

Rendered TransXChange Record

Summary Information

File Creation Date: 27 April 2002
 File Creation Time: 13:45

This file contains details as follows:

- 1 service
- 1 route
- 26 stop points
- 31 vehicle journeys

SERVICE: aa1234567 **PUBLICLY KNOWN AS:** 525

Service Type: Normal Stopping

Start Point: Newcastle Haymarket

End Point: Berwick

Start Date: 23 October 2000

End Date: service to operate indefinitely

Registered Operator: X-Ray Yellow Zebra Bus Transport, also known as XYZ Buses, trading as Better Buses

Application Type: New

Registration Submission Date: 20 September 2001

Registration Number: 12345

Variation Number: 1234

Traffic Area(s): North Eastern

Circulated Authorities: Northumberland and Nexus

Subsidy Details: Service is partially subsidised by Northumberland County Council and Nexus

Timetables

Service Identifier: aa1234567
Service Publicly Known As: 525
Service Starts and End Points: starting from Newcastle Haymarket, ending at Berwick
Service Dates: service start date is 23 October 2000, service to operate indefinitely
Journey Pattern Exceptions:

outbound exceptions:
 Queen's Jubilee Bank Holiday - does not operate between 3 June 2002 and 4 June 2002

inbound exceptions:
 Queen's Jubilee Bank Holiday - does not operate between 3 June 2002 and 4 June 2002

Outbound

Monday to Friday

	a b AT	FQT(S)	b FQT	FQT	DF FQT	§ FQT	§ ¿ FQT	FQT	¿ FQT	FQT(E)	¿
Newcastle Haymarket Bus Stn (M) , Bay 7	..	0945	1015	1050	1130	1203	1315	1355	1430	1504	1545
Gosforth High Street , Stop A	..	0951	1021	1056	1136	1209	1321	1401	1436	1510	1551
Regent Centre Metro (M)	..	0953	1023	1058	1138	1211	1323	1403	1438	1512	1553
Wideopen	..	0957	1027	1102	1142	1215	1327	1407	1442	1516	..
Seaton Burn	..	1001	1031	1106	1146	1219	1331	1411	1446	1520	..
<i>Stannington</i>	..	1004	1034	1109	1149	1222	1334	1414	1449	1523	..
Northumberland County Hall	..	1007	1037	1112	1152	1225	1337	1417	1452	1526	..
Morpeth	..	1015	1045	1120	1200	1233	1345	1425	1500	1534	1615

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Felton	1032	1102	1137	1217	1250	1402	1442	1517	1551	..
Shilbottle	1042	1112	1147	1227	1300	1412	1452	1527	1601	..
<i>Alnwick , Stop B</i>	..	..	1054	1124	1159	1239	1312	1424	1504	1539	1613	1645
<i>Belford IO1</i>	0911	0931	1119	1149	1224	1304	1337	1449	1529	1604	1638	1711
Haggerston Castle IO2	0923	0943	1133	1203	1238	1318	1351	1503	1543	1618	1652	1725
<i>Scremerston IO3</i>	0928	..	1138	1208	1243	1323	1356	1508	1548	1623	1657	1730
<i>Berwick-upon-Tweed IO4 , Bay 8</i>	0942	0949	1152	1222	1257	1337	1410	1522	1602	1637	1711	1744

	b	#	a b AT #	FQT(S)	b FQT	a FQT(E)	z	
Newcastle Haymarket Bus Stn (M) , Bay 7	1601	1620	1645	1714	1743	1810	1835	1910
Gosforth High Street , Stop A	1607	1626	1651	1720	1749	1816	1841	1916
Regent Centre Metro (M)	1609	1628	1653	1722	1751	1818	1843	1918
Wideopen	..	1632	..	..	..	..	1847	..
Seaton Burn	..	1636	..	..	..	..	1851	..
<i>Stannington</i>	..	1639	..	..	..	..	1854	..
Northumberland County Hall	..	1642	..	..	..	..	1857	..
Morpeth	1631	1650	1715	1744	1813	1840	1905	1940
Felton	..	1707	..	..	..	..	1922	..
Shilbottle	..	1717	..	..	..	..	1932	..
<i>Alnwick , Stop B</i>	1701	1729	1745	1814	1843	1910	1944	2010
<i>Belford IO1</i>	1727	1754	..	1840	1909	1936	2009	..
Haggerston Castle IO2	1741	1808	..	1854	1923	1950	2023	..
<i>Scremerston IO3</i>	1746	1813	..	1859	1928	1955	2028	..
Berwick-upon-Tweed IO4 , Bay 8	1800	1827	1835	1913	1942	2009	2042	2100

Vehicles are adapted for disabled passengers

Hail and Ride zones (where buses will stop, where it is safe to do so, by being hailed from the roadside) include the following: **Starts at** Regent Centre Metro (M), **ends at** Stannington. **Starts at** Felton, **ends at** Belford IO1. **Starts at** Haggerston Castle IO2, **ends at** Berwick-upon-Tweed IO4.

