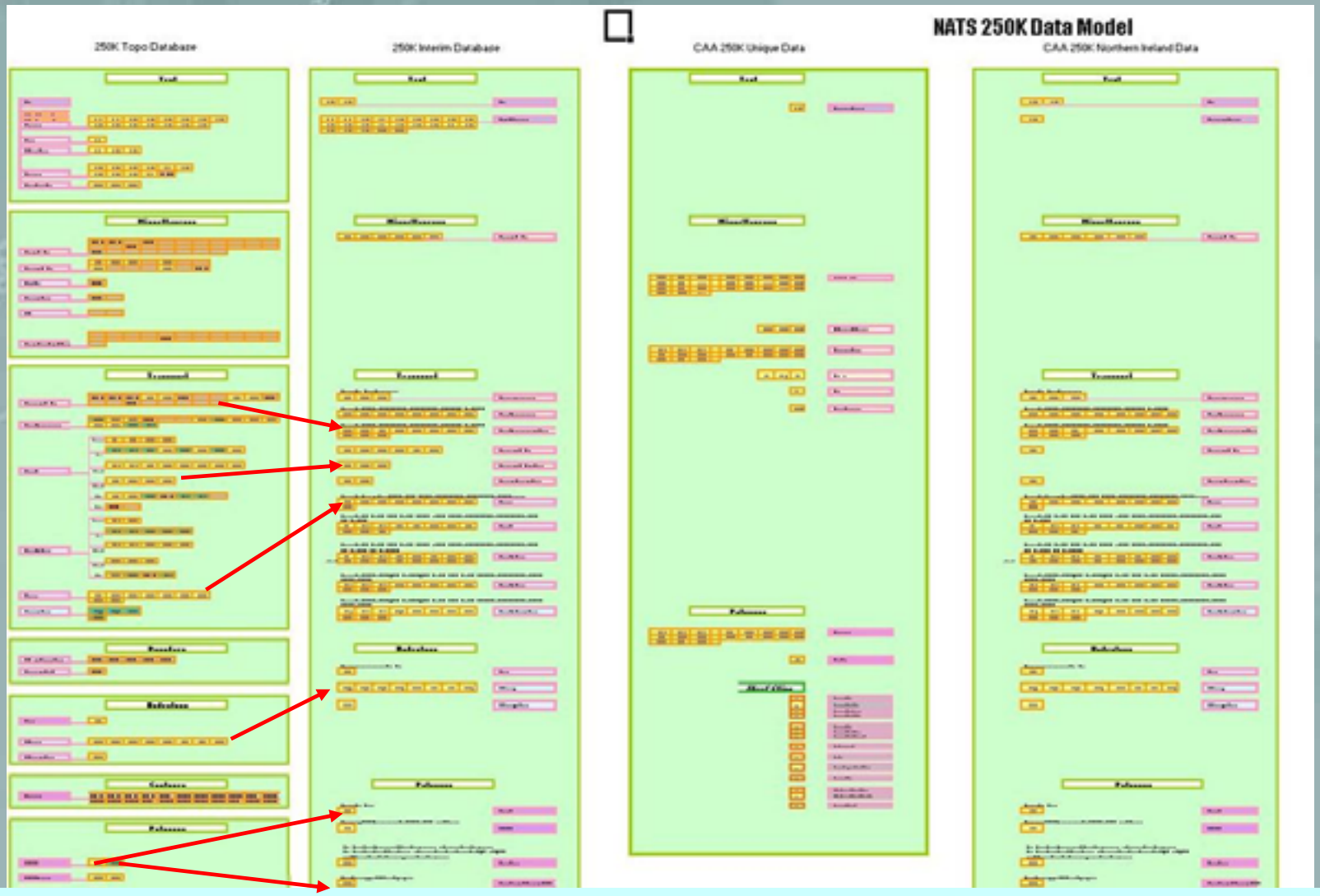
Identify the database structure

Using the Database structure from Problem 1:

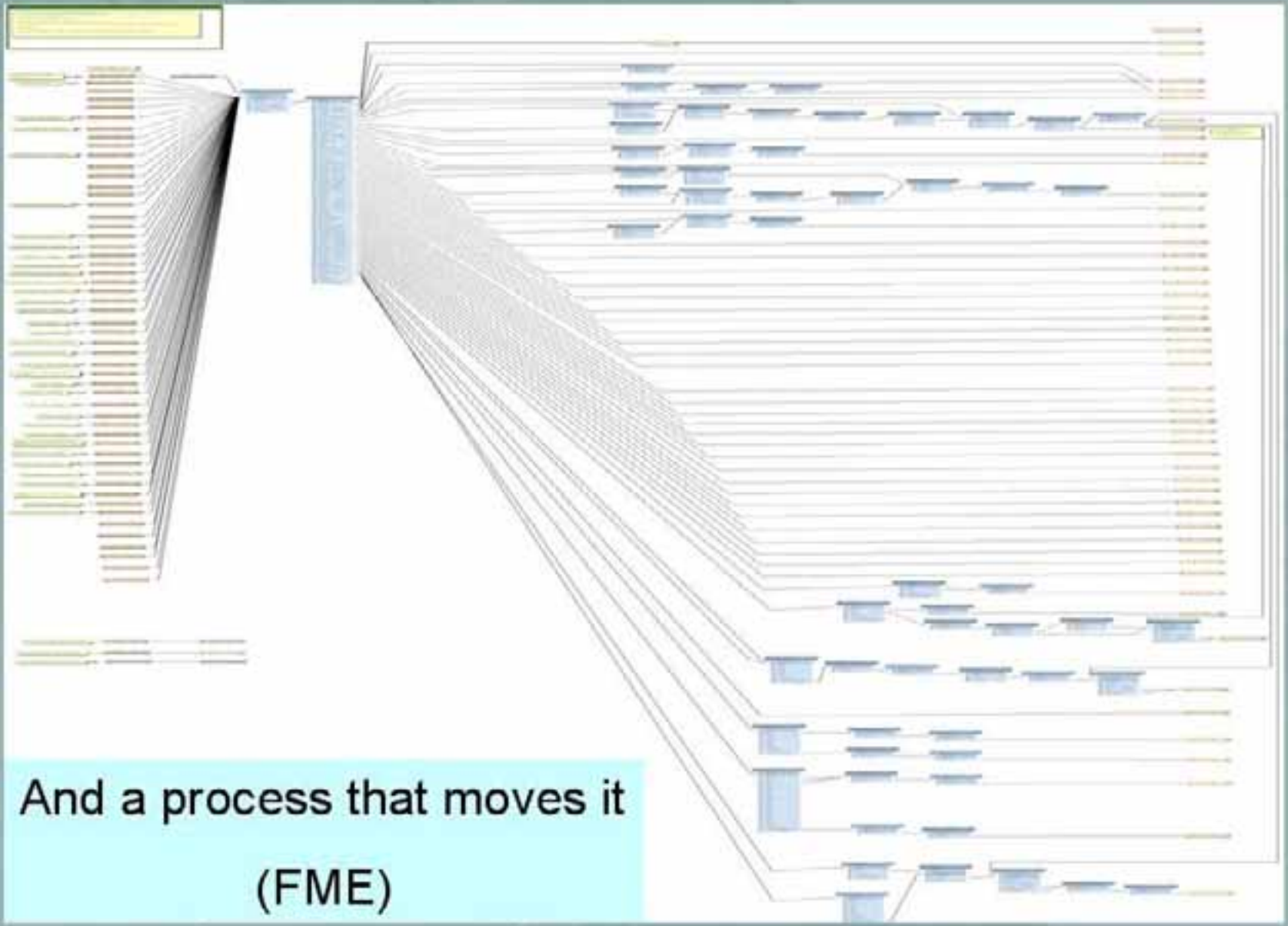
- Map the structure for the output data – for each product component



