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**Information technology — Open Systems  
Interconnection — The Directory: Use of  
systems management for administration of  
the Directory**

*Technologies de l'information — Interconnexion de systèmes ouverts  
(OSI) — L'annuaire: Utilisation de la gestion-système pour l'administration  
de l'annuaire*

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## CONTENTS

	<i>Page</i>
1 Scope .....	1
2 Normative references.....	2
2.1 Identical Recommendations   International Standards .....	2
2.2 Paired Recommendations   International Standards equivalent in technical content .....	2
3 Definitions .....	3
3.1 OSI Reference Model definitions .....	3
3.2 Management Framework definitions .....	3
3.3 System Management Overview definitions .....	3
3.4 Management Information Model definitions .....	3
3.5 Directory Model definitions.....	3
3.6 Distributed Operation definitions.....	4
4 Abbreviations .....	4
5 Conventions.....	5
6 Directory management requirements.....	6
6.1 Introduction.....	6
6.2 Sources of management requirements .....	6
6.3 Analysis of management requirements .....	7
7 Directory Management Model.....	14
7.1 Introduction.....	14
7.2 Directory Management Model components.....	14
7.3 Layered Directory Management Model.....	14
7.4 Directory Information Model and System Management Information Model.....	16
7.5 Directory Service Model.....	16
8 Provision of management services .....	17
9 Directory Management Information Model.....	18
10 Directory managed objects .....	20
10.1 DSA managed object .....	20
10.2 Known DSA managed objects .....	28
10.3 Known DUA managed objects .....	29
10.4 Upper layer definitions .....	30
10.5 DUA managed objects .....	30
10.6 Directory Service managed objects.....	30
10.7 Directory Management Domain managed objects.....	31
Annex A – Managed object definitions .....	32
A.1 Management of a DSA.....	32
A.2 Management of a Known DSA .....	53
A.3 Management of a Known DUA .....	54
A.4 Management of association.....	55
A.5 Management of a DUA .....	56
A.6 Directory Service management .....	57
A.7 DMD .....	59
A.8 Definition of attributes.....	59
A.9 ASN.1 notations.....	77
Annex B – Amendments and corrigenda .....	85

## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 9594 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Users and implementors should note the existence of a "defect resolution" procedure in ISO/IEC JTC 1 to identify and correct errors in International Standards through the publication of Technical Corrigenda. Identical corrections are made to the corresponding ITU-T Recommendations through Corrigenda and may also be made in the form of Implementors' Guides. Details of Technical Corrigenda to International Standards are available on the ISO website; published Technical Corrigenda can be obtained via the ISO webstore or from the ISO and IEC national bodies. Corrigenda and Implementors' Guides to ITU-T Recommendations can be obtained from the ITU-T website.

ISO/IEC 9594-10 was prepared by Joint Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 6, Telecommunications and information exchange between systems, in collaboration with ITU-T. The identical text is published as ITU-T Rec. X.530.

This second edition of ISO/IEC 9594-10 constitutes a technical revision of the first edition (ISO/IEC 9594-10:1998), which is provisionally retained in order to support implementations based on the first edition. This edition also incorporates Corrigendum 1:2002.

ISO/IEC 9594 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — The Directory*:

- Part 1: Overview of concepts, models and services
- Part 2: Models
- Part 3: Abstract service definition
- Part 4: Procedures for distributed operation
- Part 5: Protocol specifications
- Part 6: Selected attribute types
- Part 7: Selected object classes
- Part 8: Public-key and attribute certificate frameworks
- Part 9: Replication
- Part 10: Use of systems management for administration of the Directory

Annex A forms a normative part of this part of ISO/IEC 9594. Annex B is for information only.

## Introduction

This Recommendation | International Standard, together with other Recommendations | International Standards, has been produced to facilitate the interconnection of information processing systems to provide Directory services. A set of such systems, together with the Directory information that they hold, can be viewed as an integrated whole, called the *Directory*. The information held by the Directory, collectively known as the Directory Information Base (DIB), is typically used to facilitate communication between, with or about objects such as application entities, people, terminals and distribution lists.