General Interchanges include:

- Regent Centre Metro (M) (changing to Gosforth High Street) : related service ID is 678DFG , valid from 20 November 2001 until 20 June 2003 , interchange time is 5 mins (interchange mode is 'Walk') , type of interchange is 'Join'
- Shilbottle : related service ID is 456DEF , valid from 20 November 2001 , facilities for interchange - neighbouring bays in bus station , interchange time is 10 mins (interchange mode is 'Walk') , type of interchange is 'Join'

Non-standard operations for this service include:

- will operate on 11 October 2001, 21 March 2002
- will NOT operate on 18 August 2001, 20 February 2002
- operation is indeterminate on 30 May 2002
- periods of suspension include the following (dates given are the last date of operation prior to suspension and the first date after suspension): **from** 28 October 2003 **until** 5 November 2003
- operates on the following Bank Holidays: Good Friday
- will NOT operate on the following Bank Holidays: May Day, Local Mid-Summer Holiday

- operation is indeterminate on the following Bank Holidays: Boxing Day
- a** ~ conductor aboard
b ~ smoking permitted on this journey
FQT(S) ~ vehicle journey denotes start of frequent service period
FQT ~ vehicle journey within frequent service period
FQT(E) ~ vehicle journey denotes end of frequent service period
§ ~ journey-specific interchanges apply as follows:
- 12.03 departure from Newcastle Haymarket Bus Stn (M) interchanging at Seaton Burn (changing to Stannington) : related service ID is 123ABD, publicly known as 525 , valid from 22 October 2001 , facilities for interchange - Lay-by , interchange time is 5 mins (interchange mode is 'Walk') , type of interchange is 'Join'
 - 13.15 departure from Newcastle Haymarket Bus Stn (M) interchanging at Alnwick (changing to Shilbottle) : related service ID is 123ABD, publicly known as 525 , valid from 22 October 2001 , facilities for interchange - Lay-by , interchange time is 4 mins (interchange mode is 'Walk') , type of interchange is 'Join'
- #** ~ journey-specific layover points apply as follows:
- 16.20 departure from Newcastle Haymarket Bus Stn (M) has a layover point (Wideopen Station) lasting 2 mins
 - 16.45 departure from Newcastle Haymarket Bus Stn (M) has a layover point (Scremerston Village Hall Car Park) lasting 2 mins
- AT** ~ vehicle description: Articulated
DF ~ vehicle description: Disabled Friendly
ζ ~ journey-specific non-standard operations apply as follows:
- 13.15** departure from Newcastle Haymarket Bus Stn (M)
- only operates on First, Second, Third and Fourth week of each month
- 14.30** departure from Newcastle Haymarket Bus Stn (M)
- will operate on 11 October 2001, 21 March 2002
 - will NOT operate on 18 August 2001, 20 February 2002
 - operation is indeterminate on 30 May 2002, 22 June 2002
 - periods of suspension include the following (dates given are the last date of operation prior to suspension and the first date after suspension): **from** 28 November 2001 **until** 8 December 2001, **from** 8 June 2003 **until** 30 June 2003
 - operates on the following Bank Holidays: New Year's Day, Good Friday
 - will NOT operate on the following Bank Holidays: May Day, Late Summer Bank Holiday (Not Scotland), Local Mid-Summer Holiday
 - operation is indeterminate on the following Bank Holidays: Christmas Day, Boxing Day
 - only operates on Second and Last week of each month
 - operates on school days of St.Trininans Local Comp
 - does NOT operate on school days of St.Trininans Local Comp Hogwarts Dotherbys
 - operates on school holidays of Hogwarts Dotherbys
 - does NOT operate on school holidays of St.Trininans Local Comp
- 15.45** departure from Newcastle Haymarket Bus Stn (M)
- will operate on 11 October 2001, 21 March 2002
 - will NOT operate on 18 August 2001, 20 February 2002
 - operation is indeterminate on 30 May 2002, 22 June 2002
 - periods of suspension include the following (dates given are the last date of operation prior to suspension and the first date after suspension): **from** 28 November 2001 **until** 8 December 2001, **from** 8 June 2003 **until** 30 June 2003
 - operates on the following Bank Holidays: New Year's Day, Good Friday
 - will NOT operate on the following Bank Holidays: May Day, Late Summer Bank Holiday (Not Scotland), Local Mid-Summer Holiday
 - operation is indeterminate on the following Bank Holidays: Christmas Day, Boxing Day

19.10 departure from Newcastle Haymarket Bus Stn (M)

- operates on school days of local education authority; Hogwarts Dotherbys
 - does NOT operate on school days of local education authority;
 - operation to be decided on school days for local education authority; Grange Hill Bog Standard
-