32nd ESRI User Conference 24th July 2012

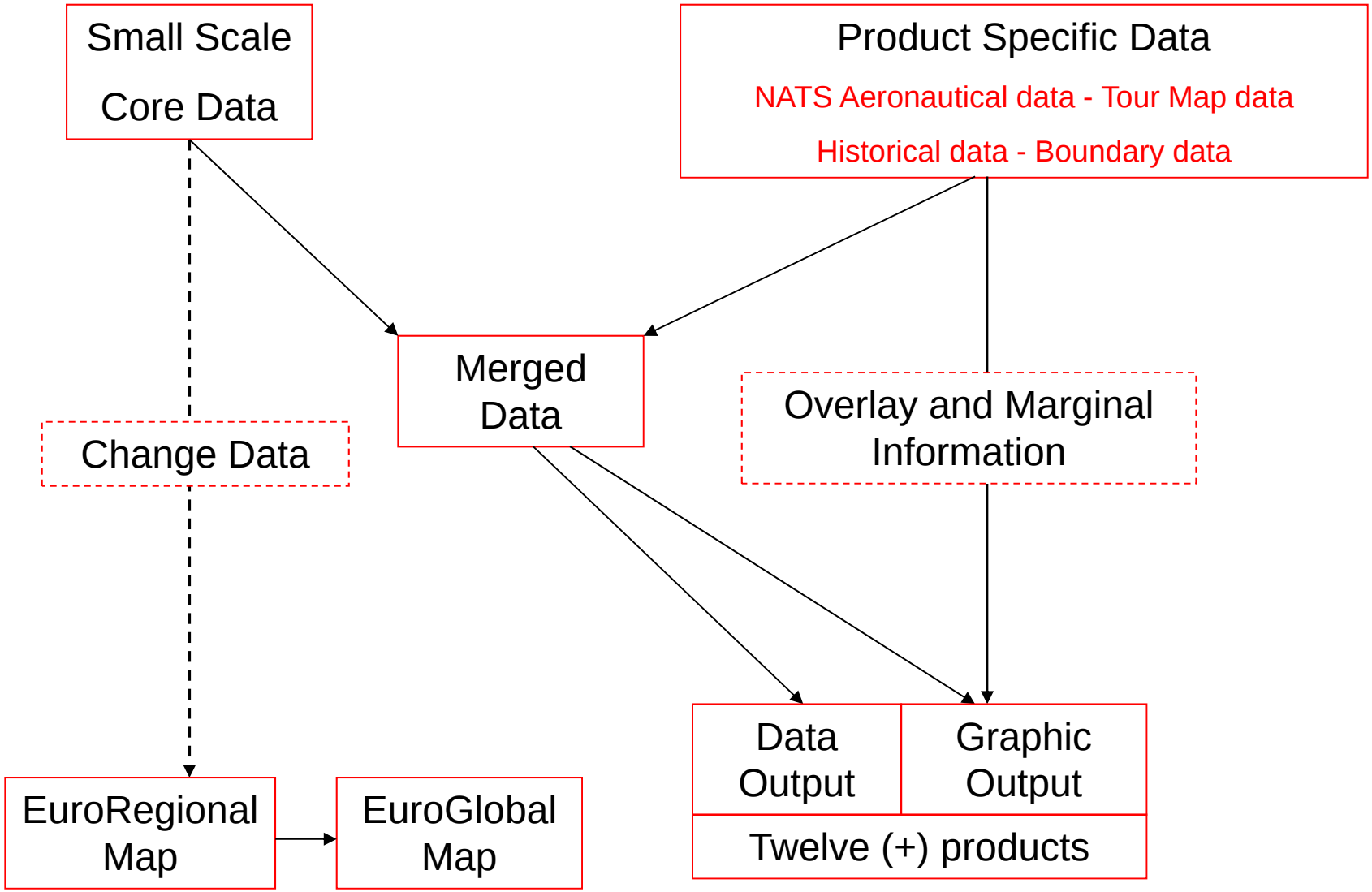


Then define the route for the data



And a process that moves it

(FME)


Small Scale
Core Data
Product Specific Data
NATS Aeronautical data - Tour Map data
Historical data - Boundary data
Merged
Data
Change Data
Overlay and Marginal
Information
Data
Output
Graphic
Output
Twelve (+) products
EuroRegional
Map
EuroGlobal
Map

Benefits

1. Topologically structured databases
- Improved geographical and data consistency
2. Reduced resource requirement
- Changes only applied once
3. Increased process automation
- Further reducing manual effort required
4. Better database utilisation

Problem 3:

Our business is downsizing .

From
4,500 Staff

Ordnance Survey

www.ordnancesurvey.co.uk

32nd ESRI User Conference 24th July 2012

To
1,000

Ordnance Survey

www.ordnancesurvey.co.uk

32nd ESRI User Conference 24th July 2012

We printed or own maps .

Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk

We sent the data (feature codes) to Printing, and they did the rest.

We will have no room for print facilities.

Ordnance Survey®

www.ordnancesurvey.co.uk

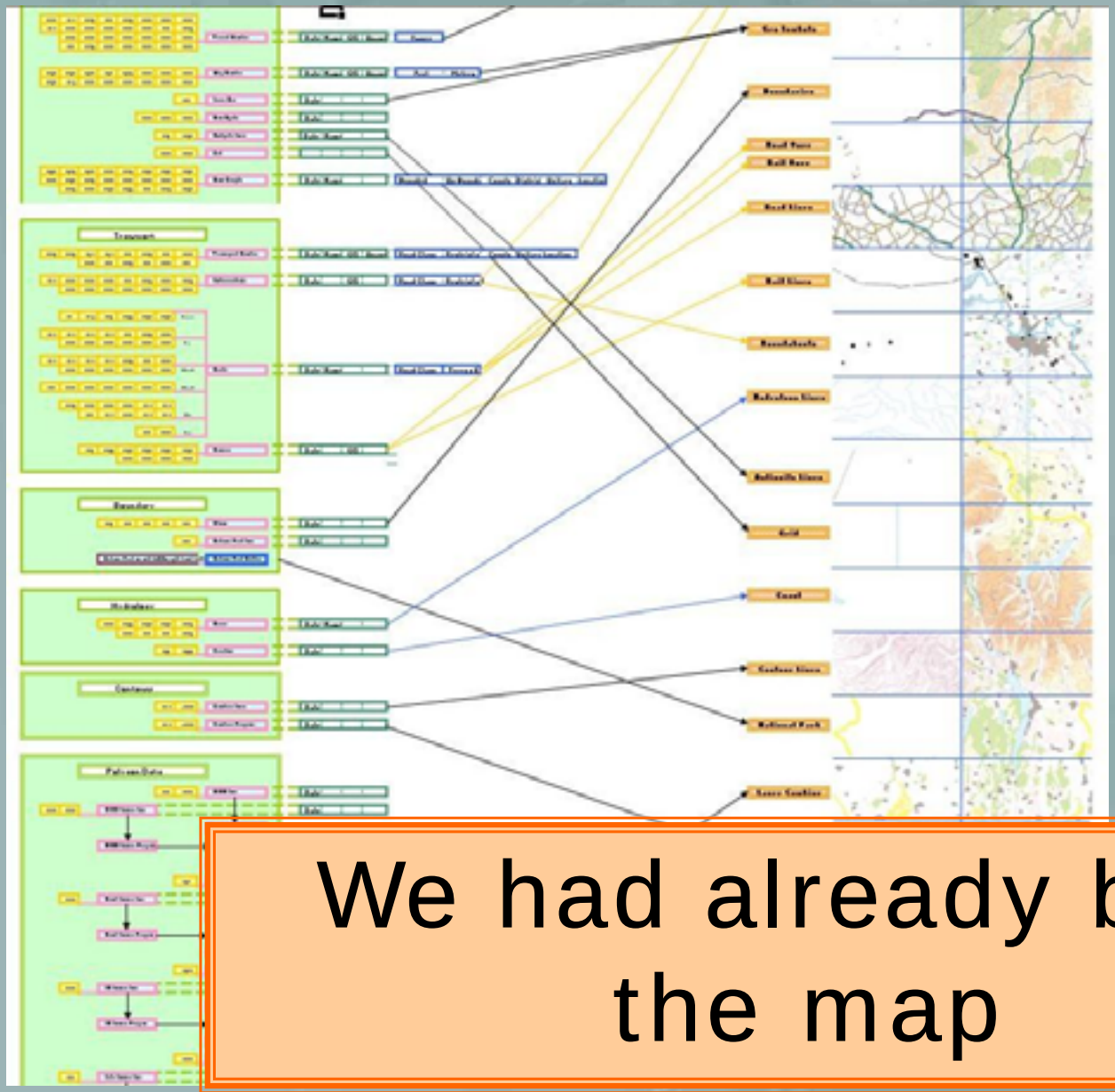
32nd ESRI User Conference 24th July 2012

Identify the database structure

Using the Database structure from Problem 1:

• Map uct
compo

The process uses the data created as a result of answering the first two problems



Using the databases:

Build the Map

We had already built the map

Ordnance Survey

32nd ESRI User Conference 24th July 2012

A style needed for each of these :

251 relevant feature codes comprising:

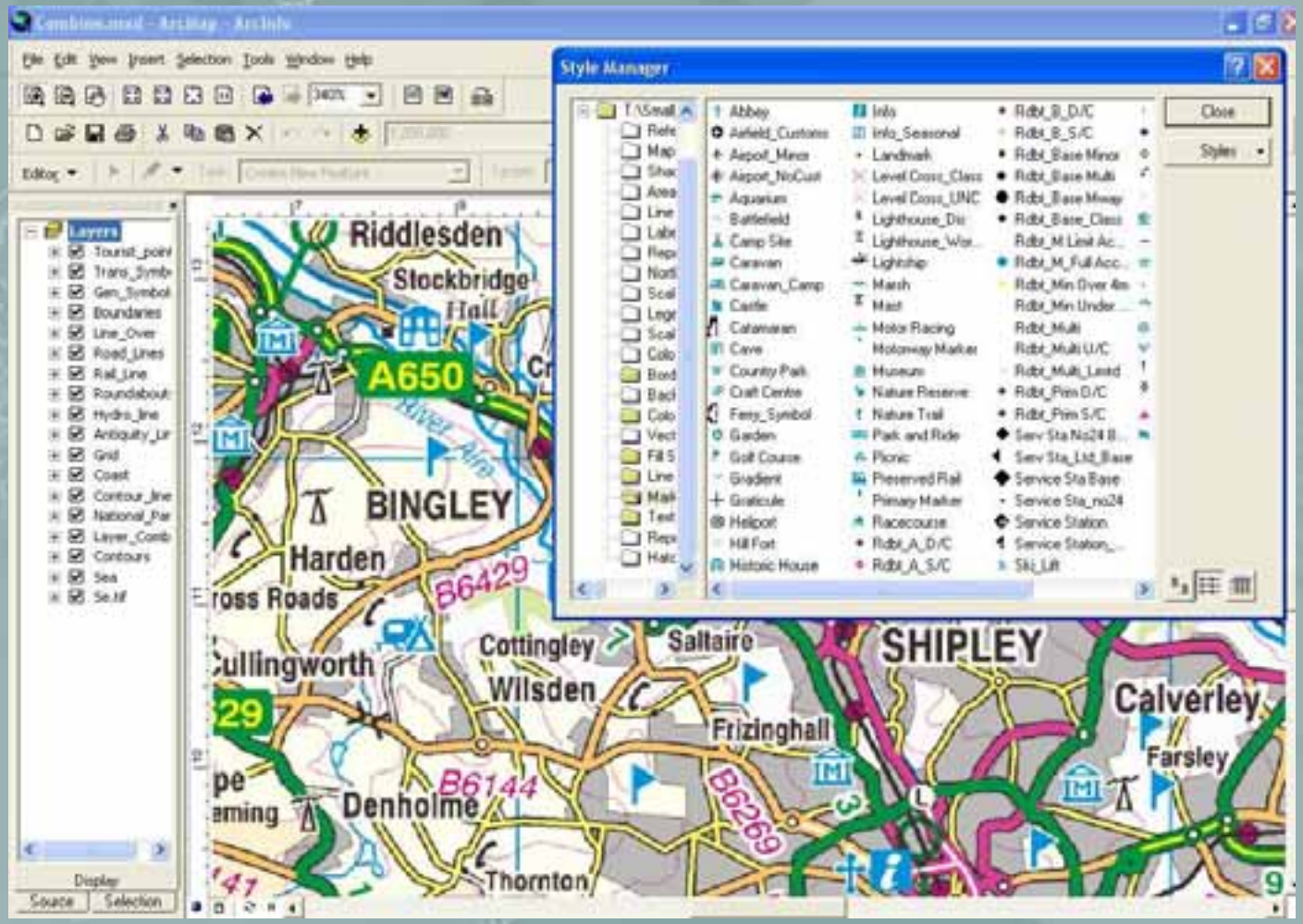
45 contours

86 line codes

78 point codes

11 polygon codes

31 text features



32nd ESRI User Conference 24th July 2012

Then identify the relationships between the features :

Road Junctions

Overs and Unders

Symbol Holdout

Roundabouts

And many more!!