The Directory plays a significant role in Open Systems Interconnection, whose aim is to allow, with a minimum of technical agreement outside of the interconnection standards themselves, the interconnection of information processing systems:

- from different manufacturers;
- under different managements;
- of different levels of complexity; and
- of different ages.

The purpose of Directory management is to assure that needed, accurate Directory information is available to users as scheduled with the expected response time, integrity, security and level of consistency. Furthermore, systems management may be accomplished with the minimum burden on processing time and memory on platforms and the communications system.

The Directory may support open systems applications such as message handling systems, File Transfer, Access and Management (FTAM) systems, and transaction processing systems. Therefore, the Directory system may be manageable from an integrated system management platform.

This fourth edition technically revises and enhances, but does not replace, the third edition of this Recommendation | International Standard. Implementations may still claim conformance to the third edition. However, at some point, the third edition will not be supported (i.e. reported defects will no longer be resolved). It is recommended that implementations conform to this fourth edition as soon as possible.

Annex A, which is an integral part of this Recommendation | International Standard, defines the managed objects used for Directory System Agent administration.

Annex B, which is not an integral part of this Recommendation | International Standard, lists the amendments and defect reports that have been incorporated to form this edition of this Recommendation | International Standard.

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## INTERNATIONAL STANDARD

## ITU-T RECOMMENDATION

**Information technology – Open Systems Interconnection – The Directory:  
Use of systems management for administration of the Directory**

## SECTION 1 – GENERAL

**1 Scope**

This Specification describes the requirements for Directory management, and analyses these requirements to identify those that may be realized by OSI Systems Management services (and protocols), those that are realized by Directory services (and protocols), and those that are realized by local means.

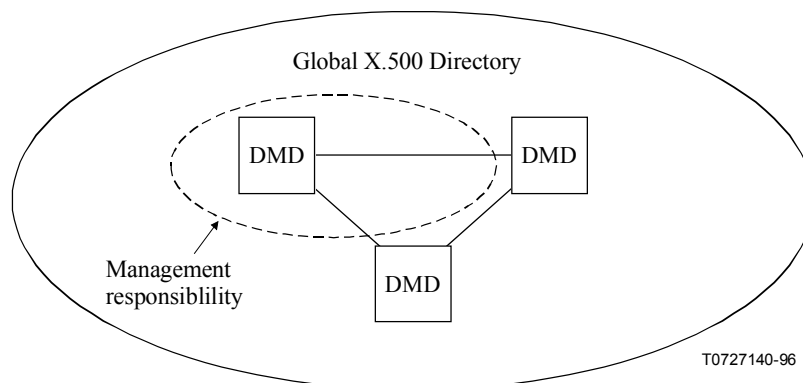
Based on the requirements, this Directory Specification defines a model for Directory management that encompasses all of the requirements.

Management of the Directory is divided into four major segments:

- a) management of the DIT (Domain; Management of Directory information);
- b) management of the operation of a single DSA within a DMD;
- c) management of the operation of a single DUA within a DMD; and
- d) management of the Directory Management Domain (DMD): Integrated management of the functional components of the Directory.

This Recommendation | International Standard covers items a), b) and c). Item d), Management of the Directory Management Domain, is for further study.

Based on the model, this specification describes the detailed OSI Systems Management Managed Objects used to manage Directory System Agents (DSAs) and Directory User Agents (DUAs) within a Directory Domain, and describes the detailed OSI Systems Management Managed Objects used to manage the interfaces to DUAs and DSAs in other domains as shown in Figure 1.



