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Note

Producing a printed telephone directory using data from an X.500 system

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Abstract

This note describes the data structures required, and the software used, to print a telephone directory from data held in an X.500 Directory.

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1 Acknowledgements

The development of the software described in this note was funded by University College's Central Services department. They have graciously agreed to make the software freely available on two conditions. First, the software should be not exploited by others for commercial gain. Second, any improvements to the package made by other sites should be offered to UCL Central Services.

Particular thanks should also go to Ab Wilson, a student at UCL, who wrote the package. Ab had to contend with design modifications being made right up to the last minute (the author of this note accepts full responsibility for this!). Ab provided all the LaTeXexpertise himself.

If you are interested in obtaining the software, you should contact the author at the above address. The author's email address is `<p.barker@cs.ucl.ac.uk>`.

2 Introduction

Many sites experimenting with X.500 systems use their telephone system database as an initial source of data for populating their X.500 database. This was the case at University College London (UCL), where we were fortunate in having a very cooperative Central Services department who were interested in our X.500 work, and have provided us with data at regular intervals. It became apparent during this initial collaboration that the telephone database system offered a somewhat limited and predetermined set of facilities to the telephone system managers. One of the areas in which the system was felt to be unsatisfactory was in the production of a printed directory. A number of criticisms were noted with the existing system:

- Poor presentation of useful information - it was not possible (without cut and paste) to give information such as a general enquiries number, facsimile number, department location(s), head of department, or special dialling information, collected together with the entry for the department.

- Low print quality - the system was connected to a dot matrix printer, and pages were photo-reduced for inclusion in a printed directory.

- Database constraints - department names were restricted to 19 characters, whereas the official department names are sometimes as many as 50 or more characters.

- Time consuming to produce - because of the amount of cutting and pasting. This meant that the printed Directory was produced less frequently than desirable, and was consequently less useful.

It was thus decided, both as a serious attempt to produce a better quality printed directory, and as an experiment to test the flexibility of X.500, to produce a printed directory from the data in the X.500 system. All the data required could be stored in the X.500 database, extracted using the standard Directory Access Protocol, and then processed into an attractive format using a sophisticated formatting package.

Some key decisions about software were made. The data is extracted from the Directory using Quipu's DIrectory SHell (dish) interface. Extensive use is made of the Free Software Foundation's gawk program, which is of the GNU family of programs. gawk is freely available, with the proviso that some liberal guidelines are adhered to: ask your system administrator to get a copy of gawk if you don't have it in your system. The formatting package used is LaTeX.

The following sections describe some of the key features of the system, and the data structures used. A guide to running the package is also given.

3 Main features of the printed directory

The printed telephone directory consists of two parts:

1. Entries for people, roles and rooms, by alphabetically sorted departments. These entries are printed in two columns.

2. An alphabetically sorted list for all people, giving their telephone number and department, printed one entry per line. This list does not include room and role entries.

3.1 Department listings

Each department listing consists of a block of heading information, optionally followed by a individual entries. Entries for people are specified in *surname, personal title, initials-or-forenames* order. At UCL, we find that it assists readability by having entries for organisational roles and rooms in upper-case, while personal entries are in mixed-case.

There are in fact three types of department listings, and these are considered in turn.

It is important to note that the departments described are departments as viewed by the managers of the telephone system. They do not map one-to-one onto what are generally considered to be the instititon's departments. This flexibility is crucial as it allows for departments in the telephone directory which are purely notional, and which exist solely to assist the enquirer.

3.1.1 A normal department

A normal department has a block of heading information, followed by entries for people, rooms and roles. The fields in the heading can include any of the following: an indication as to who heads the department, referenced by their title (e.g. HEAD OF DEPARTMENT or DIRECTOR); a general department enquiries number; facsimile numbers (max 2); department location information (max 4 locations); a general information field, used for example to give special dialling information.

3.1.2 A sub-department

A sub-department entry consists solely of a pointer to the main department. These may be used to help people to find entries when the main department name is not obvious. For example, at UCL the entry for Latin consists of the note "Please see Greek and Latin".

3.1.3 Other departments

Some "departments" exist as telephone directory departments, yet are not part of the main organisation. (These are referred to within the software as stub departments, as stub entries for these departments are created but not stored in the Directory.) At UCL, such departments are usually accessible by abbreviated dialling. Such department headings may include all the same attributes as for normal departments, but have no individual entries.

