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(03/1997)

Electronic exchange of information for spectrum management purposes

SM Series

Spectrum management

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SM	Spectrum management
SNG	Satellite news gathering
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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R SM. 668-1*, **

Electronic exchange of information for spectrum management purposes

(1990-1997)

Scope

This Recommendation provides the guidelines for electronic exchange of spectrum management information and efficient solution of spectrum management by computer method.

Keywords

Spectrum management information, electronic data exchange, database, spectrum management

The ITU Radiocommunication Assembly,

considering

a)   that administrations are facing increasingly voluminous and complex tasks in spectrum management due to the increased use of existing and new telecommunications technology;

b)   that the efficient solution of spectrum management problems requires data storage, data retrieval, and analysis capabilities, and consequently requires effective spectrum management and application of computer methods;

c)   that most administrations have only very limited staff resources available to perform spectrum management functions; consequently they are in need of effective methods of enhancing their productivity;

d)   that modern electronic information exchange technologies offer "tools" that provide useful improvements in staff productivity but require appropriate planning and management to ensure these benefits are realised;

e)   that the transfer of computer programs and spectrum management data would support and facilitate national spectrum management and coordination among administrations and with the Radiocommunication Bureau (BR) ;

f)   that such computer programs and spectrum management data can be transferred between computer systems of different administrations and the BR using existing telecommunications facilities;

g)   that there are a variety of electronic information exchange technologies with varying capabilities and performance, each involving administrative and maintenance tasks which will be related to the type of method of electronic exchange selected and the administrations' requirements.

h)   that a number of computer programs for spectrum management are available from the BR, administrations, or other sources;

i)   that many administrations have been successful in implementing computer-aided techniques in the development and maintenance of their national spectrum management,

recognizing

1   that for electronic data exchange to be effectively implemented and successful, it is necessary for administrations to use both compatible transfer standards and internationally agreed data elements that have been uniquely and unambiguously described,

recommends

1   that administrations should use the provisions of the Guidelines for electronic exchange of spectrum management information (see Annex 1);

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*   Attachment 3 to this Recommendation should be brought to the attention of Radiocommunication Study Group 3.

**   Radiocommunication Study Group 1 made editorial amendments to this Recommendation in the years 2011, 2015, 2019 and 2023 in accordance with Resolution ITU-R 1.

2   that administrations should be encouraged to use the remote access facilities of the ITU computer system and first preference should be given to an implementation of a remote frequency assignment data entry system from administrations to the BR database;

3   that administrations should be encouraged to use the same data capture and validation methods as the BR ;

4   that administrations should be able to remotely retrieve spectrum management information from the BR data base;

5   that data base management systems used for spectrum management data should have adequate security features to prevent altering the data without adequate authorization;

6   that administrations should carefully consider the types of electronic data exchange available in the context of their:

–   existing computer systems,

–   future computer system and spectrum management requirements,

–   security requirements,

–   national data dictionaries;

7   that administrations should be encouraged to make use of computer programs for frequency management and EMC analyses which are available.

ANNEX 1

Guidelines for the electronic exchange of spectrum management information

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Summary

Why consider Electronic Data Exchange?

In today's rapidly changing radio communications business, it is accepted that the use of computer based techniques is essential if fast, effective, cost efficient spectrum management is to be achieved, particularly when sharing the spectrum between competing services. The continuing growth of these services has resulted in the need to exchange often complex information for coordination, planning and notification purposes. A good example of this is when coordinating satellite based systems, which require large volumes of complex information to be exchanged with many organizations. Processing this information using existing manual methods is time consuming, expensive, repetitive, and ties up valuable human resources. Loss of data integrity during the exchange process is highly likely and therefore alternative methods for exchanging information are needed.

Electronic data exchange (EDE) offers such a solution. EDE allows direct transfer of information between systems, a simplistic example is diskette exchange. There are many methods which can be used, some simple, others more complex. The method chosen will depend on the type of data to be exchanged, its quantity, the time taken for the exchange of data to be completed and the costs of the data exchange system.

Electronic data exchange not only has the potential to provide administrations and the Radiocommunication Bureau (BR) with improvements in efficiency, but also to enable new methods of manipulation and analysis of data to be developed. These new methods, like visual data analysis, will permit large complex interference scenarios to be more easily handled.

Information on the types of systems, their benefits, risks, impact on the business needs and resources, are discussed in the main body of this Guideline. Detailed information is contained in the Attachments.

When these Guidelines were prepared, the ITU-R was considering and approving the simplification of the Radio Regulations (RR). Because of the existence of both the RR and the simplified RR and the gradual transition between these, the numbering of Articles and Appendices referenced in these Guidelines may change.

1 Introduction

In response to Resolution ITU-R 10 and by Radiocommunication Study Group 1 Decision ITU-R 2/1, Task Group 1/4 was established to develop guidance and provide a source for reference on exchange of information through electronic means to share spectrum management information. This Recommendation provides guidance by outlining the issues requiring consideration by senior managers in organizations who wish to implement or improve electronic data exchange (EDE). It considers among other things the hardware, software, data storage media, data file format and dictionary, security, procedures, communications networks, and the staff necessary to accomplish this task.

The term "spectrum management information" includes, but is not limited to, that information which is needed to carry out the following functions:

– portraying frequency band allocations;

– monitoring spectrum activity;

– coordinating and/or notifying frequency assignments or orbital positions;

– specifying equipment/system characteristics;

– using and transferring analytical models;

– accessing regulatory documents.

The process of exchanging information via electronic or computer related means and transforming that information into a suitable form for automatic processing is commonly referred to as EDE. Further, it is implied that the exchanged data will convey information that must be understood by the receiving party if it is to be usable. For successful information exchange, both the sender and receiver must adhere to agreed standards for the conversion and transmission or transportation of the data. These standards may be human or computer-related. The former may be understood as a common cultural or technical background and is rarely explicitly formulated. The latter is standardized as a set of accepted formats.

EDE may be facilitated in a number of ways; from the use of physical media such as diskettes, magnetic tape, CD-ROM, to the use of sophisticated electronic file transfer protocols that permits transmitting information via wirelines, fibre optic

cables, or radio wave transmission media. The cost of implementation and the benefits available to administrations will depend on their existing computer facilities, their requirements, and their desired solution.

In employing an electronic system to exchange spectrum management information, a degree of efficiency and effectiveness is expected to be gained. Search and retrieval of documents or technical data are vastly improved. Response times associated with evaluating frequency coordination proposals are reduced or minimized. The time associated with the capture and submission of notification data to the BR is also substantially reduced. These benefits permit improvements in efficiency and may result in savings in staff time.

EDE provides the International Telecommunication Union (ITU) with the same benefits as administrations but on a larger scale. To aid the exchange of data electronically the ITU has therefore established a network facility called TIES (Telecom Information Exchanges Services) that provides diverse telecommunication services to its Members. Within this network the ITU has developed an electronic document data base (ITUDOC), forming an integral part of the ITU's TIES computer-based electronic information services. Further information can be found in Case Study 1 of § 6 of Annex 1.

The main text of these Guidelines is intended to provide an overview of each subject or issue with the detailed discussion and analyses being found in supporting Attachments. The Recommendation also provides a number of case studies and a glossary of terms.

2 Data and Data Issues

2.1 Introduction

Exchanging spectrum management information by electronic means requires a number of data related issues to be addressed in order for the process to be effective. Data can be held in many different forms and the main factors affecting the exchange will vary with each of these forms. For EDE to operate easily and efficiently it is necessary to have compatible standards for representing the data as well as standards for its transfer. However, for information to be exchanged it is also necessary to understand the exact meaning of the data, as well as having an appreciation of the legal, financial and security issues. These issues should then be addressed and agreed solutions incorporated in a set of standards.

2.2 Standards compliance

Individual countries already use many data standards, although they are not necessarily all recognised as such. For example, in the world of radiocommunications it is necessary for all to have a common understanding – "radio" (as part of the electromagnetic spectrum) needs agreed standards for terms, definitions and the way it is quantified and measured. Otherwise, it would not be possible to plan frequency assignments, negotiate and publish performance specifications or issue licences for radiocommunication services. Administrations could not perform the spectrum management function without standards for its operation, such as those in the internationally agreed rules set down in the RR.

EDE will introduce widespread data sharing and for EDE to operate efficiently and effectively it is necessary to extend the range and scope of standardisation. Identification of existing standards and the development of new international standards to cover the type of data, its format and the electronic data exchange process will help administrations to exchange data more easily (see also Attachment 1).

2.3 Critical role of data dictionaries

The single most important issue regarding the electronic exchange of data is that all parties involved in the exchange have a common understanding of the meaning of the data. This means they must understand what information is being communicated. To help ensure this understanding, the meaning of the data and how it will be physically represented when exchanged is recorded in an unambiguous, rigorous, concise and structured manner and in a form that is easily accessible. This collection of data that describes the data to be exchanged is called a "data dictionary". The Preface to the International Frequency List (IFL) and BR Circular letter CR/26 which describe the data required for the electronic notification of terrestrial services, are both examples of data dictionaries that are in use today.

The storage mechanism for a data dictionary is called a "data dictionary repository". There are many data dictionary repositories available, both computer and paper based. Computer based repositories offer advantages over paper based systems as they can aid the clear definition of data by enforcing rules and offering spelling and grammar checking facilities (see also Attachment 2).

2.4 Categories of data

The main categories of information that might be exchanged are notification data, topographic data, digital maps, antenna characteristics, accounts, assignments, licensing data, reports. Some of these are of particular help in coordination studies.

2.4.1 Topographic data

Topographic data records the land height and land usage information needed for radio spectrum engineering and coordination. Land heights are normally given in metres above sea level, and land usage is usually defined in terms of categories such as "urban" and "woodland". Topographic data enables administrations to more accurately predict coverage area, site shielding and potential interference scenarios than simple prediction models allow. The need for topographic data and the resolution required will vary according to the type of service, the administration's terrain and land usage. The resolution required will also determine the method of storage and the volume of data necessary. The topographic data may be displayed as a path profile or as a two or three dimensional image. Topographic data's main usage lies in bilateral coordination, and in validating interference prediction models.

Most topographic data is available commercially on a licensed basis (like software), therefore there are limitations on exchanging data. There is also no single standard for storage or transfer. There is little requirement for exchanging a complete topographic database but there is interest in exchanging selected parts of a topographic database for the purpose of determining path profiles (see also Attachment 3).

2.4.2 Boundary definition data

Definition of boundaries is the mapping of a state's or country's coordination boundaries into an electronic data file, as such it is invaluable in the coordination process for calculating wanted and interfering signal levels across a number of countries. Boundary definition data may be stored graphically or in a database file. Methods of defining boundary information may be unique to each administration hence, during the exchange of data this will have to be recognised and allowed for by the participating parties. The benefits of exchanging this data would probably be limited to bilateral negotiations since boundaries defined in an internationally available map would usually be sufficient.

State or country coordination boundaries may be defined by plotting a number of points on the Earth's surface using the latitude/longitude or a national coordinate system. The number of points used depend upon the accuracy required. Two options are:

–   specific coordinates which define the border;

–   points at given distances along the border which give a practical approximation as used, for example, in the ITU Digitized World Map (IDWM).

Procedures for the conversion between the various coordinate systems are available and there may be existing national or regional agreements which indicate what system is required.

2.5 Presentation of data

There are several ways of presenting data each with its own particular merits. These include textual, tabular and graphical. Textual presentation of data is most commonly used for unstructured data, whereas tabular presentation is commonly used for structured data. Graphical methods may also be used for presenting large amounts of structured data. The use of graphical presentation and the desire to electronically exchange the output is growing. Some of its specialised uses in spectrum management are detailed below.

2.5.1 Graphical presentation of data

The graphical presentation of data is used, for example, in plots of satellite footprints, antenna patterns, elevation contours, etc. This data is currently exchanged in paper form. However, the introduction of electronic notification for satellite systems will allow more administrations to display the data directly, increasing awareness of graphical presentation.

Currently the electronic notification system does not normally contain the graphical data itself, since this often extends file sizes to the order of megabytes. The raw data describing the radio system is instead transmitted allowing the visual images to be reconstructed and presented on screen, or in a hard copy, as required.

A note of caution needs to be made about such systems. If the graphical images are to be interpreted in order to take decisions, then it is also necessary to ensure that the algorithms used to generate the graphical presentation are common so that all users really are viewing an identical visual image (see also Attachment 4).

2.6   Types of data file

When data is stored electronically the repository is commonly called a data file. Structured data is usually stored in a database file, whilst unstructured data is usually stored in word-processing files. The file size may be small (a few kbytes) or large (many Mbytes). When exchanging data it is not always necessary to exchange the entire file. The data file format, of which there are many types, often depends on the proprietary software package used (e.g. WordPerfect). Many software houses provide conversion software to enable translation between the most popular software products. Complete conversion may not always be achieved which may result in some loss of data, thus the exchange of data files will be easier if a mutually agreed format is used.

2.6.1   Database (structured) files

Database files typically use an artificial language to describe the data they contain and the structure of the language needs to be exchanged with the data so that the information it represents can be reconstructed by the recipient. Database files may be very large. They are often used to hold commonly and frequently used data to support repetitive functions, this data is typically exchanged on a predetermined basis.

For administrations, the majority of the data they would wish to exchange, either with other administrations or the BR, are contained in database files particularly in the case of notification or coordination data. Introduction of electronic exchange in these areas would enable administrations to have a faster response time for their customers and possibly savings in resource and capital costs (see also Attachment 5).