**Figure 1 – Scope of Directory management**

## 2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardisation Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

### 2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.500 (2001) | ISO/IEC 9594-1:2001, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services*.
- ITU-T Recommendation X.501 (2001) | ISO/IEC 9594-2:2001, *Information technology – Open Systems Interconnection – The Directory: Models*.
- ITU-T Recommendation X.509 (2000) | ISO/IEC 9594-8:2001, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks*.
- ITU-T Recommendation X.511 (2001) | ISO/IEC 9594-3:2001, *Information technology – Open Systems Interconnection – The Directory: Abstract service definition*.
- ITU-T Recommendation X.518 (2001) | ISO/IEC 9594-4:2001, *Information technology – Open Systems Interconnection – The Directory: Procedures for distributed operation*.
- ITU-T Recommendation X.519 (2001) | ISO/IEC 9594-5:2001, *Information technology – Open Systems Interconnection – The Directory: Protocol specifications*.
- ITU-T Recommendation X.520 (2001) | ISO/IEC 9594-6:2001, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types*.
- ITU-T Recommendation X.521 (2001) | ISO/IEC 9594-7:2001, *Information technology – Open Systems Interconnection – The Directory: Selected object classes*.
- ITU-T Recommendation X.525 (2001) | ISO/IEC 9594-9:2001, *Information technology – Open Systems Interconnection – The Directory: Replication*.
- ITU-T Recommendation X.701 (1997) | ISO/IEC 10040:1998, *Information technology – Open Systems Interconnection – Systems management overview*.
- ITU-T Recommendation X.710 (1997) | ISO/IEC 9595:1998, *Information technology – Open Systems Interconnection – Common Management Information service*.
- ITU-T Recommendation X.711 (1997) | ISO/IEC 9596-1:1998, *Information technology – Open Systems Interconnection – Common management information protocol: Specification*.
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model*.
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information*.
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects*.
- ITU-T Recommendation X.723 (1993) | ISO/IEC 10165-5:1994, *Information technology – Open Systems Interconnection – Structure of management information: Generic management information*.

### 2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications*.  
ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework*.



### 3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

#### 3.1 OSI Reference Model definitions

The following terms are defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

- a) application-entity;
- b) Application Layer;
- c) application-process;
- d) application protocol data unit.

#### 3.2 Management Framework definitions

The following terms are defined in CCITT Rec. X.700 | ISO/IEC 7498-4:

- a) management information base;
- b) managed object.

#### 3.3 System Management Overview definitions

The following terms are defined in ITU-T Rec. X.701 | ISO/IEC 10040:

- a) agent;
- b) manager;
- c) notification;
- d) managed object class.

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#### 3.4 Management Information Model definitions

The following terms are defined in CCITT Rec. X.720 | ISO/IEC 10165-1:

- a) behaviour;
- b) conditional package;
- c) inheritance;
- d) naming tree;
- e) package;
- f) subclass;
- g) superclass.

#### 3.5 Directory Model definitions

The following terms are defined in ITU-T Rec. X.501 | ISO/IEC 9594-2:

- a) access control;
- b) Administration Directory Management Domain;
- c) alias;
- d) attribute;
- e) attribute type;
- f) attribute value;
- g) authentication;
- h) Directory Information Tree ;

## ISO/IEC 9594-10:2001 (E)

- i) Directory Management Domain ;
- j) Directory System Agent ;
- k) DSA-Specific Entry;
- l) Directory User Agent (DUA);
- m) distinguished name;
- n) entry;
- o) name;
- p) object (of interest);
- q) Private Directory Management Domain;
- r) relative distinguished name;
- s) root;
- t) schema;
- u) security policy;
- v) subordinate object;
- w) superior entry;
- x) superior object;
- y) tree;
- z) (Directory) user.

### 3.6 Distributed Operation definitions

The following terms are defined in ITU-T Rec. X.518 | ISO/IEC 9594-4.

- a) hierarchical operational binding;
- b) non-specific hierarchical operational binding;

## 4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

ADDMD	Administration Directory Management Domain
CMIP	Common Management Information Protocol
DAP	Directory Access Protocol
DIB	Directory Information Base
DISP	Directory Information Shadowing Protocol
DIT	Directory Information Tree
DMD	Directory Management Domain
DOP	Directory Operational Binding Management Protocol
DSA	Directory System Agent
DSE	DSA-Specific Entry
DSP	Directory System Protocol
DUA	Directory User Agent
HOB	Hierarchical Operational Binding
MIB	Management Information Base
NHOB	Non-specific Hierarchical Operational Binding
NSAP	Network Service Access Point

NSSR	Non-specific Subordinate Reference
OSI	Open Systems Interconnection
PRDMD	Private Directory Management Domain
RDN	Relative Distinguished Name
TMN	Telecommunications Management Network

## 5 Conventions

With minor exceptions, this Directory Specification has been prepared according to the "Rules for presentation of ITU-T | ISO/IEC common text" in the Guide for ITU-T and ISO/IEC JTC 1 Cooperation, October 1996.