4 Data structures

This section describes the data structures required to produce the printed directory described from an X.500 directory. The object classes and attribute types used are noted, and examples given in the EDB format used by Quipu systems. This format is chosen not only for its familiarity but also its immediacy.

Before describing the data structures in any detail, some general points about the features provided are worthy of note.

The names which appear in the printed directory are based on the RDNs of the entries, and alternative names are ignored. The printed directory names are only *based* on the RDNs for two reasons:

- Names for people have to include personal titles, and at UCL these are stored in a special attribute, rather than being included in the common name.

- Some entries have multiple value RDNs to disambiguate them from other entries. For person entries, the personal title attribute is used for this purpose, and for room and role entries the organizational unit value is used.

As noted earlier, telephone departments do not have to map one-to-one onto the departmental structure used in the X.500 database, which will generally follow a centrally determined policy on what constitutes a department.

Stub departments do not have entries in the directory. The information they contain does not fit readily within the X.500 model in that it concerns departments or organisations external to the main organisation. Furthermore the information is usually only of local interest. Information about such departments is merged in with data from the X.500 Directory.

Telephone numbers have to be stored in the X.500 database in full international format: this is specified in the standard. However numbers in the printed directory are printed as local extension numbers. A table can be used to set up mappings between local and international formats.

Many directory entries for people are annotated with qualifiers such as "(Lab)" or "(Sec)". In contravention of the letter of the standard, these qualifiers are stored as part of the telephone numbers. This is a regrettable departure from the standard, but no simple alternative seems practicable.

A facility is provided whereby some entries are treated specially, such that the entries do not have to follow the standard format. This is useful for dealing with titled people, and other awkward but influential people who like to be different!

4.1 Entry object classes and attribute types

This section describes the object classes and attribute types pertinent to the printed directory.

All entries in the X.500 Directory to appear in the printed directory must be of object class *telBookObject*. This object class has an associated attribute type, *phoneBookVersion,* which allows for a mechanism to only include the most recent set of data. This attribute is defined as a string, and values can be assigned to accord to some local policy. UCL has chosen to use version numbers of the form 1.0, 1.1, 2.0, and so on.

4.1.1 Entries for departments

An entry for a department should be of object class *organizationalUnit*. Normal departments and departments which are included from without the X.500 Directory may include some or all of the following standard X.500 attributes:

Telephone number this should be in the international format. This appears as the *Enquiries* number.

Facsimile number up to 2 numbers in the international format. A field qualifier, such as "(Main office)", is allowed.

Locality Name up to 4 locations. Since order is often important (e.g. the principal location should precede an annexe), and since X.500 provides for unordered sets of attribute values, the locations have to be tagged to indicate the order in which they should be printed. Some location values may be quite long strings which need to be broken to be printed in 2-up format. Line wrapping can be forced by the specification of a semi-colon character. Examples of the syntax can be seen in figure 7

Some further departmental information is extracted from other entries. The head of department entry is found by searching for the person's entry containing the appropriate *organizationalUnitName* attribute value and has a *title* attribute with the value "HEAD OF DEPARTMENT". This person's true job title can be extracted from the *seeAlso* attribute.

In cases where a department does not have a telephone number in the organizational unit entry, the Directory is then searched for an entry which has the appropriate *organizationalUnitName* attribute, is of object class *room*, and has the *commonName* attribute with the value "ENQUIRIES".

Sub-departments are departments whose entry consists solely of a pointer to a main department. The main department is referenced by the use of the seeAlso attribute in the sub-department entry, which should take as a value the DN of the main department.

4.1.2 Entries for people

Entries for people should be of object classes *organizationalPerson* and *pilotPerson*, which are both sub-classes of the X.500 object class *person*. Note that until systems are upgraded to use the schema definitions defined in "The COSINE and Internet X.500 Schema", the object class *thornPerson* should be used in place of pilotPerson. Similarly, personalTitle is a recent schema addition. However, versions of Quipu of 6.8 or later will have this attribute in their oidtables.

Entries MUST also include the following attributes:

Common name this is a compulsory attribute for any person entry. The forename or initials to be printed in the telephone directory are extracted from the common name attribute.

Surname this is a compulsory attribute for any person entry.