2.6.2   Word-processing (unstructured) files

Word-processing files use natural language to describe the data they contain and the structure of the language therefore does not need to be exchanged with the data for the recipient to extract the information. They are used to hold individual low volume data for infrequent use and are generally exchanged on an informal basis. They are typically used to present textual information but can also be used for accounts or licensing information. Word-processing packages are being constantly upgraded, increasing in both power and complexity, this needs to be taken in to consideration when exchanging data. It is possible to exchange documents in a number of format types but it should be noted that not all formats are compatible.

The main benefits offered by the electronic exchange of word-processing files are the speed of delivery of documents and the ability to eliminate the barriers created between individuals working in different time zones, or having different working schedules (see also Attachment 6).

2.7   Constraints on the recipient's use of the information exchanged

The recipients of electronic data may have limitations imposed in the use they can make of the data they have received. For information that is exchanged which is not in the public domain, the limitations in the use of the data may arise for example from:

–   intellectual property rights (IPR),

–   software licence restrictions,

–   national, regional and international agreements,

–   primary legislation in the countries exchanging data.

Data in electronic format is potentially more vulnerable to misuse than paper based systems because of the volume of data that can be exchanged and that once in electronic format it is impossible to prevent the data from being manipulated. Failure to recognise these issues could result in a legal challenge. In addition to legal restrictions, the release of data into the public domain may also have political and/or financial implications (e.g. the inadvertent release of information affecting the market value of a satellite operator), or other implications arising from the recipients use of the data for purposes beyond the original intention of the exchange. It is therefore the responsibility of the sender to be satisfied as to the conditions of use before passing data to a third party. For these reasons, those parties using EDE may wish to establish prior agreement on any constraints they want imposed on the use that can be made of the data.

2.8   Protection of data

Data must be accurate and the computer systems and communication systems must be reliable. In order for this to be attained protection is required from both accidental and malicious threats to their:

–   confidentiality (e.g. ensuring the data is only seen by authorised persons),

–   integrity (e.g. ensuring that the data is accurate),

–   availability (e.g. ensuring that access to data is available when required).

This is achieved through a formal review and evaluation of the systems, the operating environment and the data used, or held. This review includes a risk analysis exercise and results in the production of a set of countermeasures (e.g. virus protection, diskette protection) that are appropriate to the system and the data. In some administrations this work is encapsulated, or brought together, in a single policy document addressing the protection of the hardware, software and data which is developed in parallel with the project development work. At the end of the development phase this document is approved by those responsible for computer and communications security before the users assume responsibility for the system. The users then become responsible for ensuring compliance with established policy and that any changes to the system, the data or the operating environment are evaluated to determine whether any changes to the policy are required.

A special note should be made of the potential problems arising from computer viruses, particularly with respect to personal computers. A virus may attack both the data held on the system and the computer operating system, appropriate measures should therefore be taken to protect computer systems from viruses and to develop a recovery plan.

The implications of moving to electronic exchange should be considered before any electronic data exchange takes place. The potential impact on an administration's business from any problem occurring will vary depending on its existing computer and/or business infrastructure and the type of electronic exchange proposed (i.e. diskette exchange or direct line). Failure to give adequate consideration to protection issues could make data exchange unreliable and may reduce the benefits resulting from the adoption of electronic data exchange (see also Attachment 7).

3   Transport methods

3.1   Introduction

When planning to electronically exchange spectrum management information, a number of alternative transport methods can be used. The challenge facing the spectrum manager is to select one method or a combination of methods that best satisfies the requirements. Making this selection requires considering a number of factors including the estimated costs, timeliness for accomplishing the task, accuracy of the information transferred, capacity of the information transfer medium, availability and reliability of the communications medium, availability and reliability of required hardware/software, and availability of trained staff to assist in the execution of the procedures and operations.

From a data storage, transmission, or processing perspective there is no difference between the data files representing spectrum management information and any other data files. Consequently, the spectrum manager should draw on the experience gained by other managers who have successfully implemented effective systems and procedures for satisfying their electronic information exchange requirements.

The discussion below presents some of the major transport methods together with some factors that should be considered in selecting the appropriate methods to use.

3.2   Surface mail

Surface mail is the exchange of data using postal or package/courier services. The data can be held in a variety of different media (diskette, magnetic tape, CD-ROM, optical disc, etc). For a limited number of exchanges, with a limited number of recipients this method may prove to be highly efficient and cost-effective.

When considering this method, however, consideration needs to be given to the staff time and the materials costs for copying the data to the chosen transport media, packaging, and the costs of the postal, package/courier service. In some cases, the use of third party support for performing these copying and packaging activities may be cost-effective.

The sender should be aware of the postal or package/courier services' reliability and the likely time/location of the delivery when selecting the service provider.

3.3   Facsimile (FAX)

"Facsimile" (FAX) is a technology which permits the transmission of images from one machine to another using the public switched telephone network (PSTN). The sending machine may be a dedicated FAX machine or a PC with fax image conversion software and a FAX modem. The receiving machine reproduces the original image on a printed page, or in the case of a PC based fax modem, stores it in an image file. Since an image of the entire printed page is transmitted, FAXs can be used to exchange both text and graphic information.

FAX image conversion is performed to set standards and therefore PC software will not achieve any greater resolution than a dedicated FAX machine. The principle advantages of PC software over a dedicated machine include:

–   no manual scanning/paper feed problems;

–   PCs have a larger memory than dedicated FAX machines and therefore larger files can be sent to a greater number of recipients (this can however become a disadvantage if it ties up a user's PC for any significant length of time);

–   the information exchanged can be stored in an image file.

3.4   Electronic mail (E-mail)

"Electronic mail" (E-mail) is a technology which permits a message to be transmitted between computer systems. This transfer is accomplished without any requirement for human intervention. A number of multi-featured E-mail systems are available on the market and new products are constantly emerging. Using E-mail services offers certain benefits over the use of surface mail and facsimile; however, the factors discussed below in the implementation and use of E-mail systems should be considered.

While most E-mail systems permit sending identical messages to multiple addressees, software (known as "listservers") can be used to manage electronic mailings. Listserver software is not included in standard E-mail installations and the installation of some multi-featured listserver software may require specialized expertise to achieve full compatibility with existing E-mail systems. However, if a requirement exists for frequent electronic distribution to an extensive list of addressees, a listserver can be cost-effective.

The system's capability for establishing a message path to intended users is a critical element of any E-mail service. E-mail services available to the users connected to a local area network (LAN) may be adequate for coordinating local spectrum management activities, but the use of E-mail services to coordinate regional or international activities will require access to communications servers that can be connected either through the PSTN or a backbone network such as the Internet. While a variety of methods may be used within a given LAN or wide area network (WAN) to establish a "connection" between computers, the protocol used on the Internet permits message transmission in a "store and forward" manner. Information regarding local access to the PSTN may need to be obtained from the authority regulating the local telephone utilities, and information regarding local access to the Internet can be obtained by contacting the Internet Society at E-mail: editor@isoc.org; World-Wide Web: http://www.isoc.org; or Telephone: +1 703 648 9888 (United States of America).

3.5 Remote data access – Bulletin boards, gophers, World-Wide-Web servers, file transfer protocol (FTP) sites, and "connections"

"Remote data access" is a set of procedures and technologies which permits users to:

– connect their computers (local) to other computers (remote) in distant locations and view, copy, delete, revise, or execute files/programs located on the remote computer,

– transfer (upload) files between the local and remote computers.

As was noted in the previous section, E-mail services operate as "store and forward" systems; consequently, the message path between computers sending and receiving E-mail messages need not be a continuous connection. Remote data access services operate as "on-line" services; this means that a continuous connection (referred to as a "login session") must be maintained while the user is using or exchanging data with the remote computer. Because of this need for continuous connection during login session, spectrum manager's considering the use of these types of services need to examine the availability and reliability of the communications facilities (LANs, WANs, PSTN, Internet, etc.).

Various forms of remote data access services can be established using what are commonly known as "servers". These servers are comprised of computers and specialized applications software that offer various types of services (bulletin boards, gopher, World-Wide-Web, FTP) to users. Further details are presented in Attachment 8.

3.6 Standards compliance

Standards are required to enable a product manufactured in one country to be compatible with similar equipment in another country. In the area of telecommunications, there are a large number of sometimes very complex standards. These standards are related to both hardware and software and are required for the use and growth of complex networks. Without these standards, data could not be transferred between the thousands of nodes in networks whose various segments may be controlled by different organizations around the world (see also Attachment 1).

The Internet E-mail standards were established in 1982 and were then quite innovative. The 1982 standards allow for mail messages that contain a single human readable message with the following restrictions:

– the message contains only ASCII characters,

– the message contains no lines longer than 1 000 characters,

– the message does not exceed a certain length.

There are a number of other types of messages and services that are supported by other mail standards that have been designed more recently. In June 1992, a new Internet mail standard was approved; this new standard in called MIME. MIME is an acronym for multipurpose Internet mail extensions; this standard builds on the 1982 standard with additional fields for mail message headers that permit new types of content and organization for messages. MIME allows mail messages to contain:

– multiple objects in a single message,

– text having unlimited line length or overall length,

– character sets other than ASCII,

– multi-font messages,

– binary or application specific files,

– images, audio, video, and multi-media messages.

As has been noted in § 2 of Annex 1, efficient and effective use of the electronic information exchange methods described requires strict adherence to accepted standards. Where the information exchanges cross national boundaries, international standards are required. When specialized data files are to be exchanged, agreements need to be established between all the intended users of this data to assure reliable retrieval of the information (see Attachment 2). Failure to use accepted standards will make the intended electronic transfer of data unreliable.

4   Issues in systems implementations

4.1   Introduction

The introduction of data exchange by electronic means can have a major impact on an administration's procurement and computer system operations. The extent of the impact is dependent on the existing levels of computerisation, the type of electronic data exchange required, the level of staff skills available and the administration's security requirements. Consideration of all these factors is necessary as they will determine the cost effectiveness of implementing a particular data exchange mechanism and the level of benefits that the administration can achieve. Issues affecting staffing are discussed in § 5 of Annex 1.

The starting point for the introduction of EDE must be an assessment of both the existing computer system and what the administration wants to achieve in terms of EDE. The result of the assessment analysis, combined with infrastructure considerations, will provide the administration with an overall view of how much a move to EDE will cost, the potential benefits and the timescale required. One factor that may emerge from the analysis could be that the proposed method of data exchange is not achievable in the short term and that a programme of controlled change over a period of, for example, 2-5 years is more practical, cost effective and manageable.

4.2   Existing computer facilities

An administration's existing computer facility may consist of stand-alone computers, networked computers or both. Some administrations may not have a computer. Computers may have a simple operating system where the features available are largely dependent on the application software or a more powerful operating system with many intrinsic features e.g. UNIX. An administration's computers may have different operating systems or they may be located at a number of different sites within the country. The simplicity or complexity of an administration's computers or the diversity of their location is not a barrier to implementing EDE.

4.3   The administration's EDE requirements

The essential question for any administration implementing EDE is "what do we want to achieve?". Does the administration wish to exchange data solely with the BR, or in addition, with other administrations? Is there a requirement to exchange data with other sites in their country? Does the administration want to link the introduction of EDE of spectrum management information with the development of a networked computer facility using a LAN or WAN? Will the administration's requirements change with time?

An administration's computing Infrastructure will impact on the implementation and operation of EDE. The extent of the impact will depend on the administration's requirements. The following list contains typical factors requiring consideration:

–   the layout of the building will affect network costs;

–   the number of sites to be connected in a country, and that country's topography and national communications system, will determine the type of communications network used;

–   the cost of communicating via the PSTN varies considerably from country to country and therefore may be of primary importance to one administration and insignificant to another;

–   skilled staff who understand communications and network requirements are essential for implementing any network solution (see § 5 of Annex 1).

Moving to EDE need not require any major computing skills. The only essential requirement is to implement security measures appropriate to the value of the data and system (e.g. virus protection). For personal computers, the simplest form of EDE (i.e. diskette transfer) can be implemented easily, cheaply and effectively. As the EDE mechanism becomes more sophisticated then potentially more benefits become available to the administration. However with this increase in sophistication and benefits there is a corresponding increase in the complexity of the installation and the cost of both implementation and maintenance.

In a stand-alone computer facility and with today's sophisticated modern software, most users do not need to acquire computing skills beyond those necessary for using the application software. The support required to maintain these computers can therefore be provided either by the users or by specialist computer support staff. Administrations are more likely to have specialist support services if they already have either local or wide area network systems, or if any of their computer systems are running some of the more powerful operating systems such as UNIX. More extensive computing facilities are also likely to have more highly developed system security arrangements. If an administration already has these facilities in place, it could be easier for them to implement more sophisticated EDE systems since the impact on their existing computer systems operations may then be small.

4.4 Procurement

All administrations will have an approach to procurement, whether the selection of the hardware and software is made by specialist support staff or by the users. Procurement can be based on standardisation around a particular brand of software, hardware or on the desire for the best possible solution to individual work requirements. The more sophisticated the EDE system becomes the more software and hardware is available that will potentially meet the administrations needs. However, care needs to be exercised in selecting software or hardware since not all network or communications software is necessarily compatible with other software packages and hardware. There may also be additional problems with some application software and operating systems. Identifying the potential problems and successfully implementing EDE may therefore require the administration to take a pragmatic approach to procurement by selecting the best overall fit of software and hardware to meet the administrations' needs. Successful implementation may also mean acquiring experience in communications.

4.5 Managing change

It is necessary for administrations to consider how they will manage the transition to their required standard of EDE. If the transition is considered to be significant the implementation of one or more pilot schemes is highly recommended (perhaps with more than one type of software) to gain experience. This approach also allows in-house staff time to gain new skills and experience under controlled conditions without the pressure of working on an operational system.