Interaction of lines and symbols

Ordnance Survey

32nd ESRI User Conference 24th July 2012

Road Junctions

Overs and Unders

Symbol Holdout

Roundabouts

And many more!!

Interaction of lines and symbols

Road Junctions

Overs and Unders

Symbol Holdout

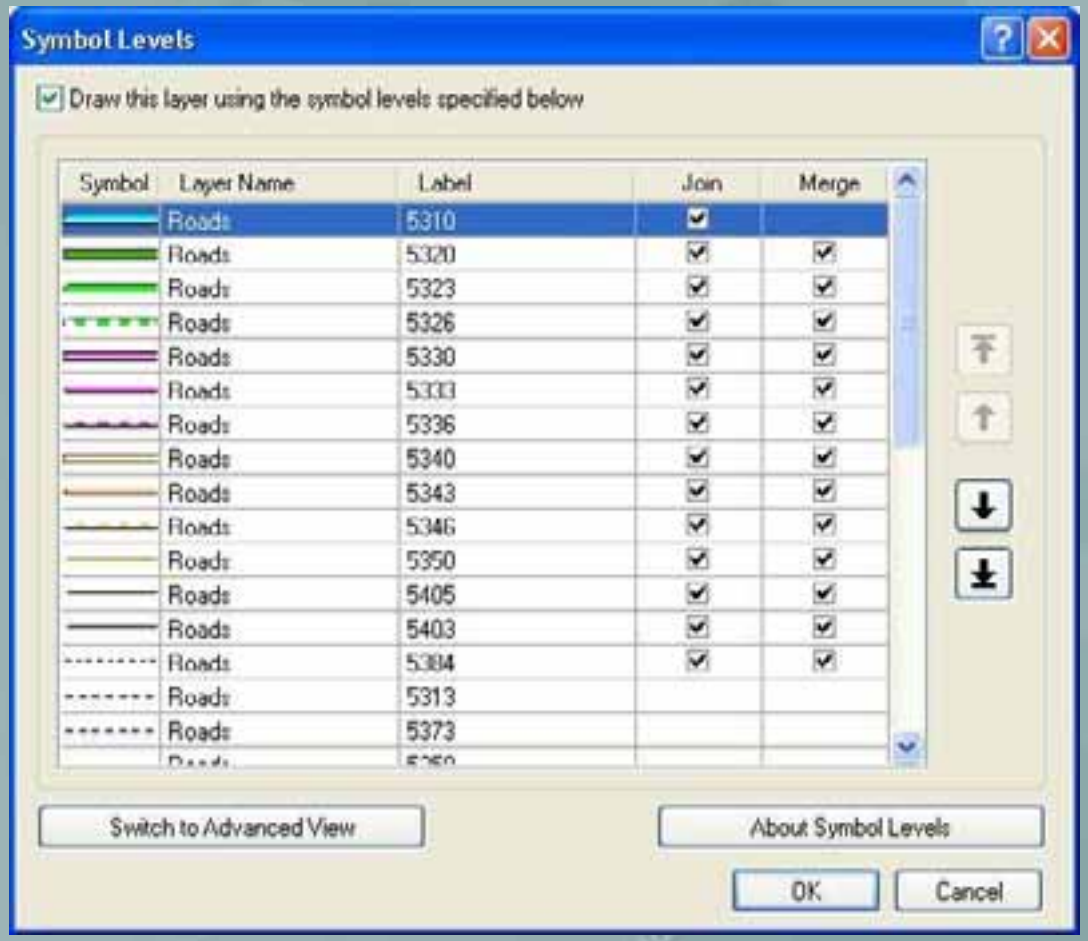
Roundabouts

And many more!!