The term "Directory Specification" (as in "this Directory Specification") shall be taken to mean this Recommendation | International Standard. The term "Directory Specifications" shall be taken to mean all of the X.500-series Recommendations | parts of ISO/IEC 9594.

This Directory Specification uses the term "1988 edition systems" to refer to systems conforming to the first edition of the Directory Specifications, i.e. the 1988 edition of the series of CCITT X.500 Recommendations and the ISO/IEC 9594:1990 edition. This Directory Specification uses the term "1993 edition systems" to refer to systems conforming to the second (1993) edition of the Directory Specifications, i.e. the 1993 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:1995 edition. This Directory Specification uses the term "1997 edition systems" to refer to systems conforming to the third edition of the Directory Specifications, i.e. the 1997 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:1998 edition. This Directory Specification uses the term "4th edition systems" to refer to systems conforming to this fourth edition of the Directory Specifications, i.e. the 2001 editions of ITU-T X.500, X.501, X.511, X.518, X.519, X.520, X.521, X.525, and X.530, the 2000 edition of ITU-T X.509, and parts 1-10 of the ISO/IEC 9594:2001 edition.

This Directory Specification presents ASN.1 notation and Managed Object Definitions in the bold Helvetica, 9 point typeface. When ASN.1 types and values or Managed Object Definitions are referenced in normal text, they are differentiated from normal text by presenting them in the bold Helvetica, 9 point typeface. Access control permissions are presented in italicized Helvetica.

## SECTION 2 – MANAGEMENT REQUIREMENTS

**6 Directory management requirements**

The collection and processing of management information is an overhead set against the primary objective of the Directory. Consequently, it is essential to ensure that all activities involved in acquiring management information are useful, valid and present the minimum overhead to the natural processes of Directory components.

In order to derive the required management information and associated actions, it is necessary to analyse the various entities which both provide the Directory service and also interact with it so that the relevant management needs are identified. Furthermore, the Directory will operate in conjunction with other networks and services. The Telecommunications Management Network<sup>1)</sup> (TMN) is designed to provide a framework for management across differing networks and services. Hence, the management features of Directory components are aligned with the expectations of TMN.

**6.1 Introduction**

This Section analyses the environment in which a Directory will operate and isolates the management requirements.

The management requirements are defined by analysis of the activities of roles concerned with using, operating and owning a Directory service. The motivation for the selection of these roles has been influenced by the functional hierarchy view of management, defined within the TMN. This takes a broad view of an organization offering Directory services and encompasses the need for low-level component management, the customer-oriented requirements of offering services and the effects of the business objectives of the owners of Directory systems.

**6.2 Sources of management requirements****6.2.1 Service agreement****6.2.1.1 Directory customer service agreement**

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A Directory service agreement is a set of terms and conditions governing the provision of the Directory services and establishing the contractual relationship between the Directory customer and a Directory service provider. A service agreement may cover a number of items relating to the expected operation of the Directory, such as accessible Directory information (including maintenance of indirect data links such as **seeAlso** attributes and **groupOfName** entries), allowed operations on accessible Directory information, quality of service operation, conditions for settlement for usage of the service, and availability of the service and access points.

Of these items, some are directly embodied by Directory components and management activities (for example, detecting aliases that point to non-existent distinguished names). Conversely, some service agreement items (for example, settlement) are indirectly embodied by Directory components in that a management process uses a record of Directory component activity as a basis for fulfilling the service agreement.