The selection criteria for the computer systems is very important, especially the software (both operating system and application software). In a small system that may consist of only one computer, e.g. basic automated spectrum management system (BASMS) software may be selected because of its widespread use. For details on BASMS see Attachment 10. Software becomes popular for many reasons; speed, user-friendly interface for the programmer and end-user, customer support, etc. If software is extensively used, one can usually assume that the product works reasonably well. There is also a good probability that if additional staffing is required, trained personnel may be available if the product selected is in wide use and availability.

5 Staffing and training

5.1 Introduction

"Staff" includes the people who do the work of radio frequency spectrum management and those people who provide support for this work. Most administrations have limited staff resources available to perform spectrum management functions and are constantly searching for methods of enhancing their productivity. Modern computer and communication products can provide improvements in productivity but careful planning is required to maximise these productivity improvements..

Significant progress has been made in applying a wide variety of computer and communication products to spectrum management activities. The resultant increase in efficiency has allowed staff to be more effectively employed in spectrum management issues. The term "computer literate" is frequently used to characterise people whose combined aptitudes, interests, training, and experience enable them to use these modern products effectively. An administration needs some spectrum managers to be "computer literate" to maximise the benefits from the introduction of modern computer technologies and to provide a link for explaining spectrum management requirements to specialist computer staff.

New computer and communications products are continually being introduced into the marketplace, hence it is impossible to compile an exhaustive list. The following is a list of some of the tools used to improve productivity:

–　computer systems,

–　computer networks,

–　communication systems,

–　databases,

–　word processors,

–　image processors,

–　graphics processors,

–　graphics displays,

–　digital libraries,

–　Internet browsers,

–　communications servers.

The effective application of these tools requires adequate and appropriate staff resources. An example of a planning list is presented in Attachment 9 that can be used to identify the necessary resources.

5.2   Nature, scope, and potential sources of required skills

The effective application of computer and communications systems for modern electronic information exchanges may require a wide range of specialised skills. Skills are needed in planning, operating and maintaining computer networks; selecting and developing standards, procurement, software development, systems management, and support. Furthermore, the effective use of specific tools such as word processors, database systems and E-mail requires yet another set of skills.

The required skills can be acquired by:

–   training of existing staff;

–   recruitment of new staff,

–   procurement of specific services from a third party.

Determining the appropriate balance of skills required from these different sources is a significant management planning task. Not only must the manager consider the costs of acquiring the skills, but also the changes to the required skills that could result from anticipated changes in an administration's business requirements. Consequently, before decisions are made regarding how specific skills will be acquired, a detailed plan should be prepared that defines the administration's immediate and long-term (at least five years) objectives for implementing modern computer and communication products.

5.3   Existing skills

Whether an administration can satisfy all of their skill requirements by providing training for existing staff, or by recruiting additional staff will depend on a number of factors including:

–   the skills held by the existing staff,

–   the number of computers planned for use in the organisation,

–   the complexity of the software to be used (including the operating systems),

–   the complexity of the computer networks, if any, to be used.

Existing staff may already hold some computing skills that have been acquired, either through previous work experience or through formal training. Radio engineers will have knowledge of some aspects of computing because many engineering courses include applications of computing techniques and many engineering tasks include practical application of problem-solving using computers. The extent of these skills will vary from engineer to engineer since engineering courses may not have standards for the level of training provided in computing. The skills acquired through engineering courses will almost certainly be limited to the development of software and some computer operations. These limited skills would typically not be adequate for developing, or maintaining, complex computer and communications systems/networks.

5.4   Computer and communications systems management/maintenance

The overall aim in the development and management of computer systems is to ensure they meet the needs of the end-users with minimum intervention from operators and support staff. However, as more spectrum management functions are performed on these systems, there is a corresponding need to ensure that adequate staff remain available to maintain the systems operations in a timely manner.

Management, or development, of a computer facility requires adherence to agreed project management guidelines, particularly when this applies to the production of documentation used for the development and maintenance of the system. This basic requirement applies irrespective of the number of computers, or the complexity of their interconnection. The only change is the increase in effort and staff time with the increasing complexity and number of the computing facilities. If this work is to be performed by staff unfamiliar with spectrum management, then it is important that they have a full appreciation of the user's' needs and timescales. This can easily be accomplished by some limited work experience in the key business areas for all new computer support staff.

Staff involved in the management, or development, of computer systems are likely to benefit from training courses in project management irrespective of their discipline. Some staff may already have experience in this area, but courses in project management can be useful to both computer development and spectrum management activities, and may therefore be viewed as of overall benefit to the administration's operations.

Maintenance of the computer systems may be performed by in-house staff, or by contracting this function out to either the hardware or software supplier, or to a third party specialist. If the decision is to use an external contractor, the need for a security clearance of the contractors' staff needs to be considered, particularly if it involves sensitive data. If support is to be in-house then it is essential that the staff have the necessary skills and training in the hardware and software used.

The effort required for management and maintenance will depend on the size, complexity and nature of the computer systems. For a small number of stand-alone systems, or where electronic exchange is by diskette, or modem, the most practical method would be to allow a suitably trained user to provide computer system support. However, there comes a point when it is probably best to create a specialised computer support group with all the relevant skills. The point at which this becomes necessary will depend on the type of computers used, the mixture of operating systems and whether the computers are to be networked. If the computers are to be networked then a specialised computer support group would certainly be advisable and they would need to acquire skills and experience in telecommunications. A specialist group would also be appropriate if the administration is proposing to move to fully interactive Interactive electronic exchange (e.g. via a backbone network such as the Internet). Telecommunications experts may only be required during the initial setting-up period and could be provided by a telecommunications contractor.

If radio engineers are to undertake these tasks in addition to their spectrum management duties it is essential that management recognises that the computing systems have equal priority and that adequate and proper training is provided.

5.5 User training

Generally, planning should include a continuing series of opportunities for all staff members to obtain appropriate training in user level software. This staff training is critical in ensuring that the benefits anticipated from the investments made in systems facilities and software can be realised. Some "on-the-job" training may be satisfactory in special cases, but the productivity of employees will be improved by basic training in the common office software. Further training on upgraded versions of software would also benefit experienced staff members. Consideration should be given to creating long-term training plans that include acquiring staff skills in all aspects of software, even for those situations where software development by a third party may be more cost-effective in the short term.

In general, training and expert assistance can be acquired from software/system suppliers but any major software procurements may require specialist training. Administrations are therefore urged to consult the BR to determine their experience for a particular software. In this manner certain benefits can be gained when both the Administration and the BR utilise the same software application.

5.6 Procurement

Procurement of hardware and software requires an understanding of the function that is to be performed, the training to rapidly assimilate information on available systems, and experience in assessing the relative merits of alternative options. Practical experience of this work is invaluable since training can only provide an initial framework in the approach to this task. This is an ideal area for providing in-house training of new staff once there is at least one person in place with the required experience and abilities.

6 Case studies

6.1 Introduction

The following six case studies are examples of the existing and planned use of electronic data exchange by a number of administrations. They are intended to demonstrate both the variety of information that administrations wish to exchange and the potential benefits for administrations and the BR.

These case studies range from document exchange – which is probably the simplest but most common form of electronic data exchange – to the more elaborate and complex requirements of coordination. The example in the monitoring environment perhaps best typifies the need for EDE as well as the need for international agreement on the format. This example shows how, as the quantity of monitoring data collected increases, the most suitable method of handling is for it to be directly loaded into a computer for analysis. It is also an indication of how, in the future, remote automated monitoring equipment could be accessed from other distant locations.

6.2 Case Study 1 – Document exchange via ITU TIES

The ITU provides a service through the Telecom Information Exchange Services (TIES) and ITUDOC, that enables electronic access to many of the documents that are available from the BR and a method of exchange for participants in meetings. This service is still in the process of being expanded and is therefore not complete, but it provides increasing access to many BR documents. The ITU facility also exists for setting up a bulletin board area for use by individual Radiocommunication Study Groups, or Task Groups, enabling their participants to exchange working documents prior to submission to the secretariat. This service is additional to the other services available through TIES (E-mail, FTP, etc).

The electronic exchange of documents is of considerable importance to the BR as it offers a potential solution to the rising cost of document production and distribution. It enables contributions to be sent quickly and easily to the BR, reducing

effort on the part of the contributor and giving the BR more time for processing the document. For administrations, electronic document exchange reduces the cost of the manual distribution of paper copies, in addition to space saving in terms of storage of paper documents.

Input documents can be submitted for all of the ITU-R meetings and output documents from the BR Secretariat are frequently available before an administration receives a hard copy. When using ITUDOC, the term "document" can refer to many different kinds of electronic information: e.g., simple text files, word processing files, formatted publications, graphics, databases, spreadsheets, software in source code or executable format. Some information is available in several formats or languages. The format and language chosen for retrieval depends on the user's preferences and the capabilities of their computing/software environment. The user should, of course, make sure they have the capability to read a specific format before retrieving it. For example, almost all computing environments can read simple ASCII text files. However, if it is required to retrieve a document posted in a proprietary file format, a matching version of the corresponding program, or its file conversion to the desired word processing format, will be needed. Likewise, if the user wishes to retrieve a document formatted as Postscript printer output, they will require access to either a Postscript printer or a Postscript file viewer. A list of formats available can be obtained through TIES.

TIES permits documents to be received by a variety of methods including Internet or X.400. TIES or ITUDOC can be accessed as required. Word processed files may need encoding for transmission and decoding on receipt. Some server systems will automatically encode files on transmission. For transmission across an Internet/X.400 interface, MIME encoding is the only current method. Help on access methods can be obtained by sending a message with the line HELP in it to itudoc@itu.ch (ref. BR Administrative Circular CA/17). The type of access method used will affect the number of services available. If the communication system does not provide a direct connection, as is the case with an electronic post-box, then certain services like Telnet and FTP will not be available (see § 3 of Annex 1 and Attachment 8). This will limit the user's ability to access and exchange data. A helpdesk facility has been established in TIES that can provide users with access to files containing information on the full range of access methods, the available valid commands, index files describing the directory structure for ITUDOC files, in addition to the help desk's telephone contact number.

6.3   Case Study 2 – Transfer of analysis

Although not normally a routine requirement, it is sometimes useful for administrations to exchange the results of an analytic exercise. This could include planning a radio link covering the territory of two or more administrations, or a group of administrations who might wish to verify their computer systems implement a coordination procedure in exactly the same manner, i.e. their systems produce the same results from identical inputs.

In the latter example, a typical approach would be for one administration to send to the other administrations details of the input conditions and results for an example calculation. Details of the radio systems involved would be transferred using the necessary data items as described in the proposed radiocommunication data dictionary (RDD). Assuming that the test system is real (i.e. not a hypothetical example), the data could be extracted from the administration's database perhaps using the same mechanism as required for notification.

There is a clear advantage in having standardised interpretation and representation of the data used for this purpose, since it greatly reduces the effort which would otherwise be required for what could be a relatively infrequent activity. However, there are two points where special arrangements might be required:

a)   depending on the type of comparison being made, data items may not be described in the RDD;

b)   If the comparison has topographic data as an input, such as terrain heights along a path profile or horizon elevation angles around an earth station, for exact agreement it will often be necessary to exchange the actual input data. Even if both administrations have a topographic database for the area concerned, extracted data will not be identical unless the databases are equivalent and the same algorithms are used to extract the derived data.

The issue in (a) will not normally cause problems, because satisfactory comparisons can usually be based on a relatively small number of results.

The issue concerning topographic data is somewhat different. There is a case that the RDD, or associated texts, should address the question of transfer standards for extraction's from topographic databases, such as terrain-height profiles and horizon-elevation arrays. It is suggested that such requirements could be met by defining an appropriate set of ASCII text file formats. A major complication would arise, however, if it is wished to include land-usage (e.g. buildings, vegetation, etc., alternatively known as "morphology" or "clutter"). There is no practical standard for defining land-usage categories, and in practice it is difficult to ensure that these categories are interpreted similarly in different areas.

6.4   Case Study 3 – Radiocommunication Agency frequency and site database

6.4.1   Introduction

As part of its spectrum management process the United Kingdom Radiocommunication Agency (RA) maintains a database of frequency assignments used as well as the locations of the radio systems using these frequencies. This system is known

as the frequency and site (FAST) registers. The input to both these frequency and site databases comes from a variety of sources, many from within the Agency as part of its day-to-day business of assigning and licensing a wide variety of radio services, others from external frequency planning organisations and telecommunications operators.

6.4.2   Current data exchange issues

Currently the bulk of the information is received on paper and is manually entered into the system. This activity is resource intensive and prone to errors during the data transfer process. The data transfer is often a duplicated process as much of the data is already held on other computing systems which first has to be transferred onto paper records then transferred back into electronic format on the FAST registers computing/storage system.

The output from the database is currently circulated on a regular basis in paper and microfiche form to a large number of users which incurs large postage and production costs. The complete frequency register is circulated after each three weekly clearance meeting. In the case of site clearance proposals the recipient has 28 days in which to comment. Due to the need to manually scan large volumes of documents vital information can be overlooked. Also any delays in responding can result in unnecessary delays in issuing the licence.

6.4.3   Benefits of electronic exchange

To overcome some of the above difficulties a decision to move to EDE was taken. The perceived benefits are:

–   the ability to input and scan the data electronically will give significant savings in the time taken to examine the request, allow a more rapid turnaround and meet the demand for a reduction in the time taken to issue a licence;

–   the savings on resources, postage, microfiche production costs and time are considerable. For some recipients who currently have to input the whole database manually the resource savings will be very large;

–   the potential for the reduction in transfer errors particularly when inputting large amounts of data is considerable.