Inbound

Monday to Friday

	FQT(S)	FQT	FQT(E)		a b	FQT(S)	FQT	FQT(E)			
<i>Belford IO1</i>	..	..	..	0925	1020	1055	1130	1200	1225	1355	1430
Haggerston Castle IO2	..	..	..	0937	1032	1107	1142	1212	1237	1407	1442
<i>Scremerston IO3</i>	..	..	..	0943	1038	1113	1148	1218	1243	1413	1448
<i>Berwick-upon-Tweed IO4 , Bay 8</i>	..	..	..	0957	1052	1127	1202	1232	1257	1427	1502
<i>Alnwick , Stop A</i>	..	..	..	1003	1058	1133	1208	1238	1303	1433	1508
Shilbottle	..	..	..	1016	1111	1146	1221	1251	1316	1446	1521
Felton	..	..	..	1029	1124	1159	1234	1304	1329	1459	1534
<i>Morpeth</i>	0922	0935	0947	1044	1139	1214	1249	1319	1344	1514	1549
Northumberland County Hall	..	..	..	1049	1144	1219	1254	1324	1349	1519	1554
<i>Stannington</i>	..	..	..	1054	1149	1224	1259	1329	1354	1524	1559
Seaton Burn	..	..	..	1058	1153	1228	1303	1333	1358	1528	1603
Wideopen	..	..	..	1102	1157	1232	1307	1337	1402	1532	1607
<i>Regent Centre Metro (M)</i>	0957	1010	1022	1104	1159	1234	1309	1339	1404	1534	1609
Gosforth High Street , Stop D	1002	1015	1027	1106	1201	1236	1311	1341	1406	1536	1611
<i>Newcastle Haymarket Bus Stn (M) , Bay 3</i>	1005	1018	1030	1112	1207	1242	1317	1347	1412	1542	1617

Vehicles are adapted for disabled passengers

Hail and Ride zones (where buses will stop, where it is safe to do so, by being hailed from the roadside) include the following: **Starts at** Haggerston Castle IO2, **ends at** Alnwick. **Starts at** Felton, **ends at** Stannington. **Starts at** Seaton Burn, **ends at** Gosforth High Street.

General Interchanges include:

- Regent Centre Metro (M) (changing to Gosforth High Street) : related service ID is 678DFG , valid from 20 November 2001 until 20 June 2003 , interchange time is 5 mins (interchange mode is 'Walk') , type of interchange is 'Join'
- Shilbottle : related service ID is 456DEF , valid from 20 November 2001 , facilities for interchange - neighbouring bays in bus station , interchange time is 10 mins (interchange mode is 'Walk') , type of interchange is 'Join'

Non-standard operations for this service include:

- will operate on 11 October 2001, 21 March 2002

- will NOT operate on 18 August 2001, 20 February 2002
- operation is indeterminate on 30 May 2002
- periods of suspension include the following (dates given are the last date of operation prior to suspension and the first date after suspension): from 28 October 2003 until 5 November 2003
- operates on the following Bank Holidays: Good Friday
- will NOT operate on the following Bank Holidays: May Day, Local Mid-Summer Holiday
- operation is indeterminate on the following Bank Holidays: Boxing Day

a ~ conductor aboard

b ~ smoking permitted on this journey

FQT(S) ~ vehicle journey denotes start of frequent service period

FQT ~ vehicle journey within frequent service period

FQT(E) ~ vehicle journey denotes end of frequent service period

Service

General Service Details

Service **aa1234567** publicly known as **525**:

- classified as **Normal Stopping**
- starting from **Newcastle Haymarket**, ending at **Berwick**
- service start date is **23 October 2000**, service to operate **indefinitely**
- service **does not use all stops**
- modification status is **New**, service revision number is **1**
- related services (for marketing purposes) include **515 (ID a1234)**, **535 (ID b1234)** and **555 (ID c1234)**
- service requires additional stops - **Dinnington, Chathill and Spittal**

Registration Details Include:

- registration application submitted by **Mr Fred Bloggs (CEO)**
- type of registration application is **New**, date of registration submission is **20 September 2001**
- registration number is **12345**, variation number is **1234**
- traffic area identified is **North Eastern**; authorities circulated are **Northumberland and Nexus**
- service is partially subsidised by **Northumberland County Council and Nexus**

Short Notice Registration Details Include:

- timetable change for all or part of the week which includes 24 and 25 December, Good Friday or any bank holiday
- the new service/change will replace a substantially similar service which another operator has stopped or intends to stop operating - **The Flyer** operated by **ABCD**
- the service to be changed or cancelled is either not available to the general public or is not generally used by them - **to be used by a closed group**
- the police, or traffic authority have requested the change/cancellation of this service on road traffic or safety grounds - **requested by local Police**
- the new service/change will cater for the additional demands of a special occasion or event - **XYZ In Concert**
- the service timetable will be changed in timings no more than 10 minutes earlier or later than registered - **this is a very minor change**
- the service timetable will be changed to match the service with an altered connecting rail, ferry or air service - **X33 Northern Express**
- the change will last for a period of 14 days or less which is a local public holiday or a holiday widely observed in the area - **Local factory holiday change**
- the service is to be changed solely to comply with traffic regulation conditions or a road traffic order made by a local authority - **Northumberland County Council Alnwick**