Interaction of lines and symbols

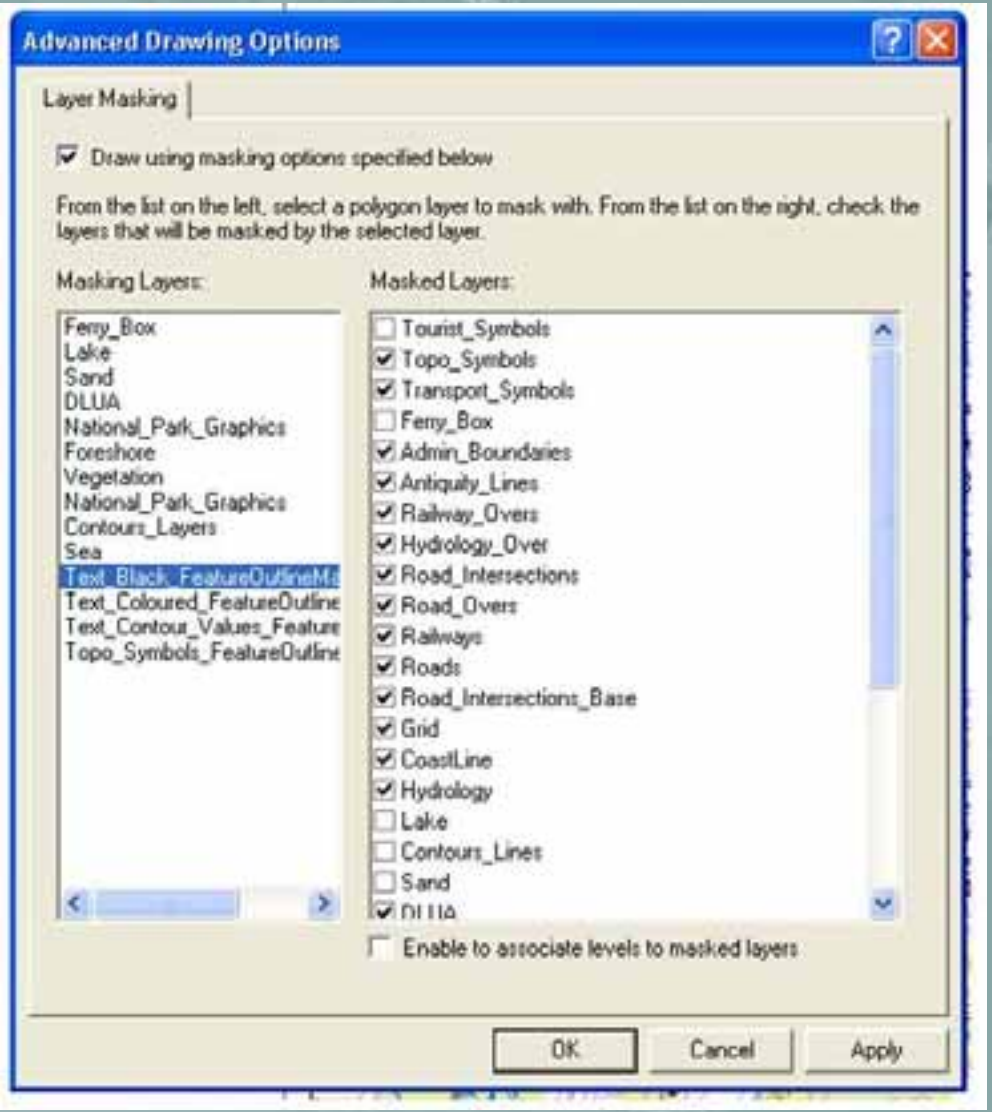
And set them up

32nd ESRI User Conference 24th July 2012



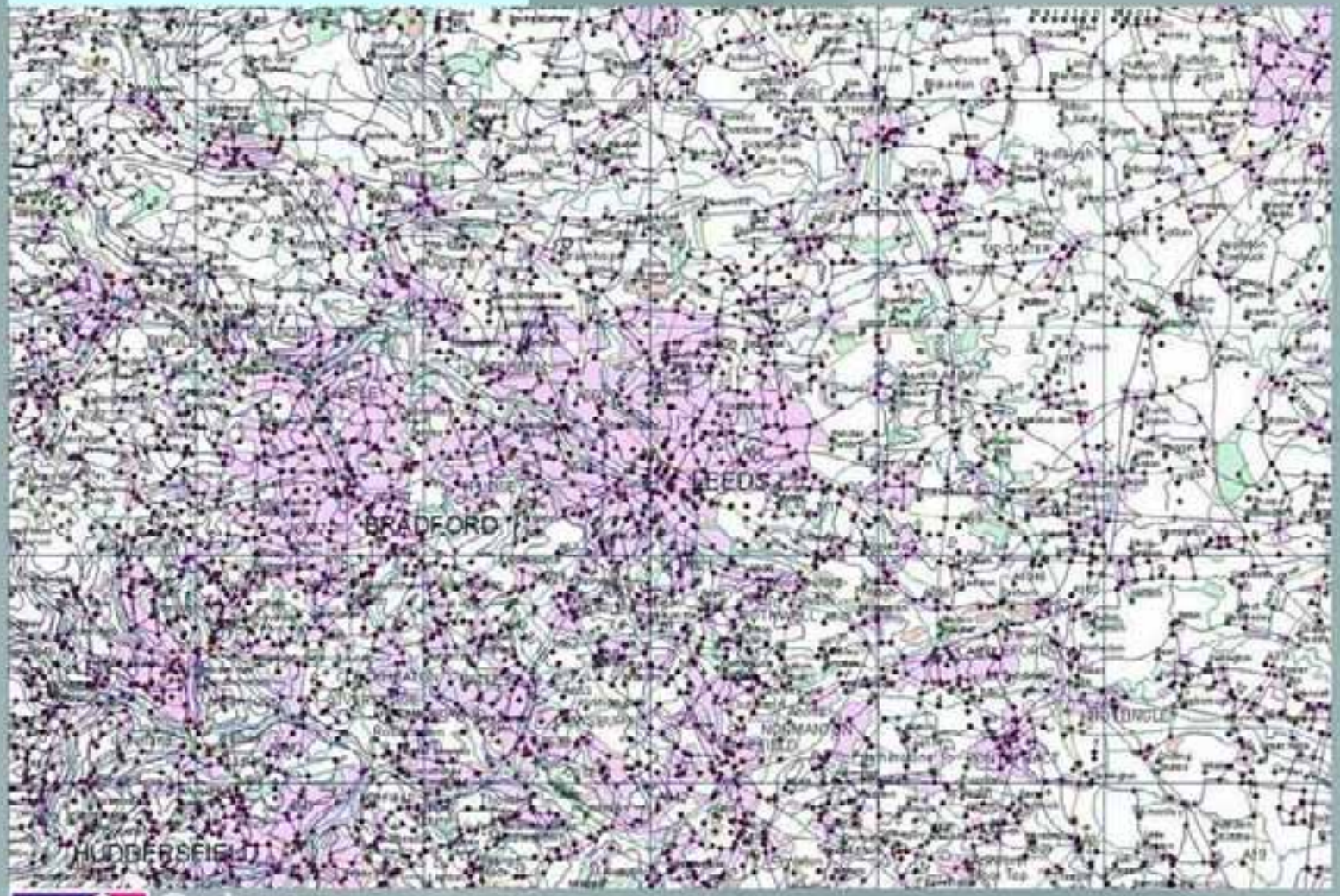
34 types of road feature

Including masks



4 masks holding out data from 20 layers

Turns this

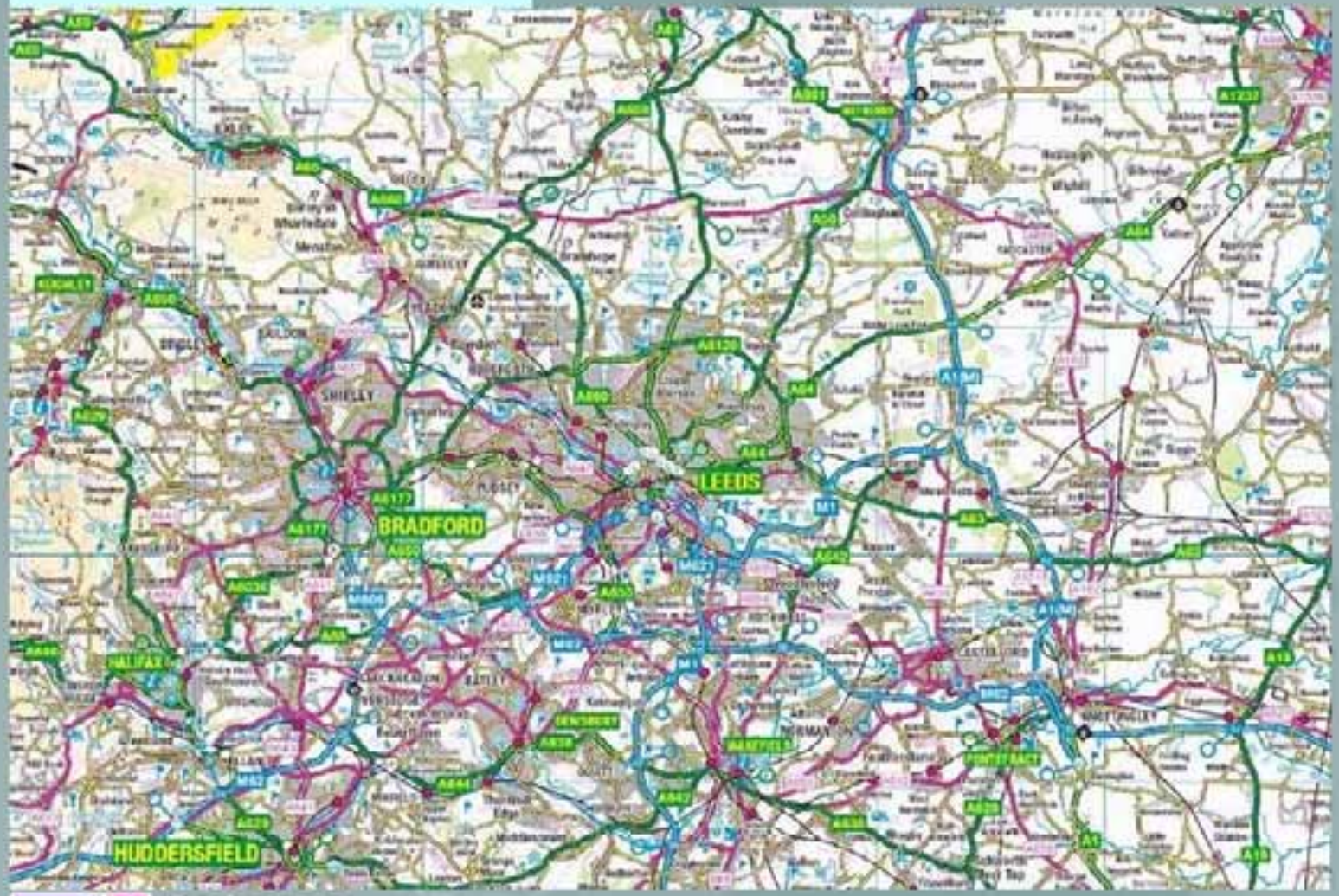


Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk

Into this



Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk

Benefits

1. Cartographers control the map
- Instead of hoping that the printers know what we want
2. Electronic delivery method
- Can be sent anywhere for printing
3. Reduced costs and environmental impact

Problem 4:

We need to produce a complicated data product in house

Meridian™2

32nd ESRI User Conference 24th July 2012

Ordnance Survey

www.ordnancesurvey.co.uk

The data was revised annually by a third party contractor

Incorporating new road detail and revision data supplied by Ordnance Survey

DOTTED EYES

In December 2007 management decided to bring production in house

To be delivered by the end of October 2008

Formats

- NTF – as 2856 10km x 10km tiles
- DXF – as 2856 10km x 10km tiles
- MID/MIF – as 20 layers
- Shape – as 20 layers

