EUMETNET OPERA Data Centre

Data Traffic configuration and capacity

Stuart Matthews
Draft Version 0.2
7 January 2010

1 Overview

The ODC will

- receive raw radar data (reflectivity, radial winds, etc) from most European National Met Services;
- exchange, data required for compositing, between ODC nodes;
- disseminate composite products generated at the ODC;
- make input data available to European National Met Services

Data flow is anticipated to be evenly spread throughout the day with no significant peaks in data traffic.

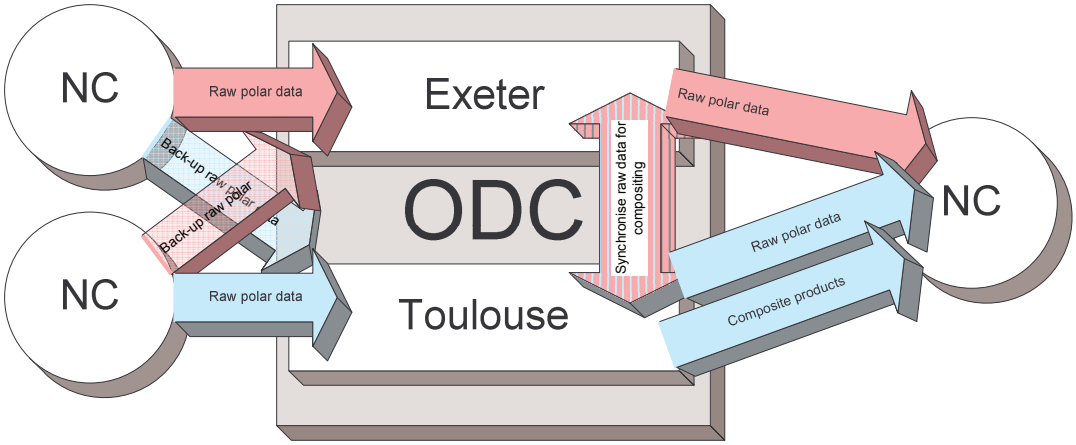


Diagram 1: ODC Data flow overview, with Toulouse as the primary Compositing centre

2 Estimating data traffic to the ODC.

For each NMS the data traffic to the ODC will vary depending on a number of factors, including:

- the number of radar,
- the characteristics of the radar
    - number of elevations,
    - azimuth angle,
    - bin length,
    - etc
- whether a full volume, partial volume or individual scans are sent;
- the update frequency (5, 10 or 15 minute);
- whether moments, other than reflectivity, are made available;
- whether compression is used or not

2.1 Data estimates for a single radar

For the planning purposes an estimate of the 'average' amount of data received from individual radar needs to be made.

The following assumptions are made about an average radar:

- a single elevation is approximately 0.1MB in size;
- 5 elevations constitute a normal volume;
- the update frequency is 6 minute;
- reflectivity and radial winds are sent;
- some form of compression takes place

Based on these assumptions, an average radar will produce 240MB of data per day.

2.2 High, Medium and Low estimates over time

Although we have defined an average radar, it is useful to estimate high, medium and low scenarios. It is also useful to make estimates over future months and years.

The following assumptions are made in calculating the high, medium and high estimates of total data traffic to the ODC.

Estimate	Radar	Elevations	Scan size	Frequency		Estimate bandwidth requirement (end 2011)*
Low	Slow build up of the number of radars received at the ODC. Approaching full coverage by end of 2013	On average only 4 elevations sent from each radar	Average scan size 30KB	Average update period for each radar - 10 minutes	Z	$0.2Mbs^{-1}$