Town Centre TRC, June 2002

- the new/changed/cancelled service is requested for reasons which could not have been foreseen at 42 days notice - **need to avoid roadworks along registered route**

Stops Served:

Outbound Stops Served

Newcastle Haymarket Bus Stn (M) , Bay 7
Town Centre , Newcastle
Interchange , Marked , a105108HAYQS

Gosforth High Street , Stop A
Gosforth , Newcastle
Single Stop , Marked , a103208G05

Regent Centre Metro (M)
Gosforth , Newcastle
Paired Stop , Marked , a120808REGF

Wideopen
Wideopen , North Tyneside
Paired Stop , Marked , a2802016

Seaton Burn
Seaton Burn , Northumberland
Paired Stop , Marked , a2502013

Stannington
Stannington , Northumberland
Paired Stop , Marked , a627750059

Northumberland County Hall
Morpeth , Northumberland
Single Stop , Marked , a627250054

Morpeth
Morpeth , Northumberland
Paired Stop , Marked , a638950173

Felton
Felton , Northumberland
Paired Stop , Marked , a624750026

Shilbottle
Shilbottle , Northumberland
Paired Stop , Marked , a624250021

Alnwick , Stop B
Alnwick , Northumberland
Paired Stop , Marked , a624050019

Belford IO1
Belford , Northumberland
Paired Stop , Marked , a622850006

Haggerston Castle IO2
Haggerston Castle , Northumberland
Paired Stop , Marked , a622750004

Scremerston IO3
Scremerston , Northumberland

Paired Stop , Marked , a622650003

*Berwick-upon-Tweed IO4 , Bay 8
Berwick-upon-Tweed , Northumberland
Paired Stop , Marked , a622450001*

Inbound Stops Served

*Belford IO1
Belford , Northumberland
Paired Stop , Marked , a622850006*

*Haggerston Castle IO2
Haggerston Castle , Northumberland
Paired Stop , Marked , a622750004*

*Scremerston IO3
Scremerston , Northumberland
Paired Stop , Marked , a622650003*

*Berwick-upon-Tweed IO4 , Bay 8
Berwick-upon-Tweed , Northumberland
Paired Stop , Marked , a622450001*

*Alnwick , Stop A
Alnwick , Northumberland
Paired Stop , Marked , a624050020*

*Shilbottle
Shilbottle , Northumberland
Paired Stop , Marked , a624250022*

*Felton
Felton , Northumberland
Paired Stop , Marked , a624750027*

*Morpeth
Morpeth , Northumberland
Paired Stop , Marked , a638950174*

*Northumberland County Hall
Morpeth , Northumberland
Single Stop , Marked , a627250055*

*Stannington
Stannington , Northumberland
Paired Stop , Marked , a627750060*

*Seaton Burn
Seaton Burn , Northumberland
Paired Stop , Marked , a2502014*

*Wideopen
Wideopen , North Tyneside
Paired Stop , Marked , a2802017*

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Regent Centre Metro (M)
Gosforth , Newcastle
Paired Stop , Marked , a120809REGF

Gosforth High Street , Stop D
Gosforth , Newcastle
Single Stop , Marked , a103208G04

Newcastle Haymarket Bus Stn (M) , Bay 3
Town Centre , Newcastle
Interchange , Marked , a105109HAYQS

Stopping Arrangements:

Outbound Stopping Arrangements:

disused land (between Alnwick and Belford IO1) .

Inbound Stopping Arrangements:

Use of car park (between Wideopen and Regent Centre Metro (M)) ;

extended lay-by (between Gosforth High Street and Newcastle Haymarket Bus Stn (M)) .

Journey Pattern Exceptions:

Outbound Exceptions:

Queen's Jubilee Bank Holiday - does not operate between 3 June 2002 and 4 June 2002

Inbound Exceptions:

Queen's Jubilee Bank Holiday - does not operate between 3 June 2002 and 4 June 2002

Registered Operator Details:

X-Ray Yellow Zebra Bus Transport, also known as **XYZ Buses**, trading as **Better Buses**

Licence Number: **LKJ1234567**

Licence Type: **Standard_National**

Enquiry Tel: **1112345678**

Contact Tel: **1112345679**

Correspondence Address:

42 Station Road
Othertown
Anyshire
EF3 4GH
UK

Other Address(es):

22 The Road

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Someplace
Wonderland
IJ5 6KL
UK