  plus a Coverage file

  plus an E00 file

Supply Sets

- Great Britain or,
- Scotland or,
- England or,
- Wales

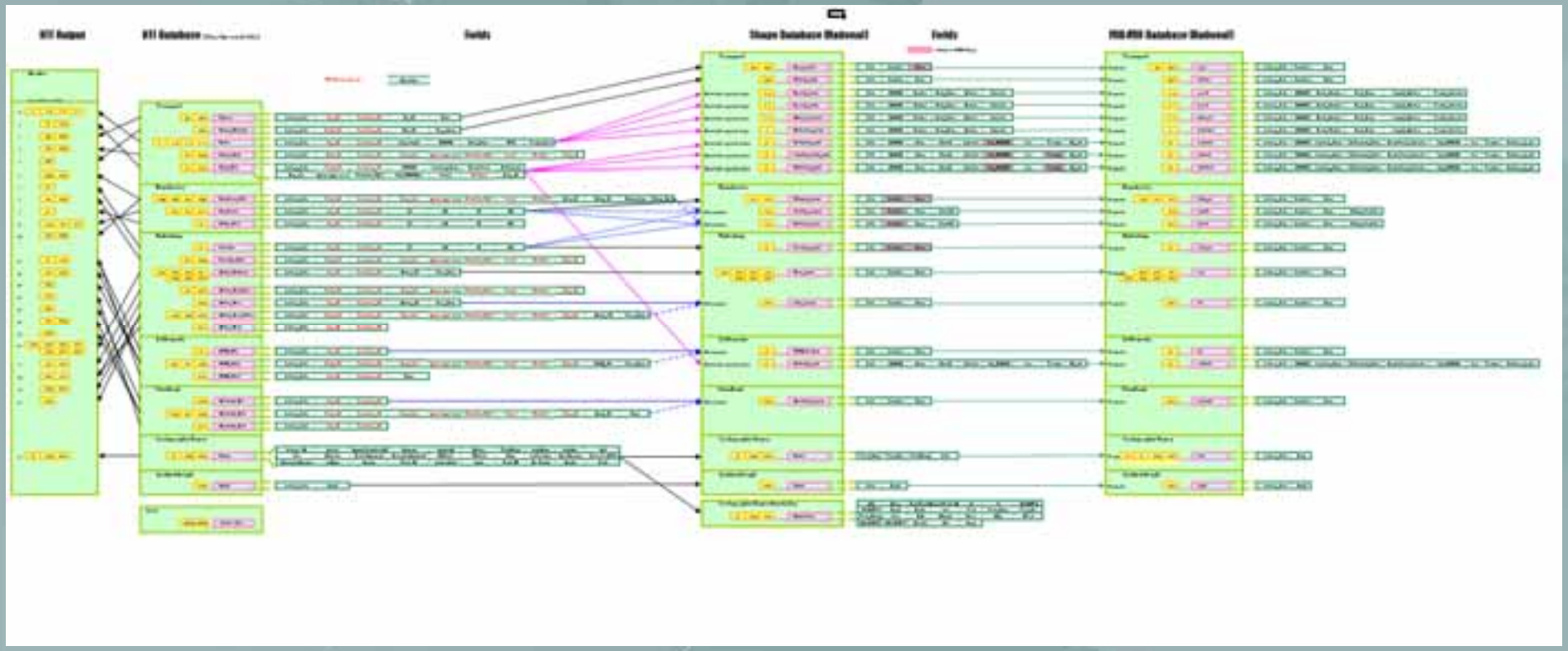
as

- Everything or,
- Communication or,
- Topology

48

Different ways to supply the data

New product – new data model



all imported from the NTF original data

```
14100255ODO16CN80C7VXTWFC3002LL00026PNST DOGMAELS ROAD\RNB4546\0%
23100256100256011002560%
21100256200020798707058 0795107031 0%
14100256ODO16CMJ7C7BWTWFC3004LL00045PNMELIN Y DRE\0%
23100257100257011002570%
21100257200050722304624 0754504762 0785504962 0798705251 0804805314 0%
14100257ODO16CML0C8CETWFC3001LL01125RNA487(T)\TRY0%
23100258100258011002580%
21100258200030889505994 0855606075 0827106075 0%
14100258ODO16CM91V7U2AWFC3001LL00634RNA484\0%
23100259100259011002590%
21100259200040804805314 0817605522 0821005920 0827106075 0%
14100259ODO16CMEPC80KAWFC3001LL00810RNA487(T)\TRY0%
23100260100260011002600%
21100260200070555602917 0554802525 0554402407 0549802100 05474019741%
00 0542801825 0527601590 0%
14100260ODO16CNQTV9R5TWFC3001LL01385RNA487(T)\TRY0%
23100261100261011002610%
21100261200070722304624 0676604497 0657304479 0642504393 06410043771%
00 0634104175 0627804102 0%
14100261ODO16CNABC8MBAWFC3001LL01171RNA487(T)\TRY0%
23100262100262011002620%
21100262200040885006804 0866906744 0865306736 0861806719 0%
14100262ODO16CM7DC7GMTWFC3002LL00247PNABERYSTWYTH ROAD\RNB4548\0%
23100263100263011002630%
21100263200030890806777 0889106788 0885006804 0%
14100263ODO16CM3TC7FWTWFC3002LL00064PNABERYSTWYTH ROAD\RNB4548\0%
23100264100264011002640%
21100264200030771002081 0770702153 0776602877 0%
```

Building the Editing System

32nd ESRI User Conference 24th July 2012

Ordnance Survey

www.ordnancesurvey.co.uk

One Database

or

2856 ?

Ordnance Survey

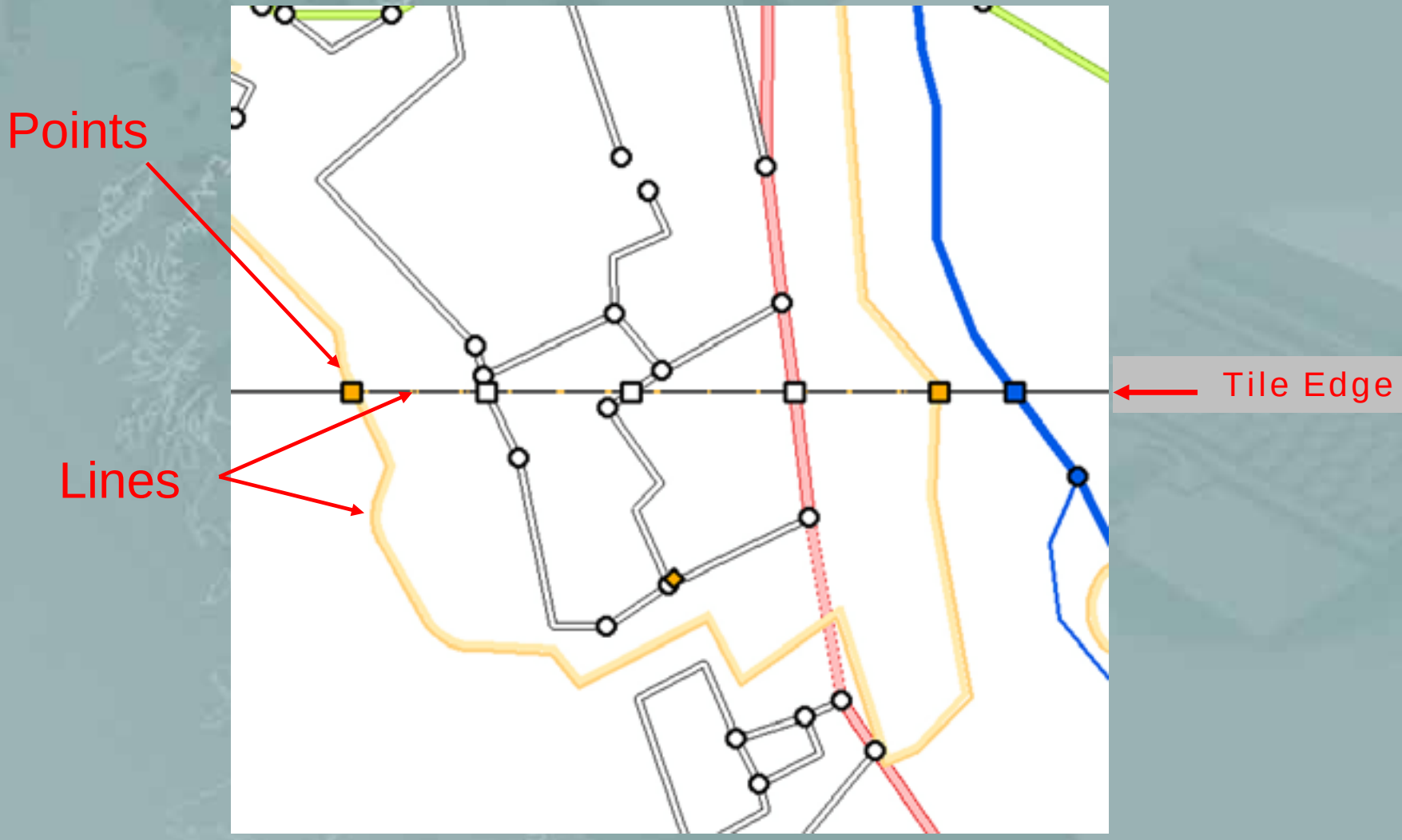
32nd ESRI User Conference 24th July 2012