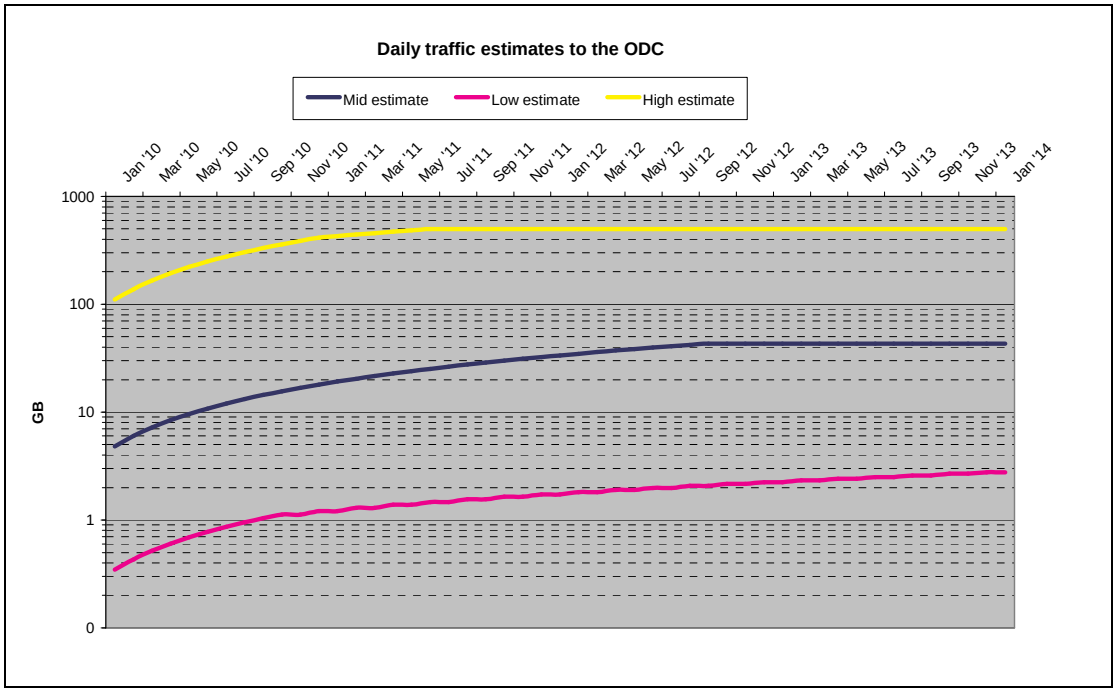
Mid	Linear build up from 20 at the start of 2010 to full coverage by mid 2012.	On average 5 elevations received from each radar	Average individual scan size 100KB	Average update period for each radar – 6 minutes	Z, V	3.3Mbs^{-1}
High	Rapid build up with most European radars available by the end of 2010	On average 8 elevations received from each radar	Average individual scan size 300KB	Average update period for each radar – 5 minutes	4	50Mbs^{-1}

Table 1: Assumptions made in estimating data traffic to the ODC.

*Bandwidth estimate = Estimated daily data volume (GB) x Convert to Bytes (1024^3) x Convert bits (8) / Number of seconds in a day (86400) / Convert bits to Mega bits (1,000,000)

Date	Low estimate		Mid estimate		High estimate	
	Daily total (GB)	Bandwidth estimate (Mb/s)	Daily total (GB)	Bandwidth estimate (Mb/s)	Daily total (GB)	Bandwidth estimate (Mb/s)
01/01/10	0.3	0.03	5	0.5	111	11
01/04/10	0.6	0.06	8	0.8	194	19
01/07/10	0.9	0.09	12	1.2	276	27
01/10/10	1.1	0.11	16	1.6	359	36
01/01/11	1.2	0.12	19	1.9	429	43
01/04/11	1.4	0.14	23	2.3	470	47
01/07/11	1.5	0.15	26	2.6	498	49
01/10/11	1.6	0.16	30	3.0	498	49
01/01/12	1.7	0.17	34	3.3	498	49
01/04/12	1.9	0.19	37	3.7	498	49
01/07/12	2.0	0.20	41	4.1	498	49
01/10/12	2.2	0.21	43	4.3	498	49
01/01/13	2.2	0.22	43	4.3	498	49
01/04/13	2.4	0.24	43	4.3	498	49
01/07/13	2.5	0.25	43	4.3	498	49
01/10/13	2.7	0.27	43	4.3	498	49
01/01/14	2.8	0.27	43	4.3	498	49

Table 2: High, Mid and low estimates of data traffic to the ODC over time



Graph 1: High, Mid and low estimates of data traffic to the ODC

2.3 NMS Input routing to the ODC

Each National Centre will be allocated a Primary and Secondary ODC node connection.