Transportation House
Over There
Metropolis
KL4 8NP
UK

Associated Operator Details:

Barrie Paterson Travel (Travelsure), also known as
Travelsure, trading as **Travelsure**

Licence Number: **PDA1234567**

Licence Type: **Standard_National**

Enquiry Tel: **1112345678**

Contact Tel: **1112345679**

Correspondence Address:

18 High Street
Thistown
Anyshire
AB1 2CD
UK

Timetable for Service aa1234567 publicly known as 525 is provided in the
timetable section

Rendered TransXChange Record

Route

General Route Details

Route Description: Berwick-Newcastle_Newcastle-Berwick
 Revision Number: 1
 Nature of Route Modification: New

Route Link Details

Route Links Identified: **Outbound Route Links** Haymarket Bus Station (300m), Percy Street (500m), Barras Bridge (100m), Great North Road (2000m), Gosforth High Street (1500m), Regent Centre Metro (200m), Great North Road (2500m), Wideopen (4000m), Seaton Burn (2000m), A1 (7000m), Stannington (6500m), A1 (4800m), Morpeth (5200m), A192 (8000m), A1 (14000m), Felton (800m), A1 (11000m), Alnwick (4000m), A1086 (13000m), Belford (4000m), Haggerston (6000m), Scremerston (7000m), Berwick (8000m), **End Of Outbound Route**

Inbound Route Links Belford (4000m), Haggerston (6000m), Scremerston (7000m), Berwick (8000m), A1086 (13000m), Alnwick (4000m), A1 (11000m), Felton (800m), A1 (14000m), A192 (8000m), Morpeth (5200m), A1 (4800m), Stannington (6500m), A1 (7000m), Seaton Burn (2000m), Wideopen (4000m), Great North Road (2500m), Regent Centre Metro (200m), Gosforth High Street (1500m), Great North Road (2000m), Barras Bridge (100m), Percy Street (500m), Haymarket Bus Station (300m), **End Of Inbound Route**

Route Modifications Identified: **Route Links To Be Deleted** Haymarket Bus Station .
Route Links To Be Revised Great North Road , A1 , Felton , A1 .

Manoeuvres Identified: Scremerston (InboundAndOutbound) Reverse Round Corner, 3 Point Turn
 Barras Bridge (Inbound) Reverse Round Corner

Route Variation Details

Rendered TransXChange Record

Route Variations Identified:

1: Lower Stannington (6500m), A1001 (7000m), **End Of Route Variation**

2: Upper Alnwick (4000m), A1086(M) (13000m), **End Of Route Variation**

The Following Documents Are Associated With The Registration
Submission

CAP GEMINI UK PLC
Cap Gemini House
1 Avenue Road
Aston
Birmingham B6 4DU
Tel: +44(0)121 333 3536
Fax: +44(0)121 333 3308

Clerk to the Traffic Commissioners
Midlands Traffic Area
Cumberland House
200 Broad Street
Birmingham
B15 1TD

Dear Sir

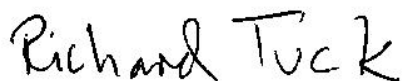
LOCAL BUS SERVICE X80 – Ansley to Birmingham

I am writing to support the application made by Lionspeed Ltd. to register local bus service X80 with effect from Monday 6th September 1999.

The late registration is due to the operator that had originally been awarded the service, deciding to withdraw from the contract. Lionspeed Ltd. tendered for the service initially and were the next lowest bidder.