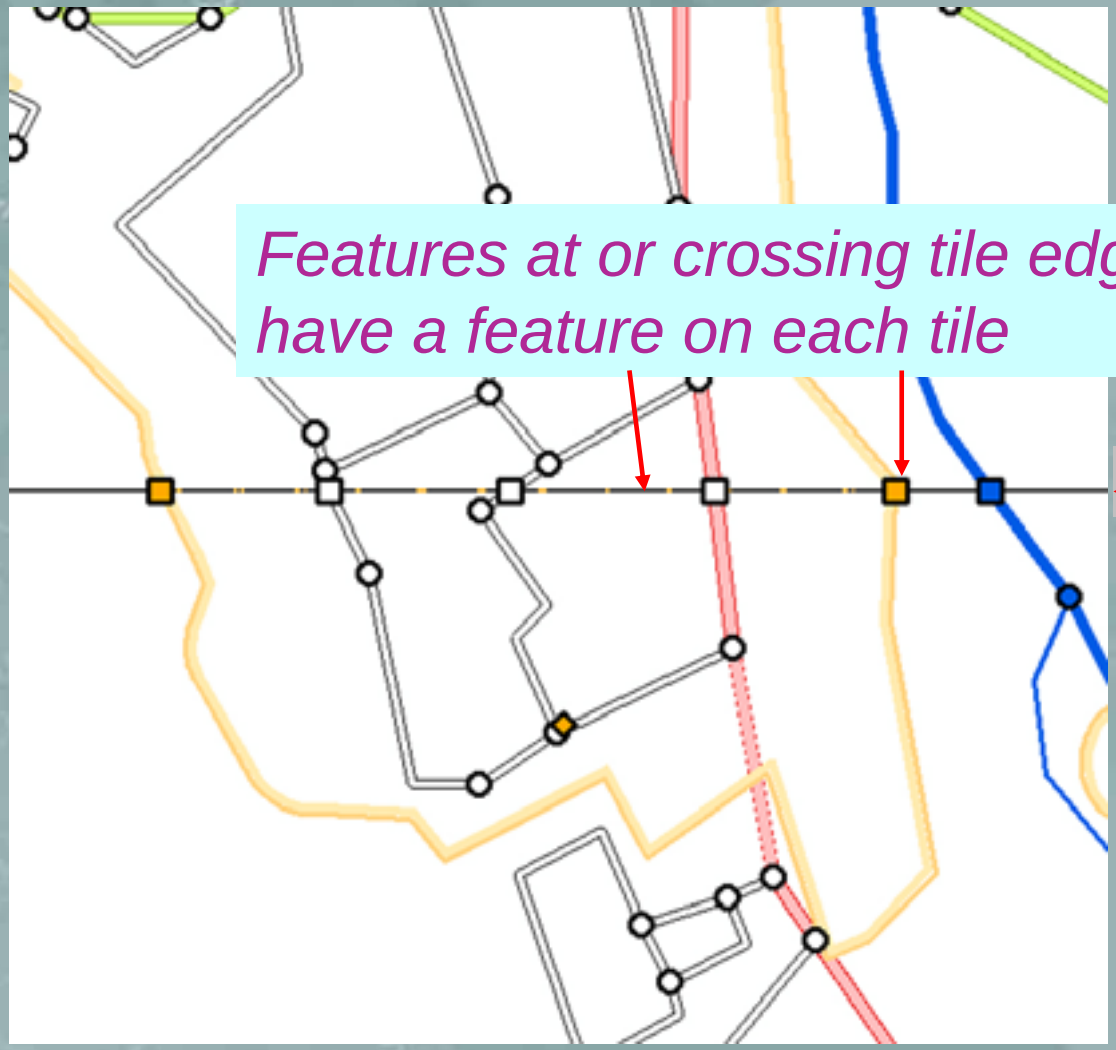
www.ordnancesurvey.co.uk

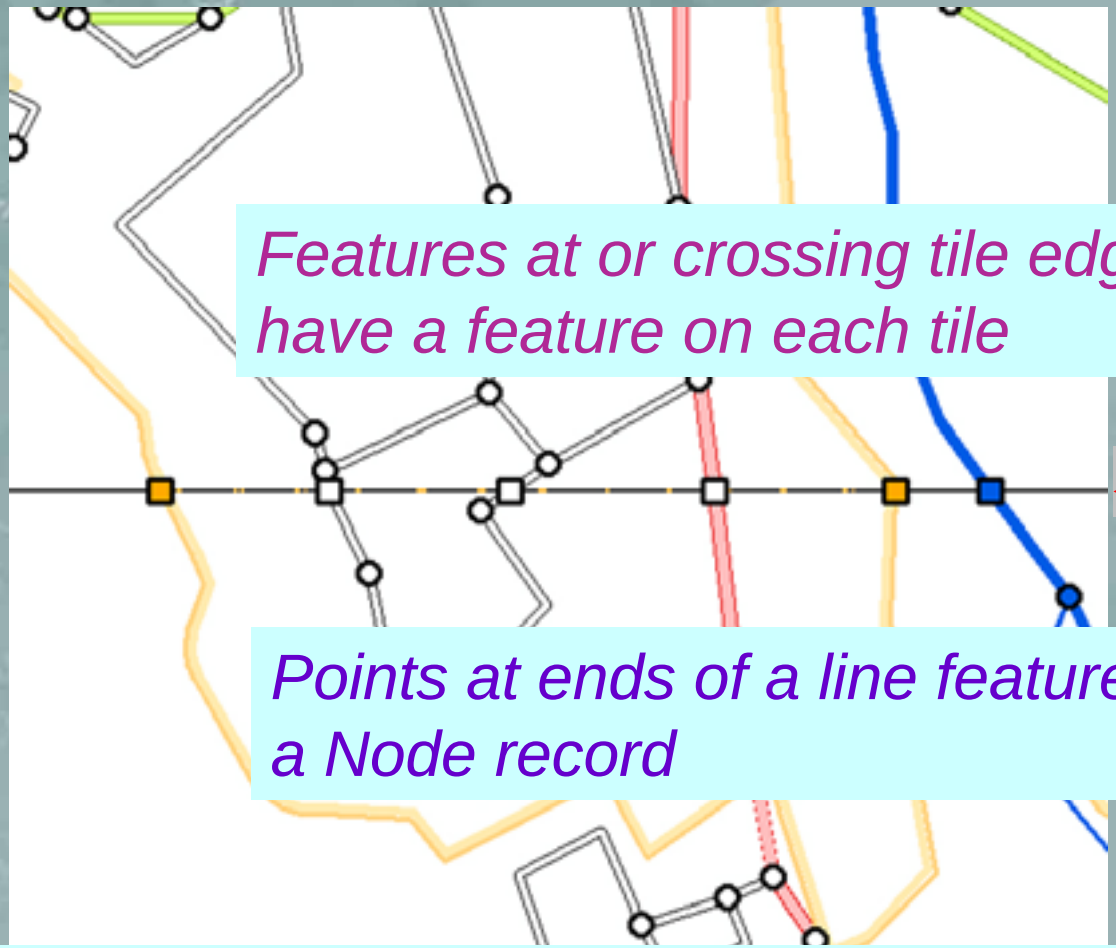
NTF data

consists of lines, points and nodes

No polygons !


Points
Lines
Tile Edge


Features at or crossing tile edges have a feature on each tile
Tile Edge



Features at or crossing tile edges have a feature on each tile

Points at ends of a line feature have a Node record

Line, Point and Node identifiers are tile based

i.e. each tile will have feature number 1

Which means 2856 databases !