In the event of a failure of the message switching capability at Toulouse or Exeter the secondary routing will need to be activated.

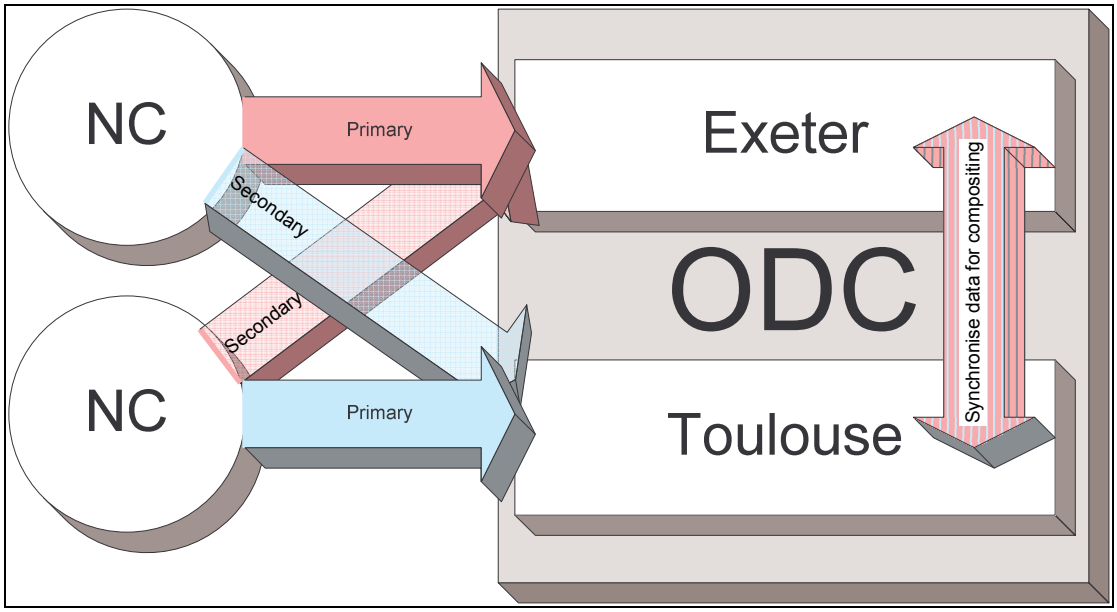


Diagram 2: ODC Input to the ODC nodes in Exeter and Toulouse

National centre connections

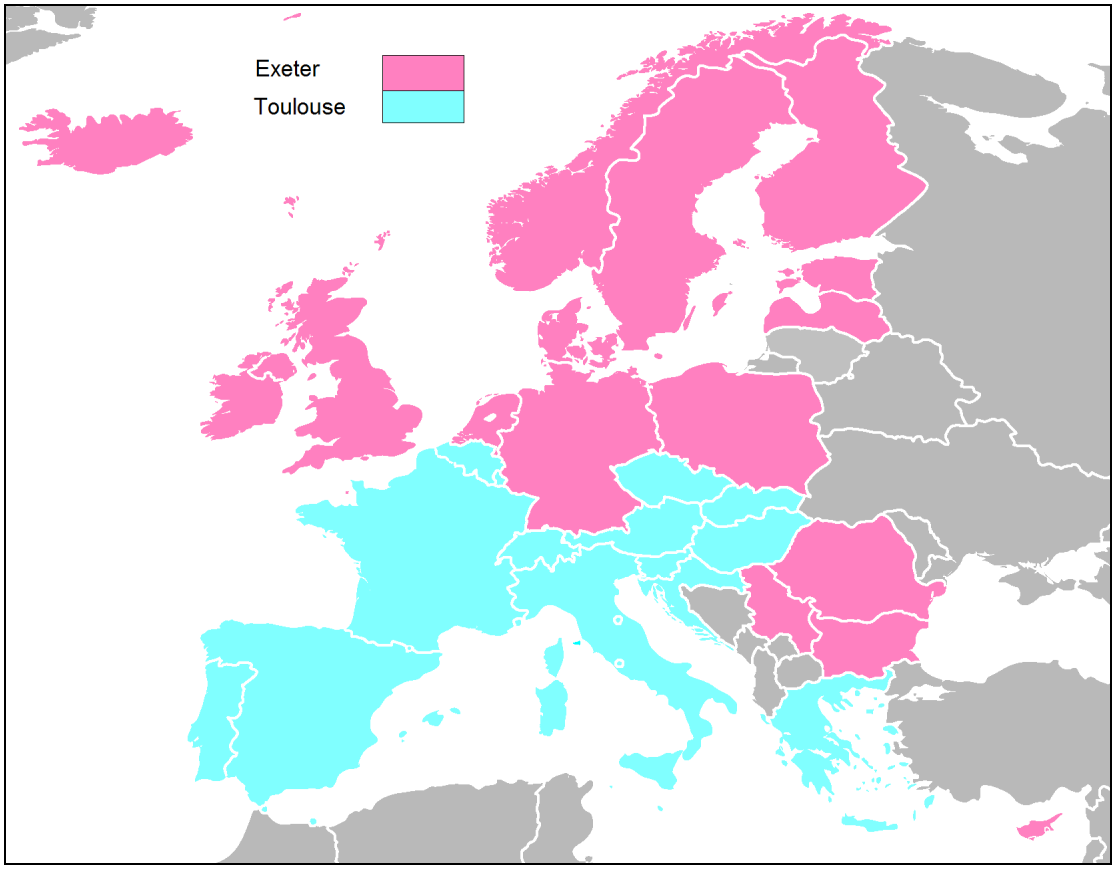


Diagram 3: Map showing counties sending data to Exeter and Toulouse

Primary Node	Secondary node	Countries	Total potential radars
Exeter	Toulouse	Bulgaria, Cyprus, Denmark, Estonia, Finland, Germany, Iceland, Republic of Ireland, Latvia, the Netherlands, Norway, Poland, Romania, Serbia, Sweden, UK	103
Toulouse	Exeter	Austria, Belgium, Croatia, Czech Republic, France, Greece, Hungary, Italy, Luxembourg, Portugal, Slovak Republic, Slovenia, Spain, Switzerland	90

Table 3: Countries and their primary and secondary ODC nodes

3 Data Traffic between the ODC nodes

Data required for compositing needs to be available at both ODC nodes. Therefore these data need to be exchanged as soon as possible after reception at the primary node. It is expected data traffic to each ODC node will be approximately equal.

3.1 Estimates based on number of radars and scans

- Estimates based on an “average” radar but only reflectivity exchanged.
- Total bandwidth estimate for a single ODC node based on two way traffic. I.e. the table represents bandwidth requirements of a single ODC node, disseminating to the other node and receiving data from the other ODC node.
- The most likely requirement is highlighted. I.e. 160 radars and 5 elevations exchanged.