6.4.4   Possible problem areas

There may be difficulties in validating the input data by electronic means and this issue has been the subject of careful study. The types of errors possible in electronic compilation of data are potentially quite different from those occurring in a paper based system; but RA are confident that these errors can be minimised by the careful design of validation software. There is a possibility that this validation software may be developed by the BR in collaboration with administrations.

6.4.5   Method of transfer

In the initial stages RA will use a 1.44 Mbytes diskettes for the weekly distribution of the site clearance proposals and CD-ROM for the frequency and site database. The frequency register is distributed every three weeks, but distribution of the site register is expected to be every three months as customers should be able to update their site database from the weekly distribution of the site proposals on diskette. On-line access has been considered for the next stage but it has been decided that some experience of the new system might be beneficial before commencing development of a more sophisticated system

6.4.6   Future plans

In September 1994 the BR sent out a Circular letter CR/26 on the electronic notification of terrestrial systems and has plans for a similar document on satellite notification. This move by the BR towards electronic input of formal documents is a major step forward for administrations and the BR, in reducing the cost, time and errors inherent in the paper based system. RA are therefore developing computing systems to take full advantage of the opportunities provided by the introduction of electronic notification. However for the full benefits to be realised it is necessary for the RDD to be completed and suitable validation software developed.

6.5   Case Study 4 – Electronic data exchange between monitoring stations

6.5.1   Introduction

Monitoring stations routinely collect large volumes of data. Much of this is for their own purposes and much is now likely to be collected and stored electronically. These processes have largely grown up with the routine tasks at the station and are in formats designed to meet their own needs and are influenced by any proprietary formats in any hardware or software that they may have acquired.

If there are a number of remote controlled facilities then inevitably they will have inbuilt EDE. Again the formats will have been determined by a mix of individual needs and the proprietary facilities available.

Publications by the ITU-R such as the IFL and Weekly Information Circular (WIC) are available on CD ROM and diskette respectively and these formats may influence working practices at monitoring stations.

The following examples of EDE illustrate typical tasks where monitoring stations need to exchange data. Some may still be paper based, others may be in varying stages of transfer to an electronic format. All lend themselves to total electronic transfer once the RDD and agreed proformas are in place. The examples are:

–   Appendices 22 and 23 to the RR (Geneva, 1994) reports of infringement of the RR and of harmful interference;

–   a request for a bearing (QTE);

–   the collation of monitoring data from a specific exercise arranged between two or more administrations.

6.5.2   Example of electronic exchange of data concerning BR Appendices 22 and 23

The basic format of these reports is already defined in the RR. The key advantage of such a pre-set format, even in paper transactions, is that instructions can be in the national language and the data entered in the format, set out by the ITU-R, which is language independent.

Note that only the data shown underlined need be sent. The explanatory words *in italics* are generated locally and will be in the administration's own language. Annotations to the example are given in SMALL CAPITALS.

AP22<cr/lf>   THIS PRE-DEFINES THE FORMAT OF THE FOLLOWING DATA SET

From   **RADCON××PARIS××××××××××× F××<cr/lf>**   AS IN LIST OF MONITORING STATIONS

To   **RADCON××LONDON××××××××××× G××<cr/lf>**

APPENDIX 22 REPORT OF AN IRREGULARITY OR OF AN INFRINGEMENT OF THE CONVENTION OR THE RADIO REGULATIONS

1. Name   **RUGBY×××××××××××××××××××××<cr/lf>**

2. Call sign   **MSF×××××××××××<cr/lf>**

3. Nationality   **G××<cr/lf>**

4. Frequency   **×60K000<cr/lf>**

The first data item in this exchange is "AP22" and it is assumed that data items are delimited by a carriage return/line feed symbol <cr/lf>.

The order of the following data elements is then known from the agreed format.

That is a "from" field of 25 alphanumeric characters followed immediately by a nationality designator of 3 alphanumeric characters and terminated by a <cr/lf>.

The next data element is a "to" field of identical format.

The fourth data element is the "name of transmitting station" in 25 alphanumeric characters, and the fifth data element its callsign.

In this example a locally generated heading "APPENDIX 22 REPORT..." has been inserted between data elements 3 and 4. This is simply for the convenience of the operator. The recipient station might choose to display a similar title, in their own national language, immediately on receipt of the first data element "AP22". It is that element which sets the expected order and purpose of all subsequent data elements.

It is essential that all data elements are sent, blank if necessary. That is most easily and reliably achieved by a program presenting the sending operator with an on-screen proforma into which the data is inserted. The layout and even the ordering of the on-screen presentation is irrelevant and can be entirely a matter of local preference. The essential task, performed automatically by the software, is the correct formatting of each data element and that they are sent in the set order, agreed and shown by the "AP22" designator.

A similar format can be devised for an "AP23" which will use many of the same data elements but in an agreed ordering which, logically, will equate to the existing Appendix 23 format as set out in the RR.

The formats of these two electronic exchanges are relatively simple to devise being based very much on the current paper procedures. Indeed even with paper methods the explanatory words are often omitted since it is universally known that item No. 5 in "AP22" format will be Class of Emission. It is also common to put all the item numbers in the faxed copy of the notification (even though many will be blank) simply to avoid risk of confusion.

6.5.3 Request for a bearing

A QTE is currently handled as free text. There is no defined format although many monitoring stations will have developed some form of "house style" that is followed to a greater or lesser extent.

The format below is offered as an example. This follows the same logic in construction as the examples above and is signalled by the key word "QTE"<cr/lf> as the first data field. The reader will now, no doubt, have realised that a set of proformas and key words to identify them will be needed once an agreed system for electronic exchange is in place. Also, at this stage, assumptions have been made as to the eventual format of the data elements used in these examples. Clearly the example will need to be modified to accommodate the final definitions of the data elements. This need not, however, influence the underlying style proposed in these examples.

QTE<cr/lf>   THIS DEFINES THE NATURE AND ORDER OF THE DATA ELEMENTS TO FOLLOW

QTE Request

From   **RADCON××PARIS×××××××××××   F××<cr/lf>**   AS IN LIST OF MONITORING STATIONS

To   **RADCON××LONDON××××××××××   G××<cr/lf>**

Details of signal for which bearing is requested

Frequency   ××××M×××<cr/lf>   K, M, G OR T USED AS DECIMAL POINT. NOTE: THIS FIELD WILL BE A MEASURED FREQUENCY AND WILL BE A DIFFERENT DATA ELEMENT TO "ASSIGNED FREQUENCY"

Mode   ×××××<cr/lf>   5 CHARACTERS AS DEFINED IN RR

Centre frequency   ××××M×××<cr/lf>   *Shift*   ×××××<cr/lf>*Hz*

                        OR

        leg 1 ××××M×××<cr/lf>   *leg 2*   ××××M×××<cr/lf>

Callsign   ××××××××××××××××<cr/lf>

Our QTE of this signal   ××××<cr/lf>   3 FIGURE EAST OF TRUE NORTH BEARING AND A/B/C CLASS OF BEARING DESIGNATION

QTE of another monitoring station

Name of station   ××××××××××××××××××××××××××<cr/lf>

QTE obtained ××××<cr/lf>

Details of any other, in-band, signal NOT subject of QTE request.

Frequency ××××M×××<cr/lf>

Mode   ×××××<cr/lf>

Centre frequency   ××××M×××<cr/lf> *Shift* ×××××<cr/lf>*Hz*

                OR

        leg 1 ××××M×××<cr/lf>   *leg 2* ××××M×××<cr/lf>

Callsign   ××××××××××××××××<cr/lf>

Date and time **ddmmyy hhmm**   THE DATA ELEMENT FORMAT IS DDMMYYHHMM BUT HAS BEEN SPLIT "ON-SCREEN" FOR EASE OF READABILITY. EQUALLY IT COULD BE LOCALLY RE-FORMATTED TO MEET NATIONAL PREFERENCES.

Comments

××<cr/lf>

            COMMENTS FIELD 70 ALPHA NUMERIC CHARACTERS.

6.5.4   Collation of monitoring data

The final example concerns an ad-hoc monitoring exercise organised by a small group of neighbouring countries to address a specific task.

Clearly a pre-set proforma prescribed, for example, by an ITU-R Recommendation is inappropriate. However the coordinating administration may wish to suggest a suitable format so as to greatly aid collation and processing of the received data.

This example shows a joint monitoring exercise by several European countries of illicit use of 6.6 MHz. This was coordinated by NERA, the Netherlands monitoring station. Vast quantities of data were collected and many reports from several monitoring stations concerned the same observed emission.

Collating this information could only realistically be done on a computerised database. It was essential that all administrations used the same data format to allow the data, contained on diskette posted by each participating station, to be successfully read into the master database. The Netherlands devised a database structure in a proprietary database package and mailed a diskette to participating administrations, who also used the same software to avoid conversion difficulties.

With the actual database being prepared centrally, in advance, the issue of common electronic format is automatically taken into account, only the formatting of the data to be entered remains. This is covered by the example below.

Data item	Example	Comments
Station or callsign	JB 12	Please not JB12 or JB-12
		<F10> will display any other entries of this callsign.
First Name	JOHAN	
Country	HOL	ITU abbreviation of country in which the station is probably located. If unknown enter a single '-'.
City/area	AMSTERDAM	NERA will check if place name really exists!
Add info	NORTH OF	
Frequency	6 670.00	Frequency (kHz) (or 6 670)
Date	21-05-95	The PC date is entered automatically
Day	FR	This will be expanded to Friday
Time	2119	Your PC time is entered automatically. **Please change your PC time to UTC or change entry manually.** If a bearing is taken please enter the time of the bearing to facilitate comparisons with bearings from other countries.
QTE	330B	Bearing and class of bearing
LAT	56N23	Latitude degrees N/S min
LONG	005E47	longitude degrees E/W min
MON	BAL	Observing country/monitoring station. This is the user-ID which is entered automatically to every record.
Additional information		Two lines of 50 characters each for additional comments.

6.5.5   Summary

The large quantities of data collected by monitoring stations can only be comprehensively collated and searched electronically. The move to electronic exchange for monitoring information is therefore both practical and convenient. It also is compatible with the trend towards automated monitoring equipment that can be interrogated from a remote location.

6.6   Case Study 5 – Canadian international frequency coordination for the terrestrial services

6.6.1   Introduction

Because of the geo-political situation in Canada, two distinct frequency coordination methodologies are used for the terrestrial radio services; bilateral coordination and international coordination/notification. Frequencies which are likely to be of interest or concern to countries on an international scale, such as AM broadcast, shortwave, maritime mobile and aeronautical mobile bands, and certain microwave bands shared with space services, are coordinated through the ITU, while frequencies only of regional concern are coordinated bilaterally with the United States of America. Because both Canada and the USA have highly developed infrastructures, agreements are often negotiated between the two administrations without involving the ITU. Bilateral procedures are more responsive to radio users needs as they can be completed in faster turnaround times. The ITU encourages all countries to make greater use of bilateral and multi-lateral agreements dealing with coordination matters.

In the past, frequency coordination was done largely on a first-come-first-served basis. While being relatively simple, this method has disadvantages in that it tends to favour the first country to successfully coordinate and license radio stations for a given frequency in a given area. As can be appreciated, this method can be very resource intensive.

In recent years, Canada and the United States of America have jointly sought to improve bilateral coordination methods. Recent agreements are designed to permit equitable access by both countries to new frequency bands, prevent interference and reduce the resources involved in the coordination process. As a result, frequency coordination methods have been developed which involve more advanced planning of the use of new frequency bands. This planning approach is commonly called the Block and Zone method. In an effort to promote equitable sharing along the Canada/United States border and to reduce coordination and administrative time and effort, the Governments of Canada and the United States of America have entered into arrangements whereby portions of certain bands are set aside on a block allocation basis for the unrestricted geographic use of the specified country in defined border areas or zones. The terms of these arrangements take into account the demographic differences that exist along the border areas between the two countries. That is, the country with the larger population in a given geographic area receives the larger share of the available spectrum for its use.

Opponents of the new method argue that this approach is wasteful in that a large amount of spectrum may not be used while it is being reserved. Although this view has its merits, the benefits achieved by long term planning far outweigh the inconvenience caused by reserving frequencies for future development. Safety services have realised significant benefit from this approach as it has enabled more effective planning of their radio systems and a reduction in potential interference. Although this approach has greatly improved the coordination process, it does not provide a complete solution. Many frequencies from bands not covered by a block and zone type sharing arrangement must still be coordinated individually.

6.6.2   Canada/United States frequency coordination

In Canada, demand for radio frequency spectrum has been increasing steadily since the 1980s. Faced with rising costs, increased workloads and reduced resources Canadian spectrum management staff have had to automate its activities. Automation began in the mid-70s and early 80s with the development of the Department's Assignment and Licensing Subsystem (ALS). Using the latest technology, computerized systems have automated a significant portion of the operations that were previously carried out manually.

In conjunction with the ALS another system was developed in the 1980s. This system, known as USCOORD, has been through several versions and is used to receive, update, evaluate and respond to the USA frequency coordination proposals with the help of the ALS. The present version of USCOORD is a graphical user interface, multi-user system running over the Department's local area network (LAN). It is used by technical and administrative staff to evaluate and process all terrestrial systems received from the United States of America, including fixed microwave and point-to-multipoint radio systems. USCOORD is used for processing an average of 12 000 United States' proposals annually. Response times average between 20 and 30 days, consistent with the Canada/United States agreement.

Automated coordination procedures were incorporated into the ALS in 1991 to facilitate the processing of Canadian frequency coordination proposals destined for the United States of America. In conjunction with this, an automated system called CANCOORD was developed. The present version of CANCOORD is a character based multi-user system running over the LAN. It is used to receive, update and respond to Canadian frequency coordination proposals originating from district offices across Canada. CANCOORD is used for processing an average of 7 000 Canadian proposals annually. CANCOORD provides full search and reporting capabilities and has automated every aspect of the coordination process.