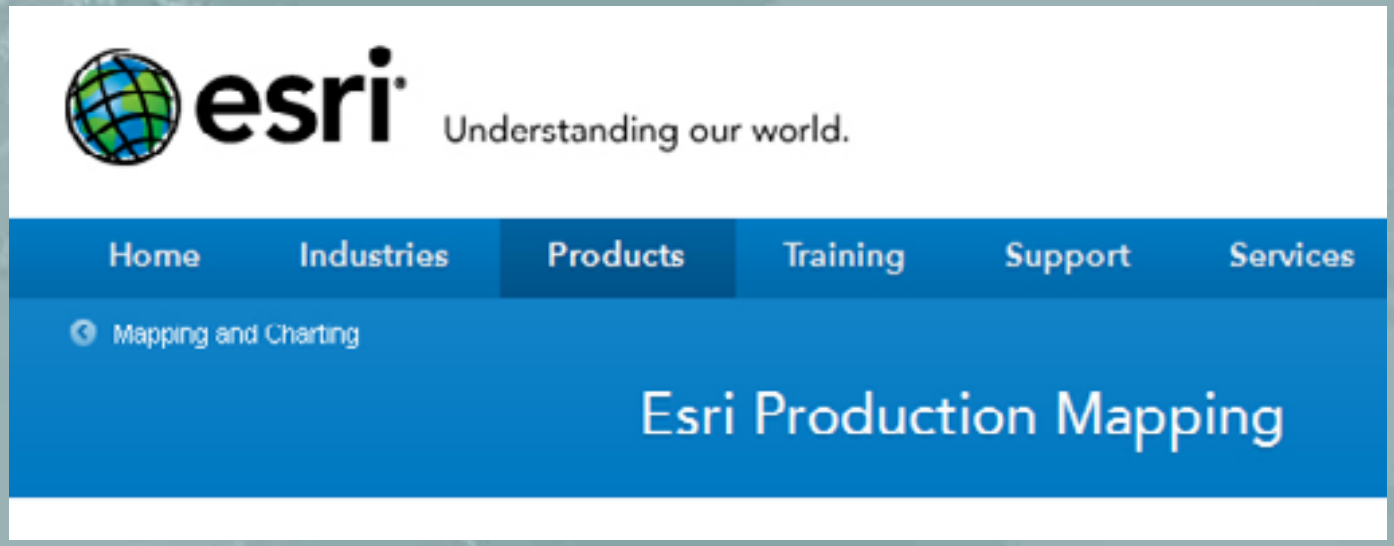
We need

Automatic validation of attribution

Especially in relation to nodes

A consistent editing environment

The same for each tile



Ordnance Survey

32nd ESRI User Conference 24th July 2012

www.ordnancesurvey.co.uk

We need

Automatic validation of attribution

The Product Library

Reviewer Batch Job Manager

Auto Date Field Population

FCT Metadata

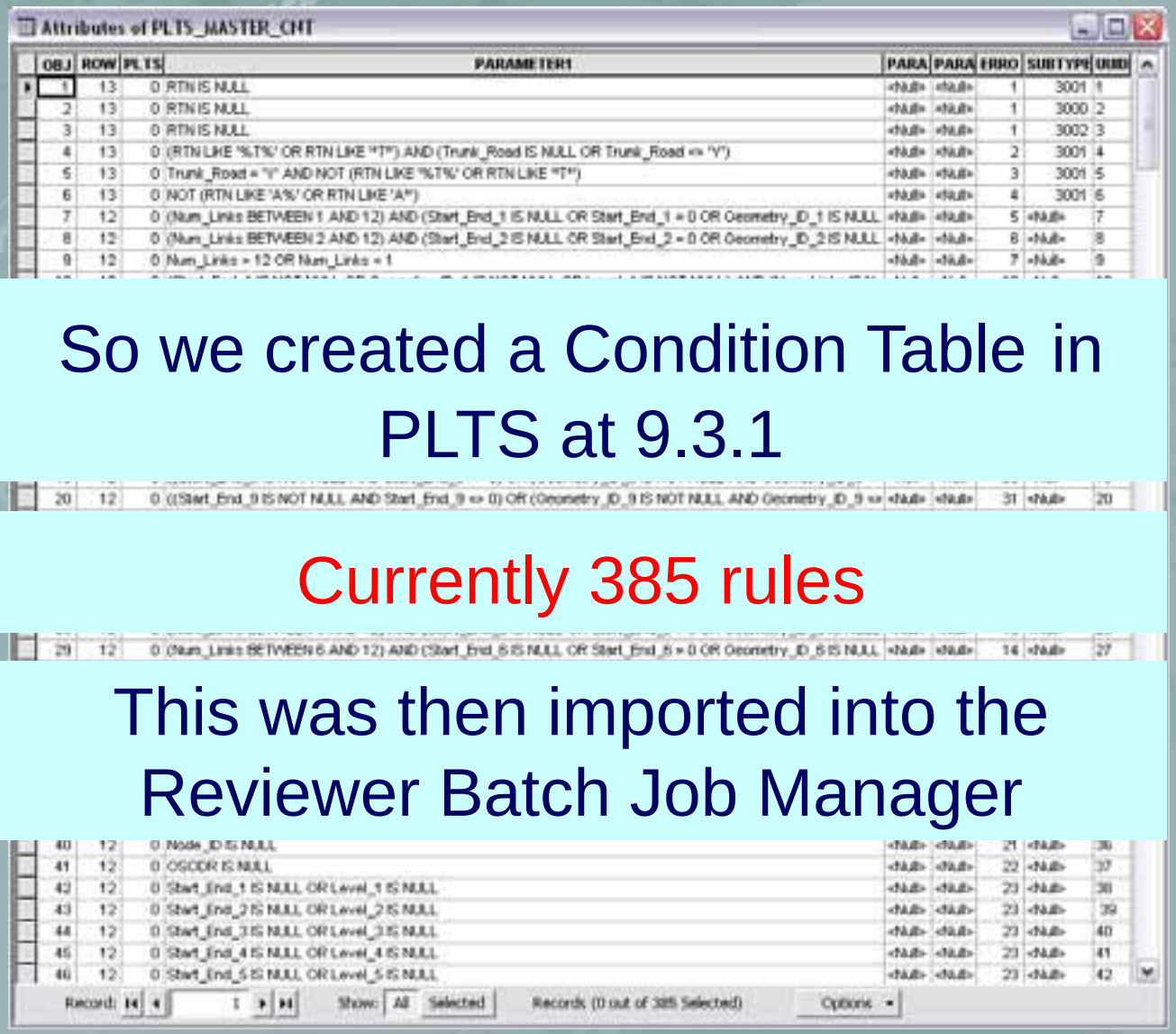
Validation

Decide what values **must** be put in

And populate them automatically where possible

Decide what values **mustn't** be entered

And create rules that trap them



Attributes of PLTS_MASTER_CNT

OBJ	ROW	PLTS	PARAMETER1	PARA	PARA	ERRO	SUBTYPE	UUID
1	13	0	RTN IS NULL	<Null>	<Null>	1	3001	1
2	13	0	RTN IS NULL	<Null>	<Null>	1	3000	2
3	13	0	RTN IS NULL	<Null>	<Null>	1	3002	3
4	13	0	(RTN LIKE '%T%' OR RTN LIKE 'T') AND (Trunk_Road IS NULL OR Trunk_Road <> 'Y')	<Null>	<Null>	2	3001	4
5	13	0	Trunk_Road = 'Y' AND NOT (RTN LIKE '%T%' OR RTN LIKE 'T')	<Null>	<Null>	3	3001	5
6	13	0	NOT (RTN LIKE 'A%' OR RTN LIKE 'A')	<Null>	<Null>	4	3001	6
7	12	0	(Num_Links BETWEEN 1 AND 12) AND (Start_End_1 IS NULL OR Start_End_1 = 0 OR Geometry_ID_1 IS NULL	<Null>	<Null>	5	<Null>	7
8	12	0	(Num_Links BETWEEN 2 AND 12) AND (Start_End_2 IS NULL OR Start_End_2 = 0 OR Geometry_ID_2 IS NULL	<Null>	<Null>	6	<Null>	8
9	12	0	Num_Links = 12 OR Num_Links = 1	<Null>	<Null>	7	<Null>	9
20	12	0	((Start_End_9 IS NOT NULL AND Start_End_9 <> 0) OR (Geometry_ID_9 IS NOT NULL AND Geometry_ID_9 <>	<Null>	<Null>	31	<Null>	20
29	12	0	(Num_Links BETWEEN 6 AND 12) AND (Start_End_6 IS NULL OR Start_End_6 = 0 OR Geometry_ID_6 IS NULL	<Null>	<Null>	14	<Null>	27
40	12	0	Node_ID IS NULL	<Null>	<Null>	21	<Null>	36
41	12	0	OSGDR IS NULL	<Null>	<Null>	22	<Null>	37
42	12	0	Start_End_1 IS NULL OR Level_1 IS NULL	<Null>	<Null>	23	<Null>	38
43	12	0	Start_End_2 IS NULL OR Level_2 IS NULL	<Null>	<Null>	23	<Null>	39
44	12	0	Start_End_3 IS NULL OR Level_3 IS NULL	<Null>	<Null>	23	<Null>	40
45	12	0	Start_End_4 IS NULL OR Level_4 IS NULL	<Null>	<Null>	23	<Null>	41
46	12	0	Start_End_5 IS NULL OR Level_5 IS NULL	<Null>	<Null>	23	<Null>	42

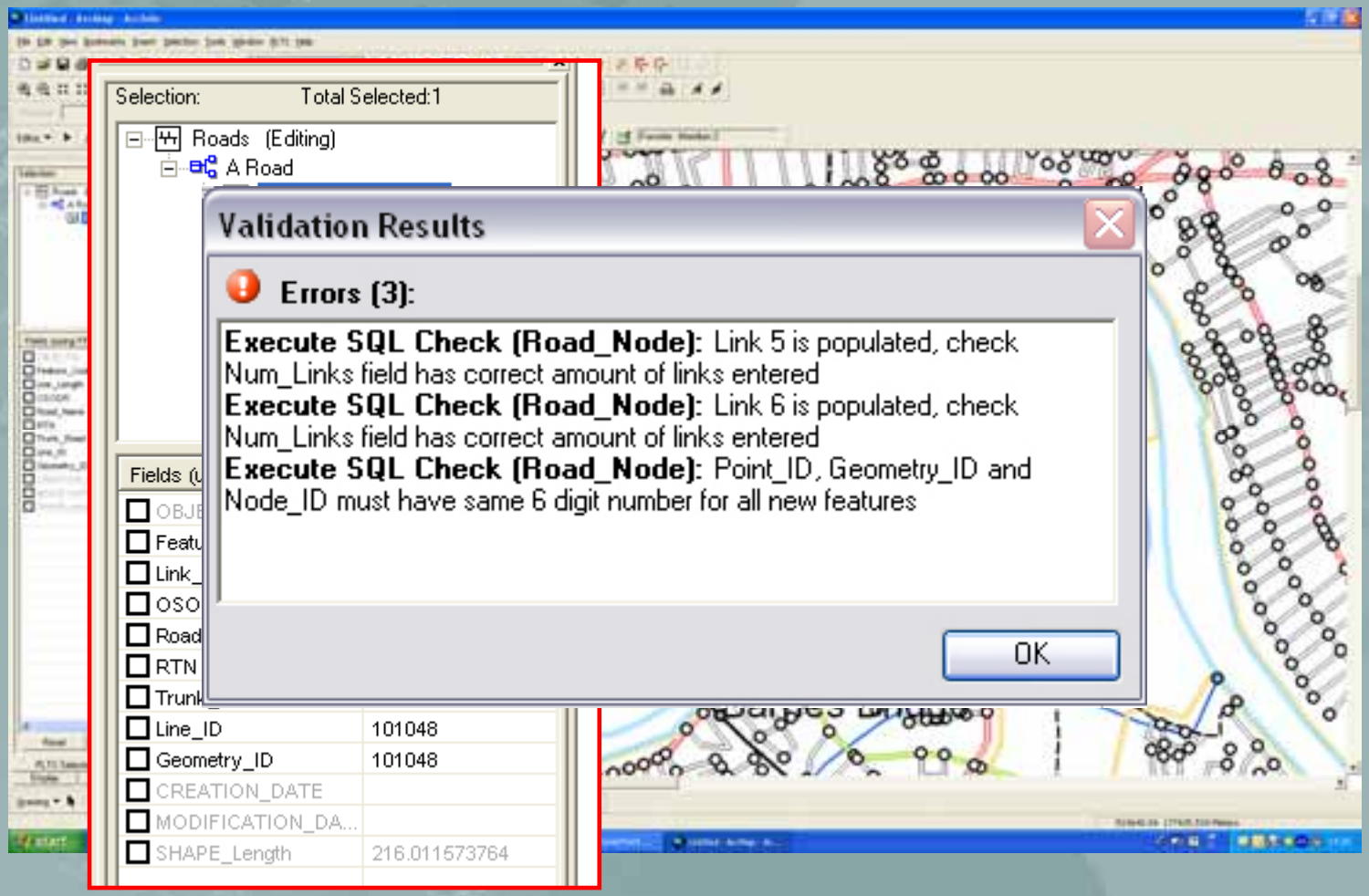
Record: 1 Show: All Selected Records (0 out of 385 Selected) Options

So we created a Condition Table in PLTS at 9.3.1

Currently 385 rules

This was then imported into the Reviewer Batch Job Manager

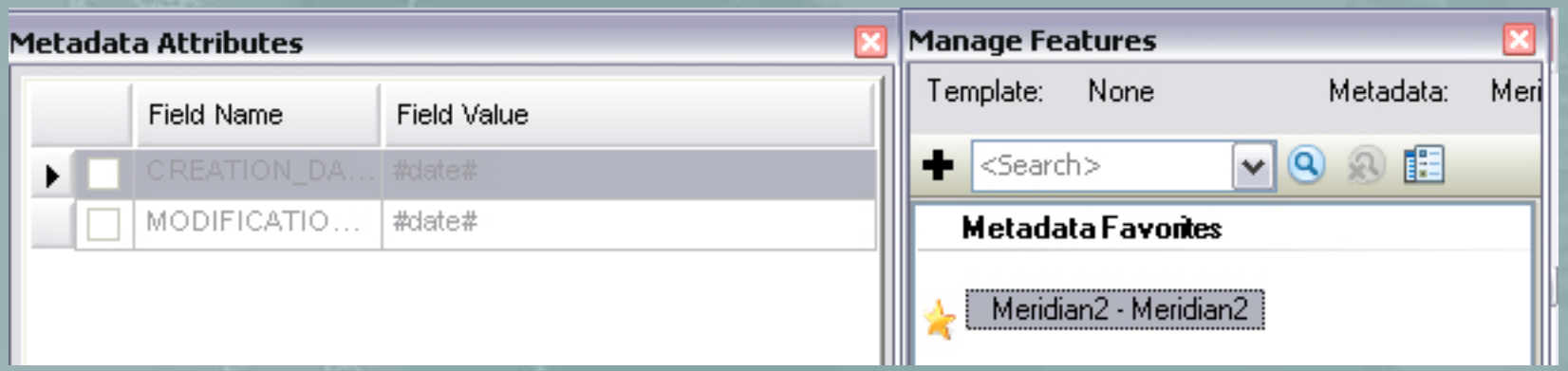
And the system tells us when we get it wrong !