Number of elevations \ Total number of radar (Received & Sent)	20	40	80	120	160	200
1	0.5	0.9	1.9	2.8	3.8	4.7
2	0.9	1.9	3.8	5.6	7.5	9.4
3	1.4	2.8	5.6	8.4	11.3	14.1
4	1.9	3.8	7.5	11.3	15.0	18.8
5	2.3	4.7	9.4	14.1	18.8	23.4
8	3.8	7.5	15.0	22.5	30.0	37.5
15	7.0	14.1	28.1	42.2	56.3	70.3
20	9.4	18.8	37.5	56.3	75.0	93.8

Table 4: Potential daily data traffic at a single ODC nodes to enable parallel composite generation. (GB)

	Less than 1.0 Mbs^{-1} required
	1.0 Mbs^{-1} to 4 Mbs^{-1} required
	Greater than 4 Mbs^{-1} required

4 Data Traffic from the ODC

The ODC will make two basic product types available:

- Input polar data as supplied by National Centres
- Composite products generated at the ODC

4.1 Input data

Polar volume/scan data sent to the ODC will be made available to other National Centres. These data will be made available from the ODC node the data were originally sent.

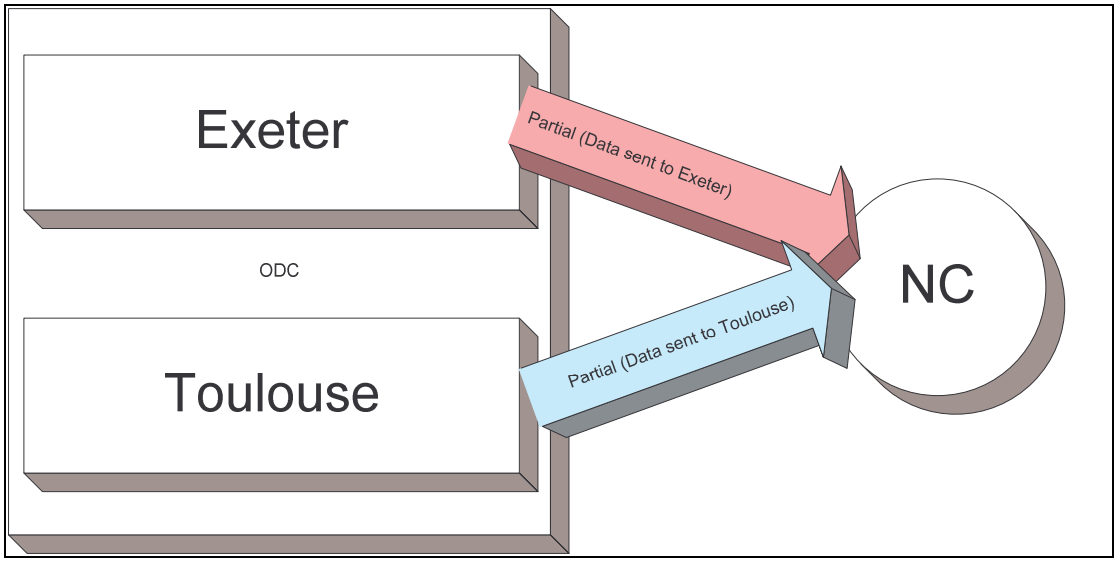


Diagram 4: Overview of ODC distribution of raw polar data

The number of countries who will require access to the raw polar data received at the ODC is currently unknown. If several countries require access to the data of 10s of radar then the bandwidth requirements will be considerable.

4.1.1 Estimates of data volume to supply 'raw' radar data

Estimates based on an 'average' radar being supplied to National Centres.

Number of Radars \ Number of NCs	1	2	5	10	15	20	25	30
1	0.2	0.5	1	2	4	5	6	7
5	1	2	6	12	18	23	29	35
10	2	5	12	23	35	47	59	70
20	5	9	23	47	70	94	117	141
50	12	23	59	117	176	234	293	352
100	23	47	117	234	352	469	586	703
150	35	70	176	352	527	703	879	1055
200	47	94	234	469	703	938	1172	1406

Table 5: Estimate daily data volumes (GB)

The table above can be used to estimate the amount of data required by National Centres.