The automation of frequency coordination has been a cooperative effort between the Administrations of Canada and the United States of America resulting in the transition to the present systems and EDE from the paper-based processes. The objectives for the transition were to:

–   establish a common file format;

–   standardise data fields and nomenclature;

–   automate data validation;

–   improve message tracking;

–   permit the use of automated data transfer.

File naming conventions, transmission methods, data structures and formats are examples of areas where agreement was reached. During the development of CANCOORD and USCOORD, Canada and the United States of America established automation strategies for the future. Refinement of systems in an environment of cooperation continues today.

This automation and the cooperation between the countries has increased the efficiency of the frequency coordination process which has improved the service to client, reduced coordination response times and the workload backlog.

6.6.3   Coordination/notification with the ITU

As a result of our bilateral coordination agreements (see Note 1), the volume of frequency assignment notifications is relatively small, but the procedures involved are quite complex requiring considerable experience before the notification officer can become proficient. Over the years an automated system has been developed which simplifies the notification procedures; reduces data input; and permits automated data conversion and validation and archiving. This system is known as the Frequency Notification System (FNS).

NOTE 1 – Bilateral agreements exist with Denmark, France and the United States of America.

The FNS operates in a manner similar to the CANCOORD system in that a download file is created from information extracted from the ALS licensing data as possible cases for notification. This file is loaded into the FNS where the data is manipulated and additional information is added to complete the ITU notification form.

An upgrade of the FNS was recently completed and commissioned. This new version brings in added functionality and significantly more features, and employs table structures identical to those used in the ITU's LFL/WIC-on-diskette program, thus conforming to the BR's requirements for permitting electronic notification of terrestrial frequency assignments (refer to BR Circular letter CR/26 of 9 September, 1994).

6.6.4   Overview of the automated Canadian international frequency coordination system

The intent of this overview is to provide a more detailed explanation of the automated Canadian international frequency coordination system (CANCOORD) and its associated processes. Figures 1 and 2 provide graphical representations of the data flow within the coordination process.

CANCOORD

District offices on-line data entry

Assignment licensing system
ALS super server

CANCOORD

U.S.A.:

Federal Communications Commission
National Telecommunications Information Administration
Federal Aviation Administration
Joint Chiefs of Staff
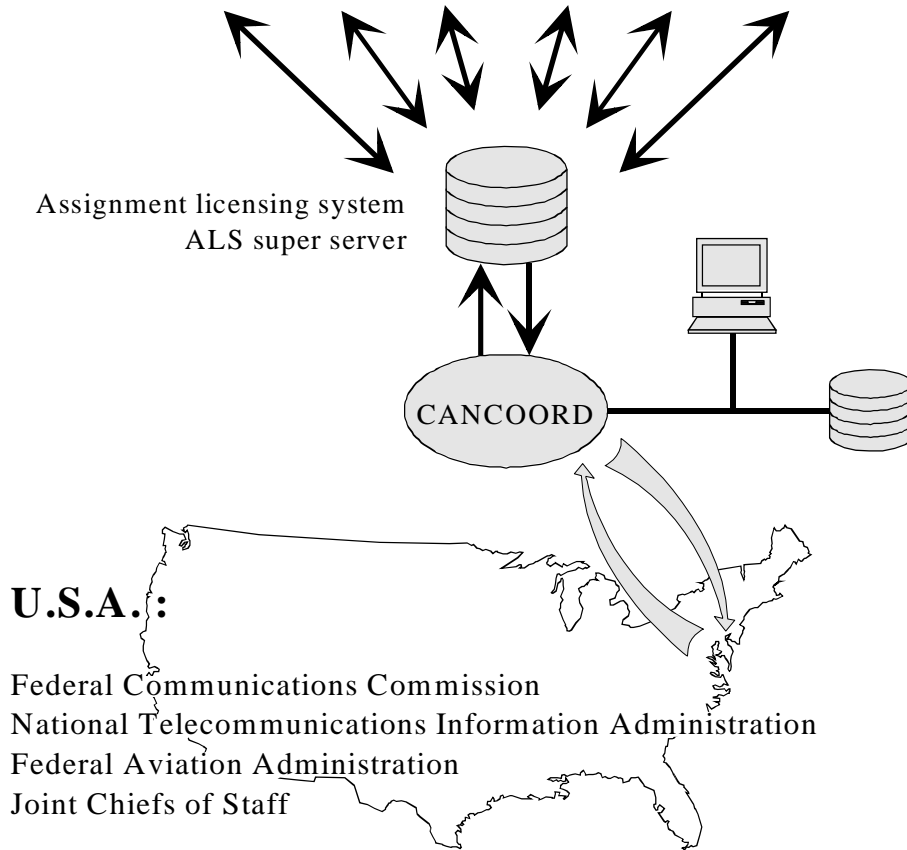
0668-01

Frequency coordination refers to the exchange of information between Canada and the United States of America pertaining to radio frequency assignments proposed for use by radio stations located within specific geographical areas along the Canada/United States border. These stations need to be coordinated to help prevent radio interference which may be caused to existing stations, or conversely to ensure that interference is not caused to the proposed station from an existing station in the other country. In the case of CANCOORD, it has enabled the automation of virtually all processes associated with Canadian frequency coordination proposals to the United States of America. This has resulted in considerable time and other resource savings while significantly improving service to our clients.

CANCOORD COMMUNICATIONS

0668-02

Within Industry Canada (a department of the Canadian Federal Government responsible for international frequency coordination) the frequency coordination process begins at the District Office level. (In Canada, spectrum licensing functions have been decentralised and are now performed at its District Offices.) Data pertinent to each station is manually entered at the district office using the On-Line Data Entry (OLDE) system. (OLDE is a stand alone PC-based program used to capture all licensing data from the radio station licence application.) Each evening this information is formatted and through the use of a LAN/WAN and dedicated phone lines, is transmitted to the Department's centralised database and placed into the ALS where all licensing information is maintained.

At the ALS a validation program called INTCOORD extracts information from those licence applications marked for coordination with the United States of America. It validates and processes the data in these applications and produces an ASCII text file and validation report. The report that is generated from INTCOORD contains the validation and

processing results for each application marked for coordination. If critical information is missing, it is rejected by the ALS and an appropriate report is also sent to the originating District Office. Any errors found during validation must be corrected by the district office and resubmitted for coordination before further processing can take place.

The ASCII file generated by INTCOORD is uploaded into CANCOORD. It is further validated by CANCOORD and the data is reformatted to produce coordination proposals to be electronically transmitted to the United States of America.

When the United States of America has completed its evaluation of Canadian frequency coordination proposals they transmit an ASCII file of their replies to Industry Canada. These reply files are then processed by CANCOORD with a corresponding message being sent automatically to update the ALS database records and to inform district office staff of the coordination replies. Electronic coordination proposal and reply files are archived as a permanent record in CANCOORD. Figure 3 provides a graphical representation of the data flow within the Canadian coordination system.

FIGURE 3

Overview of the Canadian coordination system
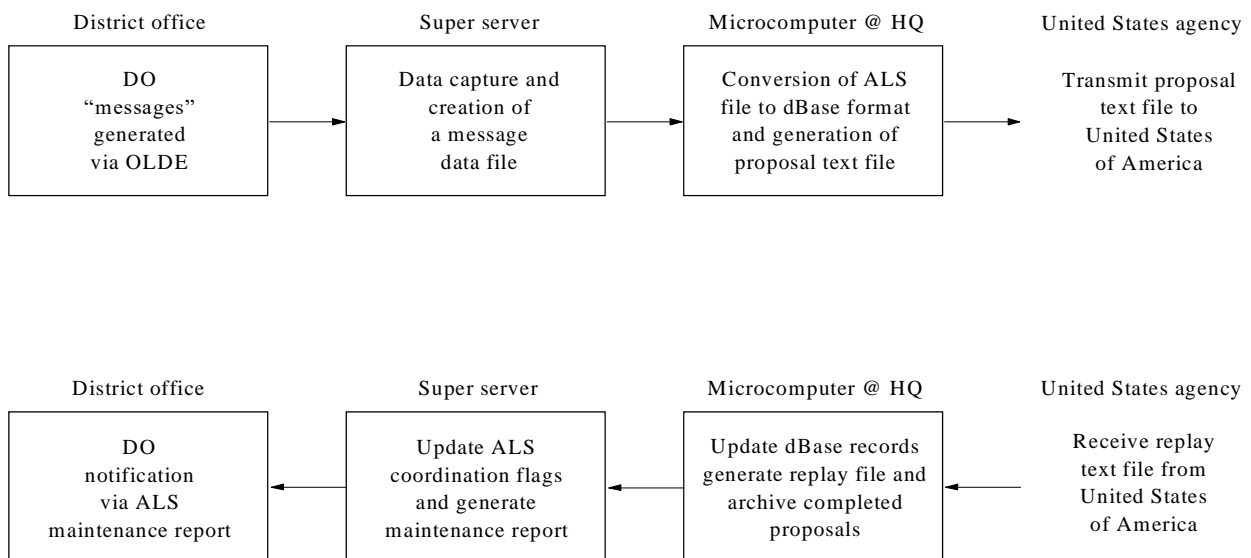
0668-03

6.7   Case Study 6 – Data exchange within the Vienna Agreement (see Note 1)

The Vienna Agreement (VA) was first signed in 1986 by six European countries. Its aim was to harmonize the procedures used for coordination, measurement and calculation of harmful interference for the fixed and land mobile services within the agreed bands and are obligatory for all signatories. In 1993 this agreement was revised and the number of signatories is now 14.

NOTE 1 – The Vienna Agreement (VA-93) is an agreement between several European countries on the coordination of frequencies between 29.7 and 960 MHz for fixed and land mobile services.

The need to harmonize became necessary because of the need to coordinate many fixed and land mobile services with neighbouring countries and the increasing pressure on the fixed and land mobile services spectrum through the rapid development of these services caused by the:

–   addition of new frequency bands;

–   use of a variety of modulation methods;

–   use of compatibility calculations which were difficult to define and did not take into account the different geographical scenarios on the propagation path.

The original signatories to the VA recognised however that harmonization of the procedures was not sufficient and that if the information was to be exchanged then there needed to be an agreed format. A data format was subsequently developed and became part of the VA-93. Due to the variety of different transmission media, the VA-93 has also standardized on the use of specific specifications for magnetic media and file structure.

Standard magnetic tape   (9-track-tape, ½ in reel)

–   no label,

–   density 1 600 BPI,

–   IBM-PC 8-bit ASCII character code,

–   fixed length of data record,

–   fixed block length.

   The data records of the data entries are combined in blocks, each one consisting of 10 data records. This yields a block length of 10 times the size of a record, and the data record size is fixed. The number of transmittable files is only limited by the storage capacity of the tape.

MS DOS diskette   (3½-in diskette)

–   MS-DOS format,

–   IBM-PC 8-bit ASCII character code,

–   fixed length of data record.

   Unlike magnetic tape the data records are not combined in data blocks but the size of a data record remains the same. The number of transmittable files is again only limited by the diskettes storage capacity.

Under the provisions of the VA-93 each signatory country has to exchange their frequency registers for the agreed service and bands twice a year. These registers have to be stored on magnetic media (magnetic tape or diskette). Coordination requests between the signatory countries, answers to coordination requests or notifications may also be stored on magnetic media, although the information may also be exchanged in hard copy form or by a direct data link (modem or via a backbone network such as the Internet). During the coordination procedure the data to be exchanged includes the following:

–   new entries,

–   modifications,

–   deletions,

–   answers.

To avoid variations in the results of calculations when performed by the different signatory countries, the same topographical data (border lines and land height) needs to be used. Because of the difficulty with acquiring a topographical database covering many countries, the VA-93 developed a format for exchanging topographical data. This format is used to exchange the national topographical data to all the signatories of the VA-93. The exchange of topographical data has led to the combination of the data, within each signatory country into a harmonized database containing their own and their neighbouring countries topographical data. This can be used by the harmonized calculation method program (HCM) which was also developed within the VA-93.

In accordance with RR Article 7 the VA-93 has been formally notified to the ITU. Further information on the VA-93 can be obtained from the Austrian Administration. The HCM program is listed in the software catalogue of the ITU.

ATTACHMENT 1

International definitions and standards

The following list contains some of the definitions and standards that may be used when exchanging data electronically and indicates the range available.

1 Definition of data to be exchanged

ITU RR,

Preface to the IFL,

VA-93 (14 European countries)

Canada – United States of America Coordination Agreement (1962).

2 Data structure standards

BR Circular letter CR/26 defines the data structures to be used for communicating terrestrial frequency notifications electronically with the BR.

Regional Coordination Agreements may either adopt the structure used by the ITU, or a structure based on the terms of their agreement.

3 Transfer standards

The following transfer standards are typical examples of different systems and methods. Readers intending to use them would be advised to first obtain an abstract to ensure that the standard is appropriate to their needs.

– File structure and labelling for magnetic tapes (ISO 1001:1986)

– File structure and labelling for flexible disk cartridges (ISO 7665:1983)

– Specification for a data descriptive file (ISO 8211:1985)

– Data element and interchange formats (ISO 8601:1988)

– Electronic data interchange – EDIFACT (ISO 9735:1988)

– Open systems interconnection (ISO 8571:1988 many parts)

– Text and office systems architecture and interchange format (ISO 8613:1989 many parts)

– Telecommunications and information exchange between systems (ISO/IEC 8885:1991)

– Text interchange systems (ISO/IEC 10021-4:1990)

– Simple file transfer service (ISO/IEC ISP 10607-3:1990).