Associated with a service agreement there are a number of roles such as:

- Directory user;
- Directory customer;
- Directory service manager;
- Directory system manager/administrator (see 6.2.2); and
- Directory business manager (see 6.2.3 and 6.3.5).

A Directory customer, acting on behalf of Directory users, enters into an agreement with the Directory management organization which determines an agreed service to be presented to users. The Directory customer may represent any arbitrary group of users, the structure and content of which are not restricted by the Directory management organization.

<sup>1)</sup> ITU-T Rec. M.3010, Principles for a telecommunications management network.

A Directory user is a consumer of Directory services. Actions of Directory users stimulate the Directory components to produce management information in order that the Directory service manager may ascertain whether the Directory is operating within the bounds of the Directory user's service agreement.

A Directory service manager is responsible for ensuring that a service agreement is implemented and maintained. The Directory service manager functions may encompass a number of areas such as:

- registration (e.g. of Directory users, Directory customers);
- configuration changes (e.g. enabling or disabling DSAs);
- assistance (e.g. help desk, technical support);
- service configuration changes (e.g. changes to service characteristics);
- quality of service monitoring and reporting; and
- accounting, billing and settlement.

#### 6.2.1.2 Peer service provider service agreement

In order to fully satisfy a service offered to a Directory user, it may be necessary to make use of Directory services provided by other Directory service providers. The essence of a peer service provider service agreement may be similar to that constructed for the basis of interaction with Directory users. That is, available information, allowed operations, access details, etc., will need to be agreed between two Directory service providers before interaction can occur.

### 6.2.2 Operations

An essential part of attaining an agreed service is the ongoing monitoring and maintenance of the Directory components which provide the service:

- Reconfiguration of Directory components:
  - a) predictable downtime due to equipment maintenance;
  - b) unpredictable downtime due to equipment failure.
- Management reconfiguration:
  - a) for example, redirecting collected management information out of office hours.
- Management of product operating limitations:
  - a) observing product maximum operating parameters (e.g. maximum number of associations for a DSA, maximum number of entries for a DSA);
  - b) observing inter-provider operating parameters.
- Troubleshooting:
  - a) configuring components to act in a specific way for the purposes of problem solving.

The role associated with Operations is Directory system administrator.

### 6.2.3 Business processes

Business processes reflect the activities undertaken by business managers in the pursuit of business objectives through the offering of Directory services. Objectives and motivations differ from one organization to another, e.g. financial gain is one motivation. Different objectives/motivations will result in different sets of management information being relevant to different organizations. The Directory management facilities shall enable the construction of management policies by organizations.

Information regarding the performance against those objectives is required. Activities which are undertaken will include sell/(advertise) services, expand/contract system, procure equipment, and evolve services.

The role associated with business processes is the Directory business manager who will strive to meet business objectives through the setting of service targets (for example, in terms of reducing operating costs), selling/advertising services, expanding/contracting capacity, procuring capital equipment, instigating new service offerings, etc.

## 6.3 Analysis of management requirements

The identification of management requirements illustrates the roles and activities concerned with both using, providing and owning a Directory service. A closer analysis of these roles and activities will identify a set of required management information and management actions which serve to maintain a successful Directory service.

### 6.3.1 General requirements

There are a number of issues to consider:

- Management information can be expressed in a number of different forms such as maintaining logs and counters, establishing gauges and thresholds, and generating events and alarms. It is expected that the management system will supply standardized mechanisms for the expression of different management information formats.
- Management activities, and thus the need for specific elements of management information, may vary over time. There is a need for the dynamic configuration of the collection of management information.
- Implementation of management policies should not be hindered by Directory management specifications.
- Operational information produced by Directory systems may change status according to which type of organization is operating the service and which type of service agreement has been made.

### 6.3.2 Directory user

#### 6.3.2.1 Allowed Directory user activity

##### 6.3.2.1.1 Successful Directory user access

Record Directory DAP, DSP, DISP, DOP activity:

- Log operation counts.
- Log operation details.
- Log details against the data retrieved rather than the operation invoked.
- Log resource usage.
- Notifications of an exceptional valid operation that will take place may be required. This may be required if, for example, the operation would cause a large amount of activity within the Directory system (e.g. a subtree search at the country level, or a shadow update is occurring).