Personal title this takes the form "Mr", "Ms", "Dr", "Prof", etc. It may be omitted only for special entries, which do not follow the normal formatting pattern.

Telephone number in full international format. These numbers may optionally be suffixed with a qualifying field such as "(Sec)" or "(Office)".

Organizational Unit Name this is used to specify the telephone department which an entry belongs to. This is required because telephone departments do not necesarily map directly onto X.500 departments.

The following attributes may also be used for the head of department entries, as they allow for more information in the departmental headings:

Title this should take the value "HEAD OF DEPARTMENT".

SeeAlso this should take the value of the DN of the role entry for the head of department. The last component of this DN is the value which is printed in the directory as the job title of the department's senior member of staff. Sometimes this will be "HEAD OF DEPARTMENT", but in other cases it may be "Director" or "General Manager", for example.

4.1.3 Role entries

These should be created with an object class of organizational role. Entries should include the following attributes, although poor quality data may mean that it is not possible to fully cross-reference role and personal entries:

Common name used for the RDN.

Telephone number as described for people.

Organizational Unit Name as described for people.

Role occupant takes as a value the DN of the person fulfilling the role.

4.1.4 Room entries

These should be created with an object class of room. Entries should include the attributes:

Common name used for the RDN.

Telephone number as described for people.

Organizational Unit Name as described for people.

5 DIT structures

This section describes the DIT structures which the software expects. These structures should prove to be fairly flexible, and cope readily with the structures recommended in the UK Academic Pilot, and those to be adopted in the US Internet Pilot.

All the entries to be included in the printed directory should appear under a single organisation entry in the DIT. Since there is a de-coupling between X.500 Directory organisational units and printed directory departments, the software does not rely on any given structure lower in the DIT. The DIT structure chosen should be designed to assist general querying of the Directory, and should conform to the X.500 schema recommendations.

Entries for people, room and roles can be stored anywhere in the DIT below the organisation entry, since the department is determined by the entries organizational unit attribute, rather than the RDN of an entry's parent node.

However, in many cases, there will be a straightforward one-to-one mapping between an organisation's organisational units and its telephone directory departments. Figure 1 shows the simple DIT structure employed to represent the example entries specified in Appendix A.