ATTACHMENT 2

Critical role of data dictionaries

1 Introduction

National spectrum management databases can contain a wide variety of data utilising a multitude of physical formats (e.g. LFL, WIC, APs and VA-93). The format used will depend on the data to be exchanged and the requirements and identities of the sender and recipient. The difficulties of dealing with multiple file formats is compounded by variations in definition of the data elements. Administrations therefore need to agree the meaning of the data and how it will be structured when exchanged.

2   What is a data dictionary?

The data dictionary is a repository that describes the data used by an administration and how that data is physically represented. An individual item of data is known as a data element. The data dictionary records information about each data element such as its name, definition, type and size. There are many data dictionaries on the market, both computer and paper based. Each dictionary uses its own preferred method for representing the data elements. These methods are commonly founded on the Entities and their relationships or one of the many object oriented techniques. A data dictionary commonly consists of at least two layers; one layer to represent the information requirements (a rigorous definition of the information used by administrations written in a natural language), one layer to represent the many physical data structures (typically a terse definition of the data needed by computers). There are numerous standards for the physical data structures, such as the BR Circular letter CR/26 which covers terrestrial frequency notification.

3   Choosing a technique

There are many techniques for modelling data and each have their own strengths and weaknesses. No single technique will perfectly match any individual administration's requirements and it may therefore be necessary to devise your own technique bearing in mind:

a)   *the benefits of existing techniques*:

–   available off the shelf,

–   skilled people readily available,

–   tried and tested in specific areas,

–   better than nothing at all,

–   supported by electronic data dictionaries and standard development tools,

b)   *the benefits of a devised or hybrid technique*:

–   can be designed to match the administration's requirements exactly,

–   need only cover the essentials.

4   How should the dictionary be structured?

Irrespective of the technique chosen to model the administration's information requirements, there exists a fundamental structure that should be evident in any data dictionary. The data dictionary should hold the conceptual model of the data (the information model) as well as the physical models of the data and most importantly it should include a cross reference between them.

The conceptual and physical models distinguish the what from the how. The conceptual data requirements will change infrequently but the physical structures will change as new technology becomes available and may even take on many forms at one time depending on with whom the data is being exchanged (Fig. 4).

5   How is the data dictionary used?

The conceptual model describes the data using terminology that the administrations understand and utilises a standard technique for representing the data. This provides a common language that can be agreed between administrations prior to any data exchange mechanism being implemented. The conceptual data model can therefore be seen as a common structure through which all physical data can be understood, managed and exchanged.

6   The cross reference

Each data element in the physical model would be cross-referenced back to the conceptual data elements from which it was derived. This enables one physical data model to change without affecting any other model.

FIGURE 4

Data dictionary structure
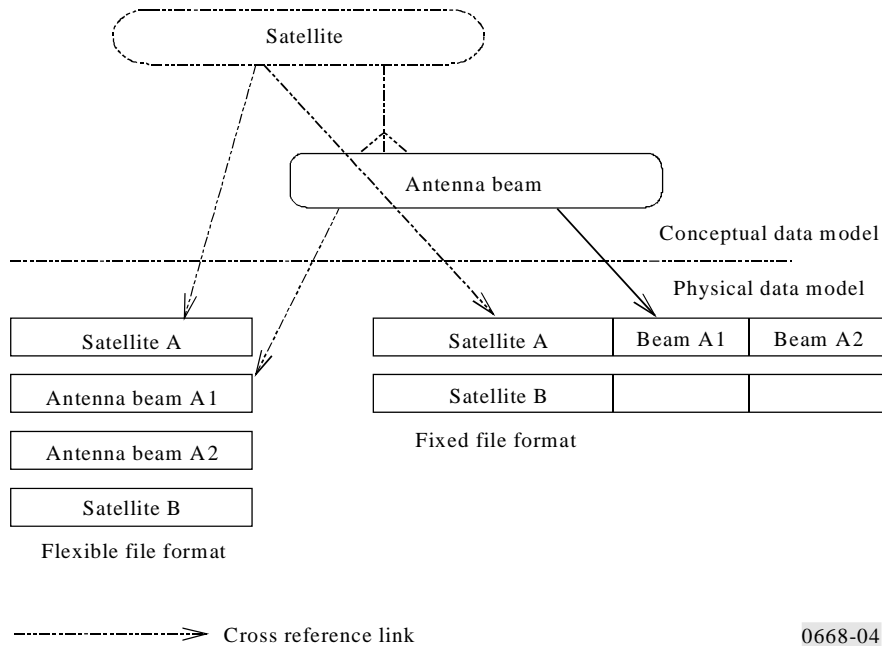
ATTACHMENT 3

Topographic data

1 Topographic data files

Data may be stored in files in raster or vector form and may contain information on elevation (land height) or morphology (clutter). Topographic databases typically involve large volumes of data and have the complications of commercial and military availability, differing projection systems, and disparate land usage classification. The technical difficulties of standardisation can be overcome, and the question of availability will improve with time. Data is normally organised in rectangular arrays, sometimes termed 'gridded data'. This Attachment does not discuss conventional maps held in digital form. These are typically used in geographical information systems (GISs) to plot screen maps for general location, but are not normally used for propagation computations. The ideal would be the availability of a world-wide database available at moderate costs to a consistent standard and format. A more practicable objective might be a standard for exchanging path profiles.

2 Geographical projection systems

Geographical projection is an additional complication in topographic data systems. A latitude longitude coordinate system can be used anywhere round the globe but various standards are in place which are not necessarily compatible. (The only worldwide standard is the World Geodetic System 1984 (WGS '84)). Latitude/longitude systems are more difficult to use than a coordinate system which approximates to rectangular over a restricted area. Many countries have rectangular national grids, and topographic data from such a country will often be supplied with reference to it. This is convenient for fairly short paths within that area, where a straight line in the rectangular grid is a sufficiently accurate approximation to a great-circle path. To assemble an international profile from more than one such database, however, requires projection conversion, and therefore latitude/longitude is normally used.

Geographical projection systems should not be confused with file formats for topographic data. Data can be stored in regular two-dimensional arrays for both rectangular and latitude/longitude projections. It is normal, in either case, to employ arrays of limited size for contiguous rectangular geographical areas (rectangular in the coordinate system used)

called 'tiles' in United Kingdom terminology. In the case of latitude/longitude, the longitude resolution may be changed according to latitude, but this can readily be handled by an appropriate format. Thus any type of gridded data can be stored in a common file format, although the interpretation of the data will depend on the cross-reference to the conversions procedures.

3   Transfer standards for topographic databases

Topographic databases are large, typically hundreds of Mbytes, and spectrum management tools frequently require intensive access. For these reasons compact binary run-time formats are usually used, optimised for the application in question. This makes it highly unlikely that the form in which topographic data is normally used will be suitable for transfer. Thus there is an argument that a transfer standard is particularly necessary for topographic data. On the other hand, topographic data is not usually exchanged in bulk very often, and although databases tend to be large, they are usually also very systematic. Thus for the occasional acquisition it is practicable, and often necessary, to write a software utility to convert incoming data to the form required.

Technically it would be easy to devise a compact transfer standard for gridded topographic data; but getting agreement on it would probably be difficult. A list of codes for geographical projection systems would be needed, but procedures for projection conversion could be outside the scope of the standard. A particularly intractable issue is that of land usage classification. Different classifications are used by different sources, and even where names coincide, such as 'urban', there is no assurance that 'urban' on one database will represent the same type of environment as 'urban' in another. Recommendation ITU-R P.1058 addresses this issue.

4   Transfer standards for terrain profiles

Exchanging topographic data for a single radio path is more likely to be a routine requirement in spectrum management, although the widespread availability of reliable topographic databases would make this less necessary. Transferring a terrain profile involves much less data than a topographic map covering an extended area, and it would be easier to agree a standard. A flexible exchange format would be particularly advantageous, since for some purposes ancillary data on the terminals would be needed, such as location, name, radiated power, etc., whereas in other situations such information could be superfluous or unavailable. If land usage categories are to be included, however, the classification problem still exists. There is also no ITU-R Recommendation for the transfer of terrain profiles.

5   Restrictions on exchanging topographic data

Most topographic data is available commercially on licence terms similar to software. Copying in any form to third parties is usually expressly forbidden. A strict interpretation of a typical licence agreement would also prevent the exchange of derived data, such as a terrain profile. Topographic data is also sometimes restricted on the grounds of military sensitivity. These restrictions should become less significant with the development of automatic methods for acquiring topographic data and a fall in prices. With widespread availability the military sensitivity should also decrease. At present, however, these are serious issues.

ATTACHMENT 4

Graphics

1   Introduction

The main requirement for graphical data in notification and coordination is in the exchange of satellite antenna footprints, elevation angle contours and antenna patterns. This data is generally exchanged in paper form, but the introduction of electronic notification of satellite systems will increase administration's awareness of graphical representation of data. There are many uses for graphics facilities and these facilities are frequently very powerful, offering considerable advantages in terms of data analysis. This Attachment therefore provides information on the uses and potential of graphics facilities, based on their benefit to spectrum management although it is recognised that for the immediate future graphical data will probably continue to be exchanged in paper form.

2   Graphical presentation

Graphics are commonly integrated into strategic applications. They have been used for many years as a means for presenting complex data as an aid to interpretation. They can for example be used to represent digital terrain models, volumetric visualisation, image display, animation, world projections, geographical information, etc. Common users of graphics are scientists, engineers, researchers and mathematicians who use large amounts of data and/or very large data sets for analysing, exploring, simulation and solving both technical and mathematical problems.

Modern visualisation packages now provide some specialised features which have resulted from the requests of technical professions over the years. Some of the more powerful features provided in graphical development environments now include generating publication-quality graphics and performing visual data analysis. They also offer impressive advantages which include productivity increases over traditional programming languages and better means for visual communication. As computer users are increasingly requiring more data to be exchanged across different hardware environments, many of the graphical computing environments offer portability between UNIX and PC based products with updates now available for electronic distribution via FTP and across backbone networks such as the Internet. In fact many software packages now permit *objects (including graphs)* that are created in other packages to be included. For example Microsoft Word (v6) supports both linking and embedding features. The main difference is where the data is stored. Embedded objects become part of the Word document itself while linked objects are stored in a source file. Typical objects can be polar plots, splines, bar charts, pie charts, filled area charts, box plots, bode plots, antenna radiation patterns, satellite antenna gain contours, path profiles, etc.

In radiocommunications and spectrum management there are numerous applications for graphical data. These may range from simple bar and pie charts, say showing major occupiers of spectrum in specific frequency bands, 2-dimensional (2-D) plots of radio path profiles, receiver filter characteristics, mapping applications or trends in major licence groups, to 3-dimensional (3-D) plots which may be used to determine natural site shielding from terrain around an earth station. A particular example of graphics use is in the capture of satellite downlink beam information, published in the BR WICs. In some countries these footprints are currently captured using a hand digitiser so as to perform interference assessment to protect Earth stations. This data could benefit administrations if it was distributed electronically so that it could be directly captured with minimal human intervention, eliminating data capture error and improving the turnaround times for agreement with affected parties.

3   Image reproduction

An image may be in one of two forms either vector or raster. Vector map images are always structured and consist of a minimum two layers for at least geometric data and attribute data. Together these define the position and descriptive characteristic of a feature, e.g. the user can create the objects such as roads, woodland, water features and buildings. Unlike raster maps, vector maps allow intelligent spatial queries and analysis of the data to be performed, and/or links to separate information databases. This enables applications to perform route planning, network analysis, etc. Vector images can also be scaled both up and down and their size is only limited by the precision of the original data in the database. A raster map image is a grid of pixels with a colour value assigned to each pixel. The raster maps usually show every detail from roads and footpaths to woods, water features, buildings, terrain contours and coastal outlines. Raster data can be provided in the following formats e.g. TIFF, BMP, GIF. Raster images are effectively fixed, scaling them up or down in size results in a degraded image.

4   Visual data analysis

Visual data analysis (VDA) permits powerful graphics tools to be used to enhance data interactively. VDA offer powerful techniques and toolsets, like surface rendering, pseudo colour (using colour to enhance analysis), light sources, wireframe modelling, surface shading and more. They allow 2-D, 3-D, 4-D or even 5-D tools to give a better insight into large data sets more quickly. The tools may also allow visual communication across a multi-user computer system, thus sharing information, while creating a visual display showing how data is changed by various transformations. Hence more complex data can be understood by picturing data as it is affected rather than by studying pages of computer code. VDA environments lend themselves to solving technical problems that require the application of graphics and mathematical and statistical analysis to data and equations. The software provides functions for importing, exporting, analysing, visualising, and communicating data and graphics.

People who use graphics want to interactively visualise and analyse large amounts of data. They usually need to quickly and easily create robust graphical and numerical analysis applications. They require an environment which permits the integration of custom algorithms and support traditional programming languages such as FORTRAN and C. It is also becoming essential to exchange data and therefore the tools and data should be portable across all major operating systems.

VDA is applied for example to test engineering, remote sensing, earth sciences, radio engineering, terrain modelling, natural site-shielding, systems design, signal processing etc. Most VDA packages now claim to support International

Mathematical Statistical Libraries (IMSL) Graphics Exponent. This is aimed at making application program interfacing easier from either FORTRAN, C or X. Functionality is supported for different plot types and attributes are provided to cater for modifying different plot characteristics. With quick customisation and data manipulation and support for popular graphics accelerators, graphical data exchange can be quick and simple without the need to re-enter the data for different analysis packages.