The service is financially supported by Warwickshire County Council

Yours Sincerely,



Richard Tuck
Passenger Transport Officer
Transport Operations

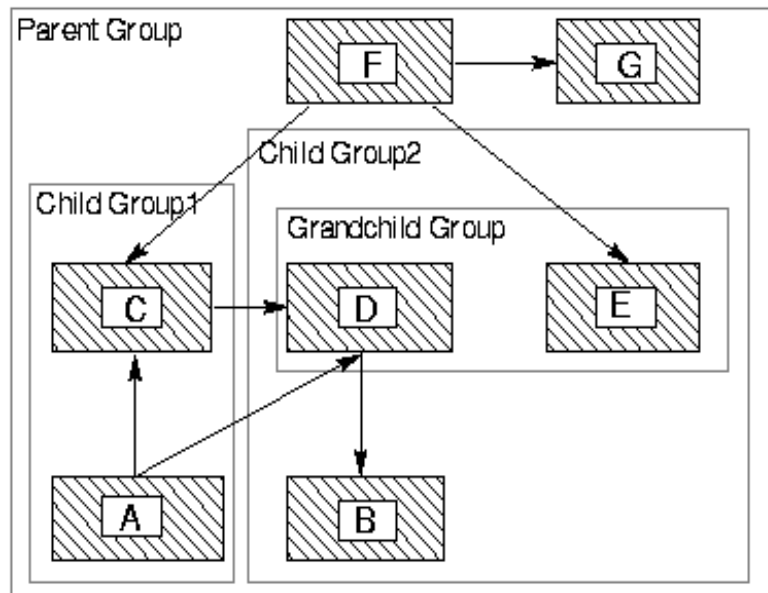


Figure 9: Groups visualized as nested regions

Dealing with multiple visual representations for grouped objects requires only a small extension to our approach of Sections 2 and 3. In particular, each individual group has its own current and anchored configurations of its (immediate) members. At any point, a single group is the focus, and actions on objects *within* the group (object creation, deletion, movement, or visual representation change) cause local layout decisions by following the exact same algorithm described earlier. Of course, many layout changes in a group imply a visual representation change for it within its parent group and, therefore, recursively trigger the configuration-change part of the algorithm for the parent.

A major reason for grouping objects is abstraction, so that users may be able to view the details (members) of a group or simply view a single object representing the group and ignoring its details. This is naturally achieved within our framework by treating groups as first-class objects that must satisfy Requirements R1-R4, and associating with them two visual representations, one “collapsed” and one “expanded”, with the obvious meaning. Any change of a group from one representation to the other is simply a configuration change for the parent group and the earlier layout algorithm is directly applicable. Continuing on with the example of grouping of subgraphs of a graph, Figures 11 and 12 show two consecutive collapses of a group and its parent and the resulting layouts.

One complication that arises in the presence of groups is that the user may change group membership or create groups at any level of an existing grouping hierarchy. Both types of actions, especially group creation, may result in extensive changes in group membership and, therefore, configuration structures and location origins. Nevertheless, each such action may be analyzed into individual object creations and deletions, which can then be dealt with directly by the general algorithm.

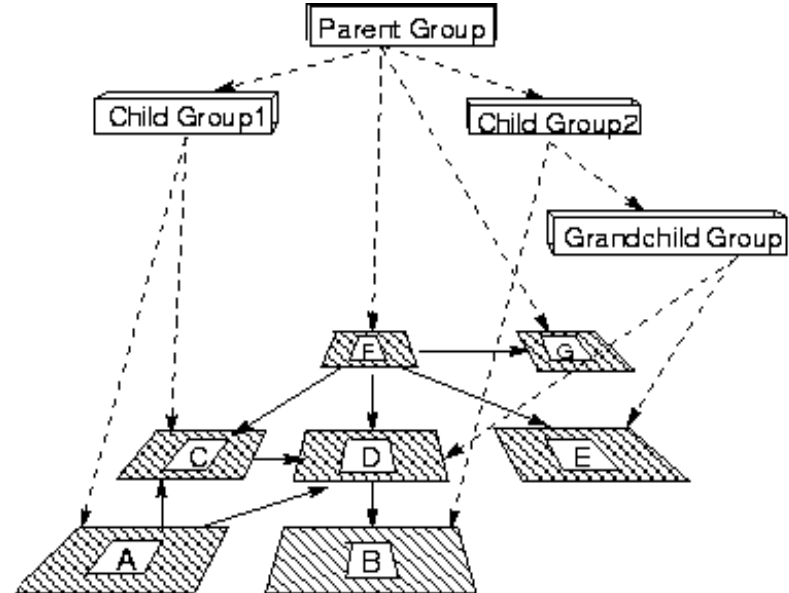


Figure 10: The grouping hierarchy, orthogonal to graph structure

5 Implementation and Experience

5.1 Implementation

The entire framework and algorithms described above, including the generalizations of Section 4, have been implemented in the OPOSSUM visualization tool [6], which is part of the user interface of the ZOO Experiment Management System [8]. ZOO is a system under development whose goal is to allow scientists from arbitrary disciplines manage all phases of their experimental studies using a single tool. One of the key issues in ZOO is providing a user interface that is primarily visual (so that it is intuitive to users who are not experts in computer science), relatively generic (so that it can be used for different styles of visualization and serve the needs of many disciplines), and able to deal with large numbers of visual objects (which is common in these applications).

OPOSSUM is part of the ZOO interface that deals with visualization of database schemas and also forms the basis for other parts of the interface. It is a generic tool that accepts as input descriptions of a data model, a visual model (capturing the structure of some class of visualizations, e.g., graphs, tables, rectangles contained into each other), and a visual metaphor that maps some of the elements of the visual model to elements of the data model. Thus, given a visualization on the screen the metaphor assigns meaning to its individual visual objects with respect to some underlying schema.