Auto Date Field Population

As we edit data, dates **must** be populated in the creation and modification fields

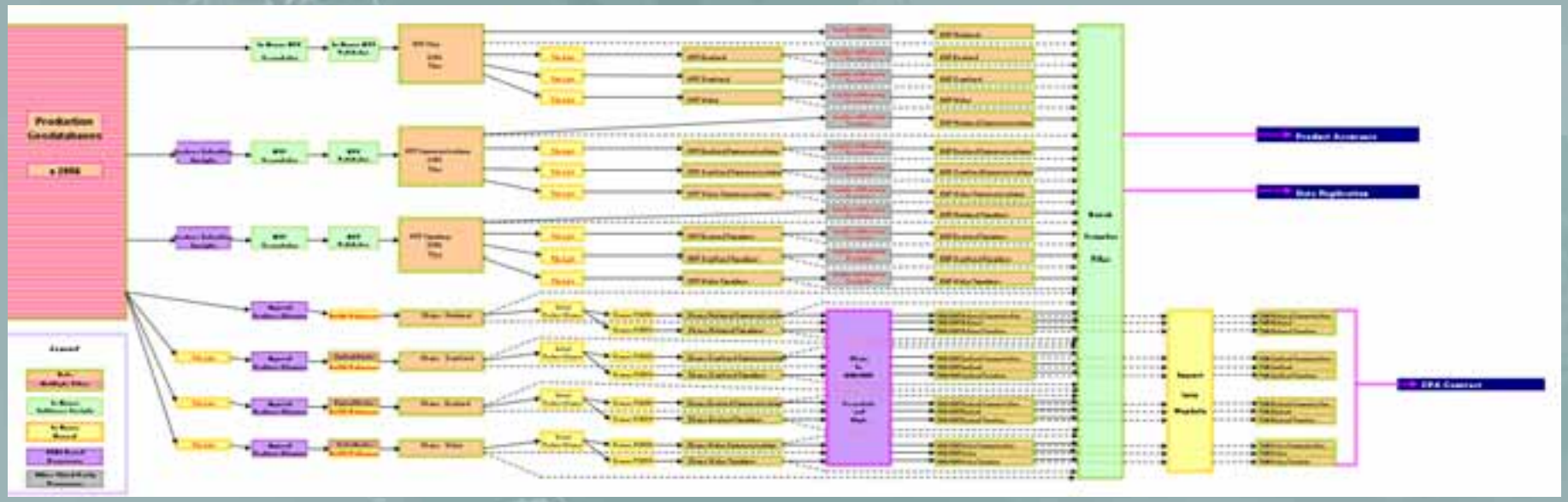
FCT Metadata allows us to do just that



Ordnance Survey

32nd ESRI User Conference 24th July 2012

And then we built a delivery model



32nd ESRI User Conference 24th July 2012

48

Diffe ays to the data

Job Done

Ordnance Survey

32nd ESRI User Conference 24th July 2012

48

Diffe

ata

Job Done

In 7 months !

Ordnance Survey

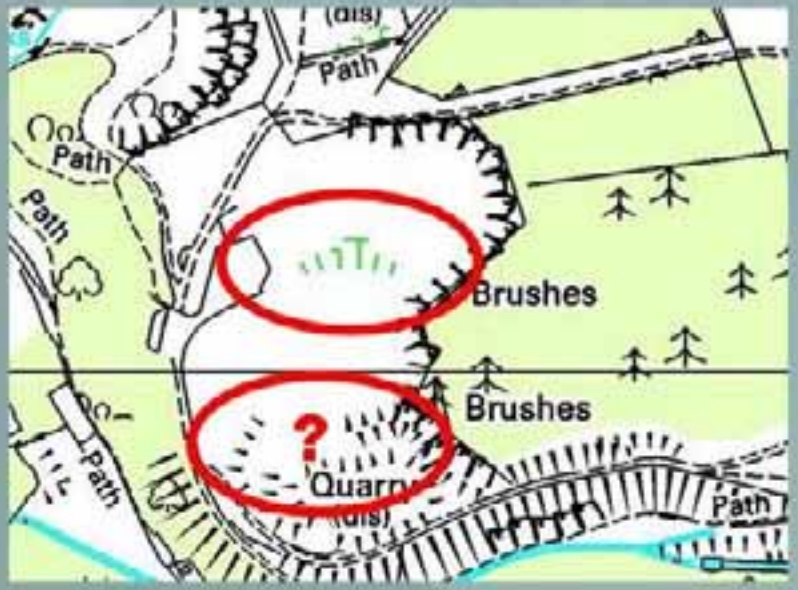
32nd ESRI User Conference 24th July 2012

Benefits

1. Data now in house
   - Improved currency and quality
   - Back in control of content
2. Cheaper – Only have to pay for update carried out rather than a set charge
3. “Customer Friendly” revisions to data being removed
4. Potential for single database on removal of NTF format a stage further forward

Problem 5:

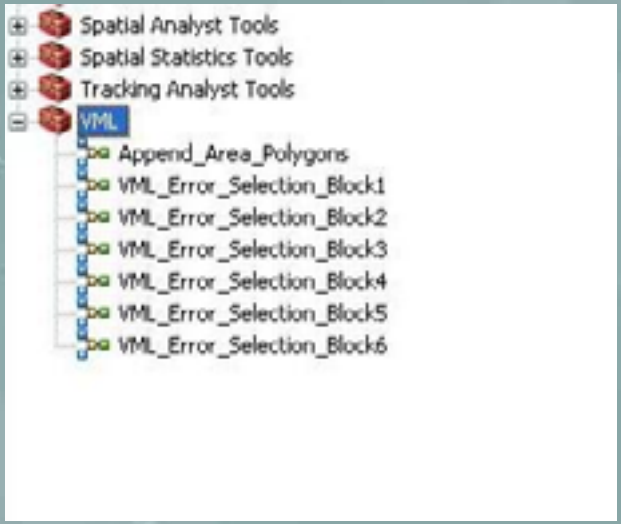
Customer complaints about data across tile edges

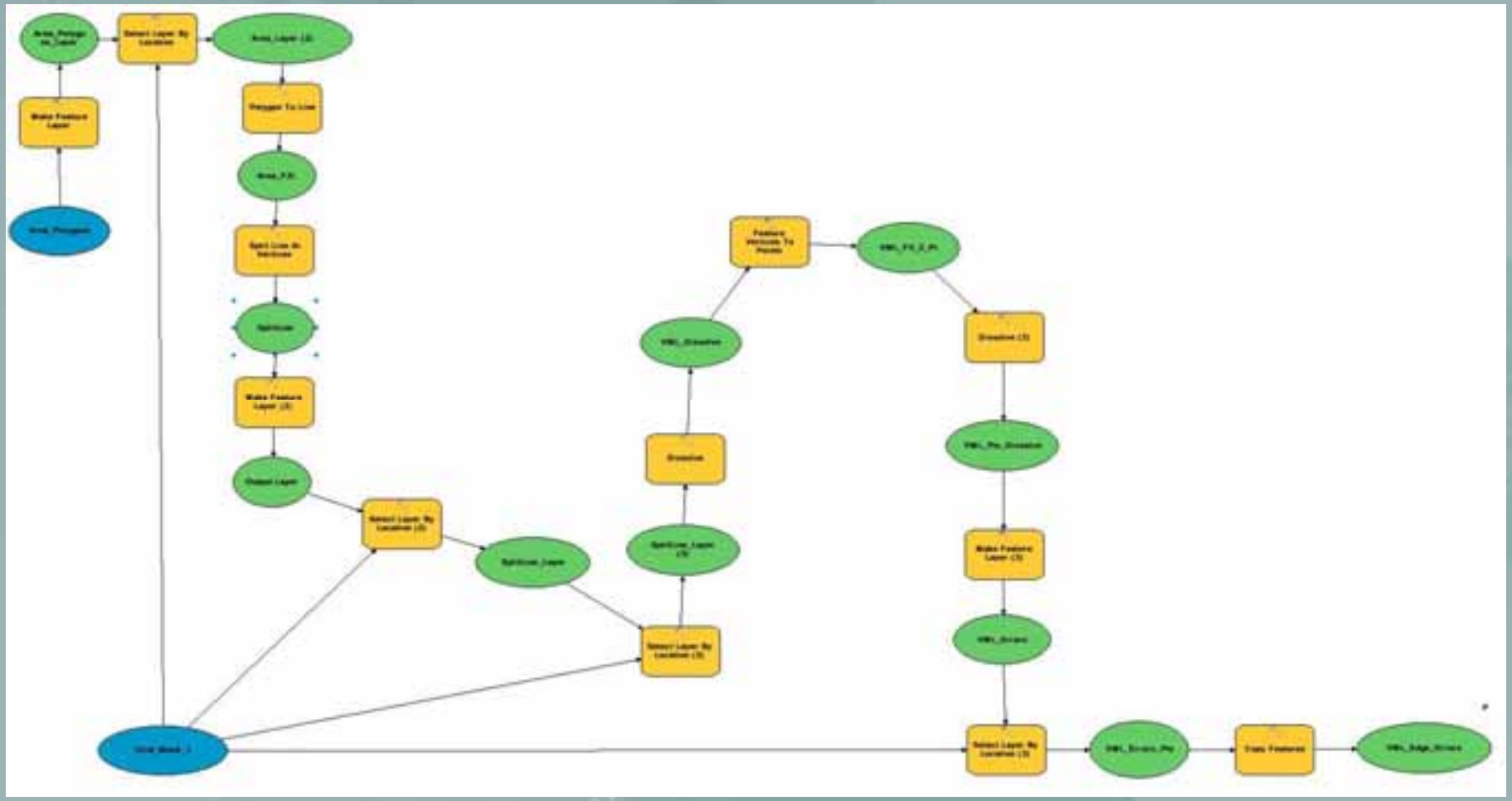


Ordnance Survey
www.ordnancesurvey.co.uk

32nd ESRI User Conference 24th July 2012

- Create a series of models in ModelBuilder to automate the identification of edge errors.





32nd ESRI User Conference 24th July 2012

- 10,567 tiles of data in .gz format
- 32,287,492 polygons

- 215,204 edge match errors involving 183,651 polygons

- Only 0.57 %.....

  but an error is an error

Benefits

1. Better data allowing successful generation of new products
2. Happy customers – One of the UK's largest insurance companies was unable to use our data within its GIS system
3. Good publicity – In showing that we understand our customers concerns and make efforts to deal with them

And that is not all !

These are just five of the processes we have delivered.

There are more……

Thank you

32nd ESRI User Conference 24th July 2012

Improving Quality

www.ordnancesurvey.co.uk

32nd ESRI User Conference 24th July 2012