5   Geographical information system (GIS)

GISs were originally designed to address environmental problems. But they can be flexible enough to accommodate specialised application packages such as support of radiocommunications planning. They usually offer 2-D geographic information representation but some additionally offer 3-D capabilities.

GIS facilities include mechanisms for the storage and retrieval of the geographical and associated data, database maintenance tools and drivers for printers and plotters. The geographical data is usually stored as digital information, although some of the earlier GIS used analogue signals from mapping information stored on 12 in laser disk. The storage media is very much influenced by cost and with hard disk prices dropping over recent years it has been more cost effective to use this type of device. Digital information also has the advantage that the geographical database can be layered to permit the user to perform intelligent spatial queries and analysis of the data. In this form it is referred as a 'structured vector database', while without intelligence the database is referred to as 'raster' or simple.

Usually custom specific data, such as transmitter sites or coverage areas, are stored as digital overlays and can be superimposed on the geographical data in real time. GISs manipulate maps and diagrams and select essential information rapidly. They are designed to be used by the novice or experienced operator with menu operation and/or touch screen and have gazetteers to enhance local knowledge for the operator. Some have sophisticated modelling packages which further customise the GIS to a particular application e.g., network coverage for broadcasting services, path profiles between desired locations, visualisation of the horizon. Current trends in radio planning link GIS with digital terrain models (DTM) and VDA to superimpose maps over terrain, or *vice versa*, while running propagation models to determine areas of interference, the results of which can be again overlaid over the GIS/DTM projection.

6   Definition of boundaries

A possible source of a digitised world data map is the ITU's IDWM. This contains databases for geographical (coastlines, seas, islands, lakes), political (countries' borders and regions' boundaries), meteorological (rain climatic zones) and technical information (ground conductivity areas, noise zones, allotment areas). However the IDWM's resolution is only 5 km which is too large for some services.

The ITU's catalogue of software for radio spectrum management shows that the IDWM is provided in two main parts; the IDWM database and the subroutines and link libraries. The IDWM is usually incorporated into the administration's radio coordination planning tools, for example, for satellite gain contours, elevation angles and spot beam coverage can be superimposed. In more developed applications the software tools can be integrated into the GIS and/or VDA allowing the user to pan and zoom areas of the earth, switch on and off the databases (including IDWM databases), warping data to fit projections e.g. global elevation data fitted around a sinusoidal projection of the Earth.

ATTACHMENT 5

Database files

1   Introduction

Database files are used to store a variety of information, e.g. technical data, terrain data, digital maps, accounting information, assignment and licensing data, in a structured format. The data is stored in a structured format to allow it to be manipulated by a computer program thus creating new information from existing data e.g. the amount of free spectrum in a specific band would be calculated from knowing which parts of that band were occupied. The format used to store the data affects the process required to exchange that data. Typically, to move data from one database file to another requires a program capable of extracting the data, converting it into an universal format and then inserting it into the target database file structure.

2   Open and proprietary formats

Database file formats can be classified into three groups based on their degree of openness:

2.1   Proprietary application-specific formats

Some data such as digital maps and satellite footprint diagrams are stored in proprietary (sometimes bespoke) application specific formats. These formats are typically used where a level of performance is required that could not be achieved with formats designed to be independent of any given application, or where the application system was developed some time ago before generalised database packages were commercially available. To exchange data using these formats is not common as it is unlikely that two administrations would have the same software. It is almost always necessary to convert the data into another format (typically an open format) before effective exchange can be achieved.

2.2   Proprietary vendor-specific formats

There are many commercially available, widely used, proprietary database formats. Almost every software house has its own file format that uses a proprietary database management system (DBMS) to describe, access and manipulate the data. Some of them have the ability to convert data to and from other formats or even directly manipulate such data files. However, it should be noted that some conversions may lead to the loss of format information or even loss of data, for example, one database may be capable of recording a specific data element as a number with two decimal places whereas another database may not record the limitation on the number of decimal places, thus during conversion the structure of the data element may be lost. Many of the proprietary formats nowadays use the operating system's native file structure, this means that whole or partial databases can be exchanged simply by copying the files from the source machine straight to the receiving machine.

2.3   Independent or open formats

The simplest independent or open formats for database files use the ASCII character set and either fixed length or comma separated fields in the operating system's native file structure to represent the data. However, there is no prescribed method for describing the structure of these files. Some database formats have been openly published. As a consequence there have emerged many software packages to manipulate files in these formats, or at least import and export data from and to these formats. The most significant advance towards exchanging data was the advent of standard data definition, query and manipulation languages such as structured query language (SQL), which is a widely used language in modern relational database management systems. SQL provides a standard language for describing and accessing data irrespective of the physical structure of the files that hold that data, allowing the easy exchange of data between organisations equipped with SQL compatible software.

Independent (open) data access methods e.g. open database connectivity (ODBC) is a standardised method of data access in a client-server environment. Some leading PC-oriented software vendors have developed and published database access interfaces. Any DBMS vendor can develop and supply appropriate software complying with this openly published specification. This software appropriately used, acts as a gateway to the proprietary database enabling data retrievals and updates. ODBC and any other (*de facto*) standard of this kind may be regarded as a common means of directly interpreting SQL statements and applying them to a specific database format. ODBC may serve as a convenient tool for building simple client-server application systems (although not very fast ones). It also allows users to access remote data independently of the format in which the data is stored.

ATTACHMENT 6

Word-processing files

1   Introduction

Word-processing text files are used for licensing, accounts, technical data sheets, spectrum management reports and recommendations relating to international organisations. It is possible to exchange documents in a number of format types.

2   Proprietary document formats

There are a number of word processor packages currently in use in international fora. The relatively rapid rate of development of these word processor packages makes it important to specify version numbers to ensure full compatibility, although nearly all have conversion facilities for documents created in earlier versions. Most word processor packages now also have facilities for converting documents that have been produced using other mainstream word processors. The facilities and features provided by word processor packages can vary considerably from one software house to another, this can cause problems in use, particularly where word processing packages have different methods of achieving the same presentational effects. If documents are to be shared for the purpose of developing and editing texts, as opposed to simply exchanging data, it may be easier for all the parties involved to standardise on the use of a single version of one word processing package.

The main advantage of using proprietary formats is that a greater range of formatting options can be used. The main disadvantage of proprietary formats is that the files tend to be larger which may increase the cost of transfer.

3   Independent document formats

Rich text format (RTF) and document interchange format (DIF), are two examples of independent document formats. Some are public domain standards and for others the IPR rests with the originating company, but the owners allow its free use. The completeness of conversion between formats depends on the formats involved. Some document formats include font and embedded graphic information, others include bold, underline, italics and possibly margin settings.

a)   These are some of the advantages of using independent formats:

–   as with the proprietary document formats, they are ready-made standards;

–   some document formats are quite comprehensive;

–   some document formatting is preserved on conversion.

b)   Some of the disadvantages are:

–   not all word processors recognise every independent document format;

–   some document formats are not very comprehensive.

ATTACHMENT 7

System security

1   Introduction

System security means the implementation of measures aimed at protecting the complete computer system covering the hardware, software (both operating system and application software) and data from threats (both deliberate or accidental) identified through a formal risk analysis exercise. Ideally the countermeasures will be appropriate to, and commensurate with, the risk.

When data is considered "classified" based upon the national security standards of a country, the only way to ensure that the data is not compromised is to never allow that computer or network to be connected via wire or modem to any other unsecured computer or network.

For all computer systems a security risk analysis of the system and any proposed changes to an existing system should be carried out by the IT Security Team (staff with experience in computer and communication systems security and procedures) on behalf of the data provider. They should use an approved method to ascertain the value and sensitivity of the data and any risks, vulnerabilities and threats that might exist. Appropriate countermeasures should then be installed to safeguard the system. Any risk analysis exercise should address the confidentiality, integrity and availability of the hardware, software and data.

2 Confidentiality

2.1 Use of the public switched telephone network (PSTN)

The risk of disclosure of data is significantly increased if use is to be made of the PSTN for WAN links.

2.2 Local area networks (LANs)

The physical structure and type of any LAN links is important e.g. if cables travel outside authorised buildings they become easier to tap into and cables other than fibre optic may radiate, enabling the emissions to be read by unauthorised persons.

2.3 Remote access

If remote dial up access is required appropriate safeguards should be instituted to ensure only authorised users have access and that this access is secure e.g. dial-back modems, dedicated line.

2.4 Backbone networks

The transmission of sensitive data over backbone networks such as the Internet is not advised. However if sensitive data is required to be transmitted then appropriate security measures (e.g. encryption) must be put in place prior to any transmission.

In computer systems that operate as communication servers, software is available to deny access to directories and services other than those available to the general users, or to separate users internal and external to the organisation. This software is known as a "firewall". It should be noted that a firewall system alone does not provide adequate protection and should be regarded as only one part of a comprehensive set of security measures.

2.5 Password access control

Login names and passwords are commonly used to control user access to systems or files. Passwords should be at least 6 characters long and comprise alpha and numeric characters, avoiding obvious formats such as proper names, initials, birth-dates, dictionary words, etc.

This type of security alone should not be considered sufficient to protect classified or sensitive data.

2.6 Location of hardware

Depending on the sensitivity of the data some hardware may need to be kept in a secure location in order to avoid unauthorised persons gaining access to it.

3 Integrity

3.1 File transfer

File transfer protocols with an appropriate error checking facility should be used. The protocol must include address authentication facilities.

3.2 Computer viruses

The risk of receiving or sending viruses needs to be minimised. Computer viruses can attack the data, the application software and the computer's operating system. The extent of damage caused can range from trivial to extremely serious. A virus can travel on any medium (diskette, CD-ROM, tape, etc.) in both data and program files, in packed or unpacked form.

All of these points, together with the nature of the system configuration (e.g. stand-alone PCs, networks), should be taken into account when defining anti-virus procedures.

3.3 Security audit logs

System auditing should be the responsibility of a named and trusted individual or group. Ideally this individual or group would be outside the computer system users' own direct management structure.

4   Availability

4.1   File transfer

Only tried and reliable file transfer protocols should be used.

4.2   Resilience

The resilience of any associated hardware and software should be ensured e.g. networks, power supply, operating systems, file transfer protocols.

4.3   Backup and contingency

To ensure that a computer system can be restored in the event of a partial or complete failure of the software or hardware it is usual to develop a disaster recovery policy. This policy would determine the frequency of backups, their location, availability of replacement hardware and of essential staff. Irrespective of the extent of an administration's disaster recovery plan, it is essential that adequate backup and contingency facilities should be maintained so that the system can be restored easily if it should fail. For a communications link these may also include alternative communication lines, message buffering etc. It is also extremely important that regular backups of data files be made so that the files may be reloaded if they are corrupted in any way.

4.4   Location and hardware security

Hardware should be kept in a secure location to minimise the possibility of accidental or deliberate damage and to discourage the theft of either complete items or high value components (e.g. memory or processor chips) the hardware might also be physically branded or, fitted with movement detection devices.

5   Preventative measures (i.e. specific recommendations that result from a risk analysis exercise)

The preventative measures used should be appropriate to the perceived threat to the computer system. These measures could range from complex and expensive to simple and cost effective. For example with electronic exchange by diskette, "threats" include inaccurate data, physical damage to the diskette and computer viruses. Inaccurate data could result in the formulation of inaccurate decisions and/or waste staff time. Damage to the diskette could prevent the files it contains from being extracted. The introduction of a virus into a recipient computer system could lead to anything from a slight inconvenience to major disruption of work. Appropriate preventitive measures would therefore include:

–   some manual or computer based data validation exercise - the extent of which would depend on the "value" placed on the data;

–   a container to prevent physical damage to the diskette;

–   virus protection software.

In terms of the latter, users should be aware of the need to keep virus protection software up to date.

ATTACHMENT 8

Transport methods

Technical details

1   Introduction

This Attachment is an expansion of § 3 of Annex 1. Various methods can be used for transporting data between organizations. For each method, the spectrum manager can carry out a cost-benefit analysis (CBA). A CBA allows a careful analysis of the factors specific to the set of requirements that need to be satisfied. The information provided in this Attachment will be useful in performing this analysis.

2   Surface mail and storage media

Production costs, postage costs, volume of data, and ease of transfer to the recipient system are some of the considerations when determining the type of media that is to be transferred.

2.1   Diskettes

Diskettes provide a low-volume and inexpensive magnetic media for transporting data. There are two common sizes available – 3.5 in and 5.25 in. The maximum capacity of a 3.5 in disk is 1.44 Mbytes and the maximum capacity of a 5.25 in disk is 1.2 Mbytes. Both media are rugged and are not easily damaged when shipped by surface mail.

2.2   Tapes

There are two types of magnetic tape media: reel-to-reel and cartridge. Nine track, 1 600 bits per inch (BPI), ASCII is a standard format for a reel-to-reel tape. There are tape drives capable of reading and writing at a density of 6 250 BPI. The nine track tapes can range up to a length of 2 400 ft. These tape drives are commonly found on mainframe and minicomputer systems, but are typically not found on personal computer (PC) systems. Reel-to-reel tape drives are expensive. Cartridge tapes do not have a standard format and any exchange of cartridge tapes will require close coordination to verify that on the recipient system, the format of the data and the tape reader are completely compatible with the sender's tape system. Cartridge tapes are typically much smaller in size than reel-to-reel tapes; however, they usually can store considerably more data than a reel-to-reel tape. A 2 400 ft reel-to-reel tape can hold approximately 10 Mbytes of data. Some cartridge tapes can hold up to 25 Gbytes of data. The price of cartridge tape systems is considerably cheaper than reel-to-reel tape systems.