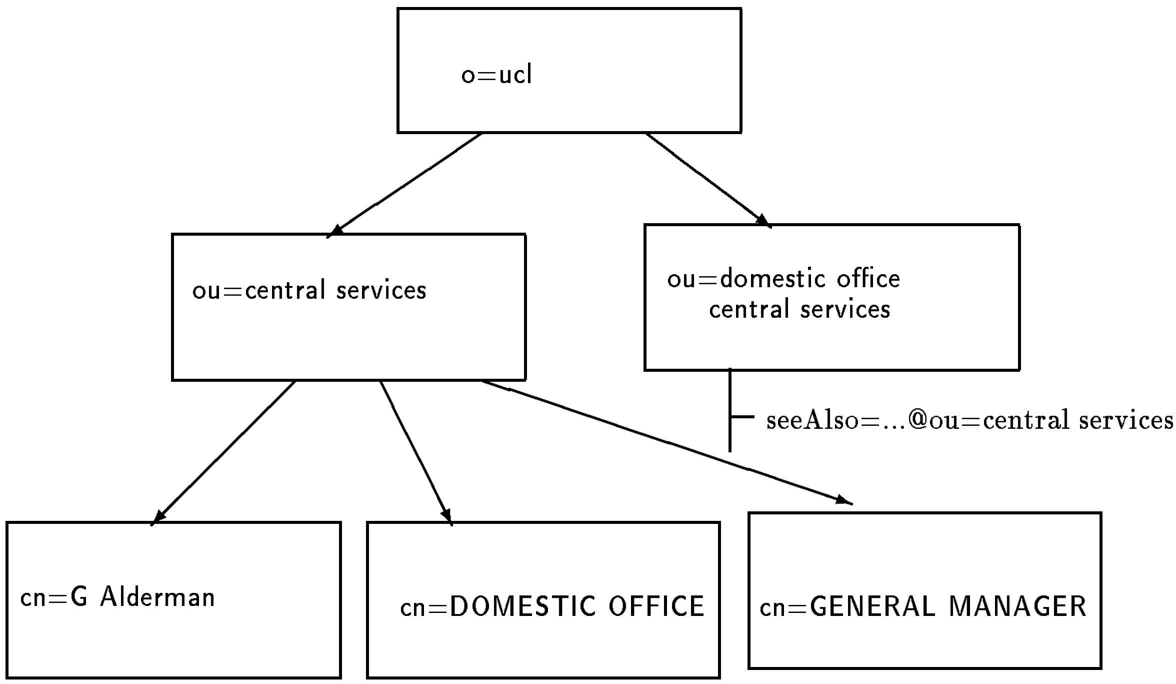

Figure 1: Simple DIT structure

Figure 2 shows a DIT structure which illustrates some of the more complex features. Both the personal entries with the surname "Williams" have the same common name, but are distinguished by the use of multi-valued RDNs which also use the personal title attribute.

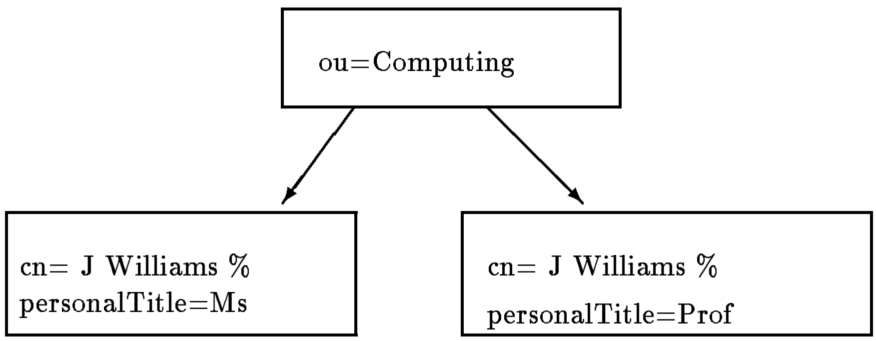

Figure 2: Disambiguating people

Figure 3 on page 7 provides an example of how printed directory departments may be mapped into the DIT when there isn't a one-to-one correspondance between these departments and the X.500 organizational units. The organizational units *Biology A* and *Biology B* are departments in the printed directory, but are not considered as separate departments "officially". Biology A and Biology B are entries with the object class telBookObject, whereas the entry for the organizational unit Biology is not. The Biology A and B entries must thus contain all the requisite telephone, facsimile and location information. These telephone department entries could be placed anywhere in the DIT below UCL. We have chosen to "hide them" at UCL underneath the "official" department as we feel the resulting structure is less confusing than one which places these telephone department entries at the same level as the main department entries.

The figure also shows how entries should then be disambiguated in such a case. Since both Biology sub-departments have an ENQUIRIES number, the two entries can be distinguished by the inclusion of the organizational unit value in the RDN.

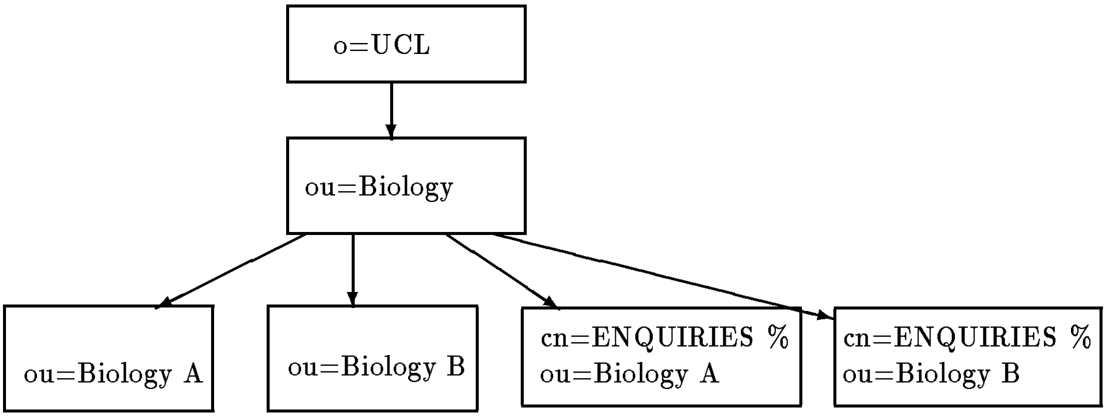

Figure 3: Mapping between DIT and printed directory

6 Schema extensions

The package requires a couple of extensions to the schema agreed for use in the various pilots. It is hoped that these extensions will be incorporated in with future releases of the Quipu system. The schema extensions are as follows:

Add the following lines to *.../dsap/oidtable.gen.local*:

```
phoneBook:                    ucl.104

phoneBookAttributeType:       phoneBook.1
phoneBookObjectClass:         phoneBook.3
```

Add the following line to the file *.../dsap/oidtable.oc.local*:

```
telBookObject:        phoneBookObjectClass.1 : top : phoneBookVersion :
```

Add the following line to the file */dsap/oidtable.at.local*:

```
phoneBookVersion:   phoneBookAttributeType.1 :CaseIgnoreString
```

Now integrate these local extensions with the main oidtable files by running the following command from the .../dsap directory:
`./make inst-oidtable.`

7 Using the package

The package consists of a program (a shell script) *phonebook*, some configuration files and a LaTeXstyle file. The package has two modes. It can be used to:

- print a complete telephone directory, or to
- print a single department

The second mode is intended primarily as a tool to allow departments to check their entries, so to ensure that the system hasn't swallowed any of them!

7.1 Configuration

The LaTeXstyle file *dir.sty* should be installed with other LaTeXstyle files. Three other files have to be set up before the phonebook program can be run, and some variables set up within the phonebook script itself.

7.1.1 Telephone number mapping

The *telnummap* file contains the mappings between the full international formats used within the X.500 Directory, and the formats to be printed. The table consists of 3 columns, of which only the second and third columns are of interest here. (The first column is used to map from the initial raw data into international format.) The second column contains patterns in the international number format, and the third column contains corresponding patterns indicating how the numbers should be represented in the printed directory. The "n" in the second column acts as a wild card. (The figures following the "n" may be ignored as they are used in conjunction with the patterns in the first column when mapping from raw data into the international formats.) The following examples relate to the table in figure 4 and should clarify use of the table.

The number +44 71-272-3070 will be printed as #6 177.

The number +44 71-636-8333 x1234 will be printed as 82-1234.

The number +44 71-387-7050 x4567 will be printed as 4567.

7.1.2 Special names

The *specials* file contains mappings between names as stored in the X.500 Directory, and how they should appear in the printed directory. The first column is in the exact format that the entries should appear in the printed Directory. The second column is split into a convenient format for the X,500 Directory. The following examples with reference to the table in figure 5 should clarify the format.

An entry with the common name "Bernard Katz" and with the personal title "Prof Sir" will be printed as "Katz, Prof Sir Bernard".

```
SAD:+44 71-272-3070:#6 177
MSSL:+44 483 274111:MSSL
82-76-0:+44 71-272-3070:82-76-0
82-2[0-9][0-9][0-9]:+44 71-636-8333 xn4,4:82-n
82-3[0-9][0-9][0-9]:+44 71-636-8333 xn4,4:82-n
82-4[0-9][0-9][0-9]:+44 71-636-8333 xn4,4:82-n
82-9[0-4][0-9][0-9]:+44 71-636-8333 xn4,4:82-n
82-5[0-9][0-9][0-9]:+44 71-387-9300 xn4,4:82-n
82-8[0-9][0-9][0-9]:+44 71-387-9300 xn4,4:82-n
82-9[5-9][0-9][0-9]:+44 71-387-9300 xn4,4:82-n
7[0-9][0-9][0-9]:+44 71-380-n1,4:n
[0-9][0-9][0-9][0-9]:+44 71-387-7050 xn1,4:n
```

Figure 4: Telephone number mapping table

An entry with the common name of "N A Lighthill" and with a personal title of "Mrs" will be printed as "Lighthill, N A".

```
Katz, Prof Sir Bernard:Katz, Bernard, Prof Sir
Lighthill, N A,:Lighthill, N A, Mrs
Lighthill, Sir James:Lighthill, James, Sir
McKienzie, Dr:McKienzie, , Dr
```

Figure 5: Specials

One caveat. The specials are organisation wide, whereas they should be defined on an organizational unit basis. This is a bug.

7.1.3 Stub departments

The *stubs* file contains EDB format entries for "departments" in the printed directory which are not departments of the organisation in the usual sense. These entries should be created in exactly the same format as normal departmental entries. These entries are merged in with the entries which are extracted from the X.500 Directory. A couple of example entries are shown in figure 6.