The example (shaded) shows:

- 1 National Centre receiving data from 100 radars (23 GB per day)
- 2 National Centres receiving data from 50 radars (23 GB per day)
- 5 National Centres receiving data from 20 radars (23 GB per day)
- 5 National Centres receiving data from 10 radars (12 GB per day)
- 10 National Centres receiving data from 5 radars (12 GB per day)

A grand total of 93 GB per day. Again the amount of data will be shared between the two ODC nodes.

4.2 Composite products

Composite products will be supplied to all National Centres, by the operational ODC node. The other node will produce composite products but these products will not be distributed.

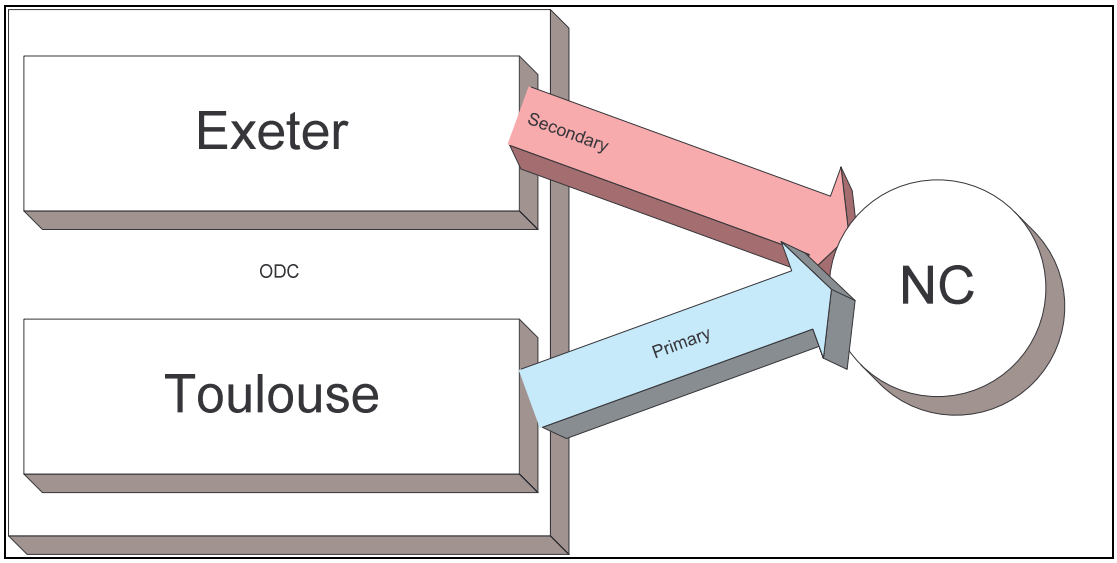


Diagram 5: Composite product delivery with Toulouse as the Primary source

The ODC will produce three composite products and these will be produced in a ‘data’ format and as a graphical image.

The data volume estimates are based on the composite products produced at the OPERA Pilot data hub.

Composite Product	Update frequency	File size (Data and image)	Daily total	# Receiving NC
Max reflectivity	15 min	100KB	13.1MB	30
		40KB		
Surface rain-rate	15 min	100KB	13.1MB	30
		40KB		
Hourly accumulation	60 min	100KB	3.3MB	30
		40KB		

Table 6: Estimate data volumes for composite products generated at the ODC

- Estimated daily data total for all composite products ~30MB
- Estimated daily data traffic to all (30) National Centres ~1GB

5 Summary

Below are estimates of the data volume and bandwidth requirements of a single ODC node in January 2012.

Data Type	Comment	Daily data volume	Approximate bandwidth required
Input Data	Approximately 140 radar received. 70 usually received at each node but full resilience required.	34GB	3.4Mb/s
ODC inter node data exchange	Approximately 160 radar. 140 radar received plus the data from node countries radar	19GB	1.9Mb/s
Composites	All composite products	1GB	0.1Mb/s
Raw data to NMS	NMS requirements are currently unclear and full exploitation of these data may be later that 2012.	93GB	9.3Mb/s
All	Including and excluding making raw data available to NMS	53GB (147GB)	5.3Mb/s (14.6Mb/s)