One may define mixed metaphors, where a single concept in the data model may be visualized in different ways, using different concepts in the visual model. The input file describing the metaphor includes information about which types of objects should satisfy Requirements R1-R2 and also a size-based total order \preceq on each one of these object types. The heuristic algorithm of Section 3.2 has been implemented in OPOSSUM in a generic fashion, without any reference to specific types of visual objects or kinds of visual representation. During any OPOSSUM session, all these are instantiated based on the contents of the input model and metaphor

The Following General Documents Are Associated With This Document

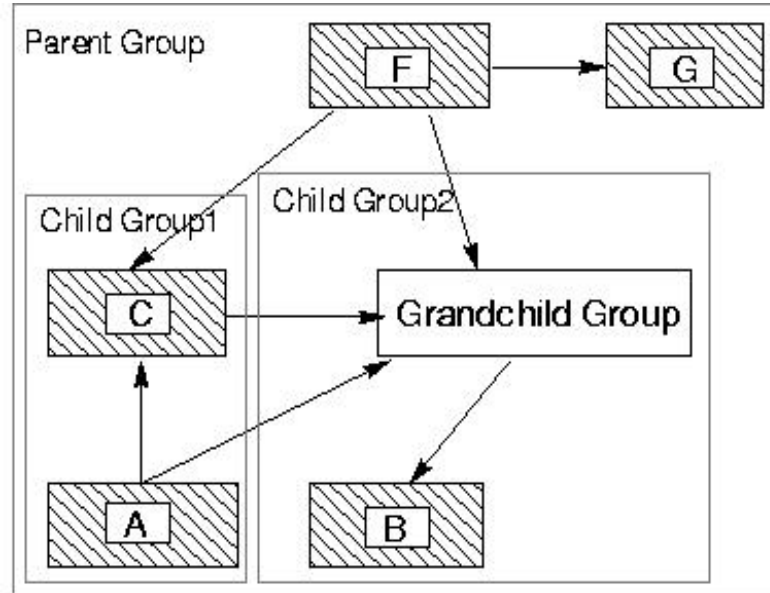


Figure 11: The same graph with “Grandchild Group” collapsed

files, and the algorithm proceeds accordingly.

We should emphasize that visualizations of graphs with groups defined based on subgraphs in rectangular regions, as in Section 4.2, can be described as a visual model to be given as input to OPOSSUM. Screenshots of the OPOSSUM display showing a large object-oriented schema in graph form, at two configurations with respect to groups being expanded or collapsed, are shown below [6]. Figure 13 presents the schema graph with all groups expanded, while Figure 14 shows the internal structure of two top-level groups allowing easier study of their details.

5.2 Experience

OPOSSUM has been used by scientists in Soil Sciences, Biochemistry, and Physics to design relational and object-oriented schemas for their databases and experiments using a variety of visual models (mostly graph-based). (The schema graphs shown in the previous subsection are from a large simulation experiment on plant grown by the soil scientists.) The feedback in all cases has been very positive for all aspects of the system, including the layouts resulting from the algorithm of Section 3.2. With few exceptions, these layouts have captured what the users expect. In addition, the notion of groups in the input visual models and their collapsed/expanded representation has proved to be extremely valuable in dealing with the very large schemas that these scientists generate.

6 Related Work

To the best of our knowledge, this is the first work that attempts to deal in a generic fashion with multiple visual representations of objects and their layouts so that Requirements R1-R4 are satisfied, especially R4 which calls for taking into account user placement.

On the other hand, there has been considerable work on automated layout of graphs and trees [5, 9, 10]. Only [10] considers user-specified location information, and that is in the context of trees (maintaining user-specified ordering of

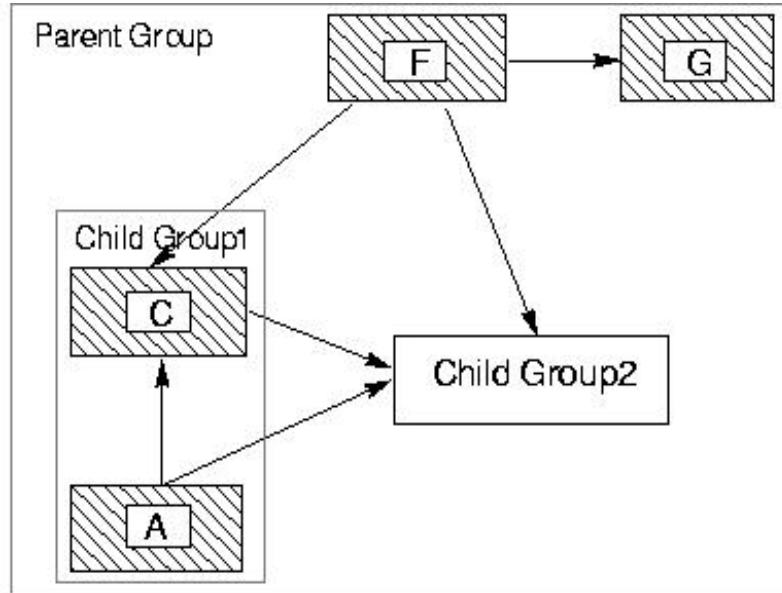


Figure 12: The same graph with “Child Group2” collapsed

siblings). The EDGE system [3] uses user-provided information for graph layout, but this is in the form of explicit constraints to restrict or supplement decisions made by the automatic layout algorithm. It requires these constraints for each spatial relationship, whereas we use user-provided information to infer layout guidelines.