7.1.4 Phonebook script

The following variables should be pre-configured in the phonebook script.

organisation This should be set to the value of the organisations RDN: e.g "University College London"

user This should be a mnemonic for the DSA manager, as set up in the .quipurc file: e.g. "dsaman". The script has to be run as the DSA manager as otherwise size limits may inhibit the full listing of departments.

startnum The number of the first page to be printed.

confDir The directory where the *telnummaps* and *specials* files are kept.

stubFile The filename where the stub entries are kept.

version The phone book version number. This must correspond to the value stored in the entries' *phoneBookVersion* attribute.

7.2 Running the script

Some of the configuration options may be over-ridden by run-time arguments.

-o org_name Sets the organisation, or department within the default organisation, to be printed.

-u username Sets the mnemonic of the directory user to be other than that of the DSA manager.

-n page_no Sets the start page number

-v version_no Sets the version number

Usage is straightforward!

```
phonebook -v 2.0 -n 4
```

produces LaTeXfor a full directory which includes all those entries with a phoneBookVersion number of 2.0, with pages numbered from 4.

```
phonebook -o "Careers Service"
```

produces LaTeXfor a directory for all entries with an organizational unit name value of Careers Service.

```
ou=Geriatric Medicine
localityName= 1. St Pancras Hospital
localityName= 2. Whittington Hospital
localityName= 3. Middlesex Hospital
info=Please see separate entry in the pink pages.
phoneBookVersion=1.0
objectClass= organizationalUnit & telBookObject

ou=Goldsmid House
info=Available on System Abbreviated Dialling from UCL  #6 230
phoneBookVersion=1.0
objectClass= organizationalUnit & telBookObject
```

Figure 6: Stub entries

A Department entries

This section shows the various types of department entries. The examples are given first, in their Quipu EDB format, and then shown as they would appear in the printed directory.

```
ou=Central Services
objectClass= organizationalUnit & telBookObject
l= 4. Post Room - Pearson Building &\
   3. Domestic Services - 25 Gordon Square &\
   2. Publications - South Junction &\
   1. Printing, Office Services, Records;- South Wing (Basement)
telephoneNumber= +44 71-387-7050 x2054
facsimileTelephoneNumber= +44 71 387 8057
phoneBookVersion= 1.0
```

Central Services

General Manager: Mrs G Alderman
Enquiries: 2054
Fax No: 071 387 8057
Location: Printing, Office Services, Records
- South Wing (Basement)
Also: Publications - South Junction
Also: Domestic Services - 25 Gordon Square
Also: Post Room - Pearson Building

Figure 7: Normal department

```
ou=Domestic Office Central Services
objectClass= organizationalUnit & telBookObject
seeAlso= c=GB@o=University College London@ou=Central Services
phoneBookVersion= 1.0
```

Domestic Office Central Services

Please See Central Services

Figure 8: Sub-department

```
ou=Geriatric Medicine
localityName= 1. St Pancras Hospital
localityName= 2. Whittington Hospital
localityName= 3. Middlesex Hospital
info=Please see separate entry in the pink pages.
phoneBookVersion=1.0
objectClass=organizationalUnit & telBookObject
```

Geriatric Medicine

Location: St Pancras Hospital
Also: Whittington Hospital
Also: Middlesex Hospital

Please see separate entry in the pink pages.

Figure 9: Stub-department format

```
cn=G Alderman
surname=Alderman
personalTitle=Mrs
ou=Central Services
telephoneNumber=+44 71-387-7050 x2053
title=HEAD OF DEPARTMENT
seeAlso=c=GB@o=University College London@ou=Central Services@cn=GENERAL MANAGER
phoneBookVersion=1.0
objectClass=organizationalPerson & thornPerson & telBookObject

cn=DOMESTIC OFFICE
ou=Central Services
telephoneNumber=+44 71-380-7001
phoneBookVersion=1.0
objectClass=room & telBookObject

cn=GENERAL MANAGER
ou=Central Services
telephoneNumber=+44 71-387-7050 x2053
roleOccupant=c=GB@o=University College London@ou=Central Services@cn=G Alderman
phoneBookVersion=1.0
objectClass=organizationalRole & telBookObject
```

Alderman, Mrs G **2053**
DOMESTIC OFFICE **7001**
GENERAL MANAGER **2053**

Figure 10: Person, room and role