##### 6.3.2.1.2 Unsuccessful Directory user access

Directory reports no errors, but service operation is not as expected. It will be necessary to report the details to service management as a violation of the service agreement. The Directory components will only collect management information as described in 6.3.2.1.1.

The unexpected event may be against any of the items of the service agreement that the user is aware of, for example:

- unable to invoke a specific Directory operation on the DIB;
- returned data is not of a quality agreed within the service agreement (e.g. the data is out of date or certain agreed optional attributes are not included).

A condition caused by a valid operation which fails because of:

- direct information failure (e.g. alias dereference failure, knowledge problem);
- indirect information failure (e.g. an entry does not exist with the distinguished name found on a previous read of a **groupOfNames** entry or **seeAlso**);
- equipment failure.

#### 6.3.2.2 Disallowed Directory user activity

##### 6.3.2.2.1 Disallowed unsuccessful Directory service access

The Directory detects and shall notify an attempt at illegal access to:

- the Directory service (i.e. the bind);
- specific information and (invocation of) operations (i.e. detection by access control procedures).

Logging of all unauthorized activity may also occur.

Additionally, resource usage incurred when making an unauthorized access. This information allows system and service administrators to assess the cost of unauthorized access.

### 6.3.2.2.2 Disallowed successful Directory service access

This situation occurs when a Directory user has successfully accessed the Directory in a way which breaches the service agreement but the Directory did not detect this as an error. This indicates an error in the system configuration against the service agreement. Detection would only take place if sufficient log information was available and was analysed off-line.

### 6.3.3 Directory customer

- Establishment of service agreement:
  - a) scope assigned to the user (i.e. anywhere, within the DMD, within the DSA).
- Represents users of service – The specific combination of users in terms of numbers, structure and service agreement features is arbitrary and not inhibited by the Directory management capabilities.
- Query status of service against service agreement.
- Query capabilities of service with a view to extending/curtailing existing service agreement.
- Settle for usage of service. Settlement arrangement is based upon an internal calculation of service management and can include:
  - a) query-oriented, based on resources used in querying;
  - b) data supplier oriented, based on resources used by information residing in DIT;
  - c) predefined absolute time limit usage of the Directory (as opposed to a specific association time);
  - d) a pre-settled resource usage of the Directory.

The customer may represent a number of users; the settlement process will need to be able to identify users with the billable customer.

### 6.3.4 Directory service manager

The Directory service manager acts upon requests made by Directory customers and the need to monitor the operation of the Directory service in order that service agreements are maintained:

- Create Directory configuration necessary for meeting a service agreement.
- Respond to requests for service information from customer:
  - a) Billing information – Based upon customer, rather than user.
  - b) Problem reports.
- Make decision as to exactly what management information is required to be collected and when, in order that the service agreement is maintained.
- Inhibit binds (for example, due to user not registered for a service, service available during limited times, service unavailable due to customer/service contravening service agreement).
- Validate operation requests against service agreements.

When considering the management of Directory information extraction, there are a number of issues:

- Control is needed over the amount of data that may be extracted, and the Directory currently addresses this concern through the setting of size and time limits on requests. Additionally, control may be imposed on users who would otherwise attempt to destroy the integrity of information within the Directory.
- Waste of resources through either retrieval of Directory information based upon an inappropriate choice of filter, which results in a large number of entries being processed (e.g. search using a substring filter of "Hotel" within a DIT subtree holding UK data).
- Waste of resources through specification of an operation that it is known will not succeed (e.g. searching for an entry with a **localityName** filter which is non-existent).
- Attempting to retrieve directory information on an illegal basis. This may either be through the usage of a particular attribute type within a filter (e.g. filtering entries against their telephone number is not allowed within the UK) or through the use of a particular matching algorithm (e.g. it is not permitted within France to use final substring filter match on surnames).
- A Directory service provider may not allow a user a wide-ranging browsing capability. This would result in a designated set of DIT access locations (distinguished names).