Also related is work on showing different amounts of detail in visualizations. Pad++, demonstrates improved approaches to zooming [2]. Fisheye views of graphs [11, 13] allow zooming of one part of a graph more than others. Neither approach offers abstractions when detail is removed. Magic lenses [14] offer different amounts of detail, but without layout management to prevent sparse or overlapping information. Hy++ [4] uses limited abstraction to better visualize graphs describing relationships between instances in a logical database. Groups of instances can be represented by their type class when there is insufficient space to display all the instances. Finally, work has been done on applying multiple-focus fisheye views to allow different parts of a hierarchically organized visualization to be seen with certain groups collapsed and others expanded [1]. The main limitation of this effort is that it only considers visualizations where everything fits on the screen at once, and whenever something gets larger, everything else must get smaller (or collapse). Also, the multiple fisheye lens approach requires huge amounts of processing time (needs two separate workstations to run).

7 Conclusions

We have addressed the problem of user-oriented layout for large collections of objects that can be viewed through multiple visual representations. We have devised a general algorithm that uses a small number of layouts that the user has (directly or indirectly) specified explicitly to derive other layouts that attempt to follow the user preferences thus expressed. The algorithm has been implemented in a system and has been used by real users who have found it quite effective. The future calls for implementation enhancements

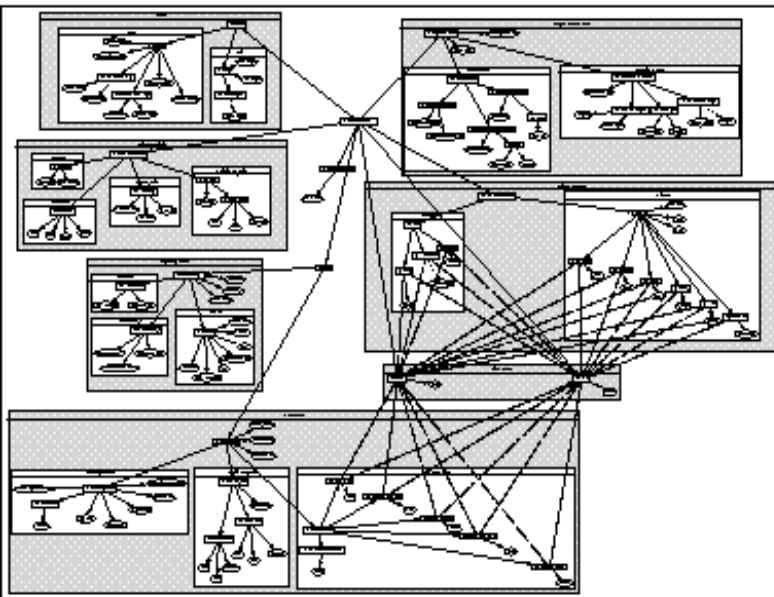


Figure 13: The CUPID input schema, partitioned into Groups

for optimal performance and a more comprehensive usability study of the algorithm.

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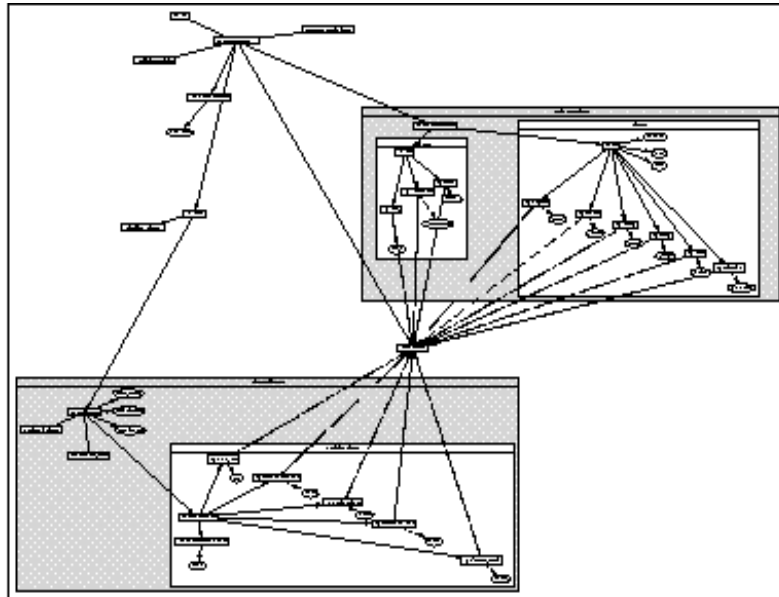


Figure 14: The same schema, partially abstracted

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