2.3   Compact disc read-only memory (CD-ROM)

CD-ROMs provide a high-density media to transfer data. Capacities are approximately 600 Mbytes. A CD-ROM is a "write once – read many" media. A commercial CD-ROM is produced by taking data, usually on magnetic tape, and making a master CD-ROM. The master CD-ROM is used to press copies. The cost to create the master can be in the range of $2 000 US, while the cost of the copies is approximately $2 US. There are CD-ROM writers that can be attached as a peripheral to a PC that produce "one-off" CD-ROMs. These "one-off" CD-ROMs cannot be used to press additional copies. The price to produce a "one-off" CD-ROM is approximately $30 US.

3   Electronic transmission

3.1   Facsimile (FAX)

The FAX transmission of an image data file over the PSTN requires the use of a FAX modem; FAX modems currently available can operate at rates up to 28.8 kbit. When considering the use of FAX systems as a method for electronically exchanging information, the cost of the FAX/computer/modem equipment should be considered. The reliability of the hardware used, the availability of maintenance and operations support for the FAX hardware/software to be used, are also factors.

FAX machines produce a printed copy of the image data file received; the image data file is not saved. Software is, however, available which can be used on computer systems with a FAX modem to capture and store the received image data files. These image files can then be archived, used to produce printed copies, or processed by optical character recognition (OCR) software to produce a file that is recognized by standard word processors.

While most FAX machines permit a user to transmit a given message to multiple addresses, FAX systems are also available that are configured with an automated electronic document database which permits the transmission of documents in response to remote requests. These systems are known as "FAXBACK" or "FAX-on-DEMAND" systems. In order to obtain a document from these systems, a user would dial the system phone number and then, in response to certain instructions, receives the requested document.

3.2   Electronic mail (E-mail)

For any messages to be transmitted between computer systems, there must be some form of computer-to-computer connection between them. E-mail systems are implemented using numerous computers that can be connected by some type of network – a LAN, a WAN, access to the PSTN, or access to a backbone network such as the Internet. Consequently, the first question to address in considering the use of E-mail for a specific task is – can a successful message path be established with the intended recipient?

When messages and attached files are transferred between computers, the intended transfer of information is only accomplished if the recipient receives the messages and attached files with an acceptable time delay, with an acceptable bit error rate, and in a recognizable format. Factors that need to be considered in this regard include the loading (the amount of capacity used) in the medium connecting the computers, the reliability of this communications medium, and the use of common formatting standards for information exchange (see Attachment 1).

E-mail can be used for satisfying a wide range of electronic information exchange requirements, but the effectiveness of this method is limited when large files are to be transmitted. What constitutes "large" depends on the installed configuration of the specific E-mail system; some systems set a fixed limit on the maximum number of bits that are allowed to be included in an E-mail message, while other systems permit a user to send files whose size is only limited by the available memory capacity of the sender's computer. However, when either a sender's or an intended recipient's access to E-mail services is limited to the use of a "dial-in" connection over the PSTN, then the "size" of the E-mail message needs to be measured in terms of the estimated time required for the message to be transmitted using the respective modems available to the sender and/or the recipient.

3.2.1   TCP/IP addressing system

TCP/IP addressing, the system used on the Internet, consists of "names" and "domains". This address may be expressed either as a name or sets of numbers. For example, library.dartmouth.edu can also be expressed as 129.170.16.11. Each level of the address is a domain. When the network address is expressed numerically, it is called an IP (internet protocol) address.

3.2.2   X.400 E-mail system

X.400 is a mail transfer standard that can serve as a gateway protocol between different types of E-mail systems. X.400 can be thought of as a way to specify a network address. This addressing system was developed in the ex-CCITT (now known as ITU-T). X.400 addresses consist of more than a name and a domain. They are constructed from a list of attributes, allowing them to be broken down in great detail and making them much more specific than TCP/IP addresses. When the user constructs an X.400 address, the user must specify the attributes to create the entire address. Each attribute is given along with an equal sign (=) and a value; and slashes separate one attribute from the next. The following is an example of an X.400 address:

> /G=John/S=Smith/O=Whitehall/C=UK/ADMD=TELEMAIL/@sprint.com

3.2.3   X.500 directory standard

X.500 was developed to establish a simplified addressing system. X.500 is a standard developed in the International Organization for Standardization (ISO). Although until recently acceptance of the X.500 standard has been slow, E-mail systems incorporating the X.500 standard are now beginning to become available.

4   Remote data access

4.1   Bulletin Board

"Bulletin board" services are those services provided on a computer to an individual using the PSTN as the method of accessing the computer. However, bulletin board systems can be configured to be accessible over the Internet using a Telnet client. There are also programs available that allow the user to create a bulletin board. There are no standards for bulletin boards; consequently, the "look and feel" of each is different from another. Some time will be required to become familiar with the method used to interact with each bulletin board. The obvious significant costs in using a bulletin board are the long-distance telephone charges that may be incurred. Another limitation to a bulletin board is that the number of simultaneous users is limited by the number of available PSTN lines.

A bulletin board system usually consists of several layers of menus and sub-menus. The user proceeds in a hierarchical manner up and down the menus searching for items of interest. Information can be read while on-line or files can be down-loaded to the user's computer for detailed review or use. Bulletin boards can provide electronic mail services, but bulletin boards generally do not provide FTP services.

4.2   Gopher services

"Gopher" services are those services provided through the use of software that was initially developed at the University of Minnesota. This software, operating on a communications server, creates menus that allow users to access network resources by moving an on-screen pointer rather than providing operating system commands. Thus the advantage of using a gopher is that it significantly simplifies the process of accessing information that is located on communications servers interconnected by the Internet. A gopher can be used to select (point) to text files, Telnet sites, and a wide range of other data.

From a user perspective, a "gopher" server is very similar to a bulletin board server. Both offer the user options to select from a series of menus; both permit either "PSTN: dial-in" or "Internet: Telnet" access; and both permit a user to download files containing various types of information (text, graphics, executable programs, etc.). A significant difference is that most of the bulletin board software products are licensed products and are only available (for sale) from the developers; however, gopher software is available (at no cost from a number of sources) on the Internet as "shareware".

4.3 Telnet services

"Telnet" is an Internet tool that allows the user to log on to remote computers and manipulate them to retrieve data. By using a set of simple commands, the user instructs the Internet service provider's computer to make a connection with another computer somewhere else on the network. The user logs on to that machine, usually by providing a user identification name and a password. Once logged on the user can take advantage of the services offered at the remote site. The differences between dial-up services *versus* Internet Telnet services are significant. When using dial-up services the user must call each computer site in turn. When Internet Telnet service is used, entrance to the Internet is through a service provider. The Internet then provides the user access to one computer after another around the world while access through the local service provider remains intact. When the user finishes using a computer, the systems prompt is displayed and the user logs onto another computer. It is possible in this way to move around the world by means of Telnet at a rapid rate, exploring resources, checking catalogues, and gathering information.

4.4 File transfer protocol (FTP)

FTP service is the simplest method of electronic file transfer between computers. Inexpensive programs are available that operate on a wide range of computer systems. These programs have protocols of Kermit, X-Modem, Y-Modem, Z-Modem, and others that provide for accurate transfer of data. The most common file transfer service on the Internet is the FTP service. The user logs onto typically a UNIX server. A READ.ME file is often available for downloading. This READ.ME file describes the contents of the files in the directory. After determining a file of interest, the user downloads the file to their computer. Internet transmission speeds are 1.5 to 50 Mbytes/s, consequently large files can be transferred quickly. There is also the facility to upload files to a server. In all file transfers between computers, the users should check for and eliminate viruses that may corrupt the software or data on their computer. There are a number of simple commands necessary to use the FTP server. These commands are fully detailed in user's manuals. Both ASCII and binary files may be exchanged using the FTP server. The file format of the transfer is specified by one of the commands.

5 System configuration

5.1 User access to the system

When specifying a system for electronic exchange of digital information, there are two significant factors that limit the configuration of a telecommunications system: the availability of a specific service and the cost of that service.

Generally a low cost method for electronically sending limited quantities of digital information between two or more locations is to use a modem connected to the PSTN. Currently available modems can operate over standard telephone lines at rates up to 28 800 characters. This transfer is, however, improved if the modems operate on relatively noise-free lines and all the transmitting and receiving computers are using compatible communications software.

Where access is available to a LAN, a WAN, or global backbone network such as the Internet their use can be highly cost effective in transmitting data electronically to recipients anywhere within the range of the network. The hardware required may be as simple as a modem, or for more complex configurations may require high-speed communications lines with direct Internet access, bridges, routers, or gateways. Direct, broad-band access to the Internet is usually obtained through a commercial provider or a university.

The choice of operating system can be a complex issue because of the many factors to be considered. Compromises may be required when considering such factors as cost, availability of the hardware and software, ease of use, vendor support, compatibility with other users.

The IBM-PC compatible microcomputer is probably the most widely available computer. The user interface was standardized on the IBM-PC with the development of Microsoft Windows. This standard includes the use of a mouse pointing device. With the Windows interface, the user is able to run a program with little or no documentation, because every software developer complies as closely as possible to the standard. Every Windows program has the same "look and feel".

The class of programs called "Internet Browsers" provide access to the "World-Wide-Web". The "web" is a collection of information resources that are accessible over the Internet and operated through the selection of special links established by using the hypertext markup language (HTML). Free versions of these browsers are available on the Internet and commercial versions with additional features are becoming available from a growing number of vendors. These network

browsers provide access to textual, graphical, audio, and video information in a user-friendly environment. The use of these browsers for accessing textual information is feasible using modest computer facilities and a low speed modem; however, if a significant number of graphical images need to be accessed, then a high-speed computer with a direct connection to the Internet will be required to avoid extensive delays in downloading large image files.

5.2   Structure of the system

The system designer must consider both present communication requirements and the best prediction of the future communication requirements. Many countries communicate between a central site and several regional sites. Communications are required for coordination with neighbouring countries. Communications are required with the ITU for international notification. For each application the speed of communications is important. For many applications the national postal system may satisfy the users' needs. For other application, communications over the phone lines via modem may be sufficient. For high-speed, high-volume communications, a system that uses wide bandwidth communications devices may be appropriate. This service to the users which can be provided by "backbone" high-speed, wide bandwidth communications networks is dependent upon the availability of the network. The Internet is a major and growing network; however, it is not available in all countries. Other significant backbone networks are also available, but are not yet interconnected.

To evaluate the structure of the system, the nature and scope of the information to be transmitted must be evaluated. If real-time data, such as monitoring results, are transmitted, a high-speed, wide-bandwidth, communications line may be required. If daily requests for frequency assignments are transmitted, then a low-speed modem may be quite adequate. For international notification, the postal system provides sufficient speed for transmission of data. The ITU now accepts electronic notifications for the terrestrial services, and soon expects to receive electronic notifications for the space services.

ATTACHMENT 9

An example of a resource planning list

Introduction

Administrations are advised to consider the staff resources necessary for the implementation of computer and communication systems. When preparing estimates of these resources, the items in the example resource planning list should be considered against the following stages of a system's life cycle:

–   selection and initial procurement of the tool (hardware, software, and documentation),

–   installation, testing, and basic training,

–   resolution of incompatibility problems and maintenance,

–   routine operation, and advanced training,

–   planning for, and procurement of, upgrades.

1   General

–   Why is electronic information exchange being considered?

–   How is spectrum management to be improved?

–   What are the functions that comprise spectrum management operations?

–   Which specific spectrum management function(s) are to be addressed?

–   What are the deficiencies of the current operations?

–   What objectives are to be satisfied and what benefits are expected?

–   What is the time frame for implementing the planned changes?

2 User access to the system

– Will users have "dial in" access over the PSTN?

– Will users have access to a backbone network such as the "Internet"?

– Will users be constrained to using specific operating systems?

– Will users be constrained to specific terminal interfaces?

– Will users have access to "graphic user interfaces" such as "Mosaic"?

– Will different users have access to different portions of the system?

– Does the stored information need to be protected?

3 Structure of the system

– What is the geographic distribution of potential users?

– What "backbone" communications networks could provide the intended services ?

– What are the nature and scope of the required information bases ?

– What storage media will be required ?

4 Issues in system functionality

4.1 Electronic mail (E-mail) services

– Which standards are required (SMTP, X.400, X.500, etc.)?

– Will there be limitations placed on some mailing lists?

– What potential problems need to be avoided?

– Will "List Server" capabilities be available?

– Which standard coding/decoding functions will be required?

4.2 Remote data access services

– Will "bulletin board" services be required?

– Will "gopher" services be required?

4.3 File transfer services

– Which standard file transfer protocols are required?

– How are standards to be selected?

5 Issues in system operations

5.1 Data integrity

– How will the information be kept accurate and current?

– Who is responsible for reviewing the accuracy of the information data bases?

5.2 Standards compliance

– How will compliance with accepted standards be achieved?

– What can be done to make all users aware of the accepted standards?

5.3 Virus protection

– What can be done to avoid disseminating viruses?

– What is the user's role in virus protection?

5.4 Geographic information systems

– What different reference systems are required?

– Can a standard reference system be adopted for use by some or all users?

– Can translation facilities be made available when multiple reference systems need to be used?

5.5 Sources for engineering models, standards, reference works

–   What indexing system is appropriate to identify sources of information?

–   Could a World-Wide-Web browser be used to direct a user to the intended source of information?

6   Staffing and training

–   What is the nature and scope of the staffing required to operate specific systems?

–   What staff assistance is available?

–   What is the nature and scope of training required by the system operations staff?

–   Where is this training available?

ATTACHMENT 10

Basic automated spectrum management system

1   Overview

The Basic Automated Spectrum Management System (BASMS) has been developed according to Recommendation ITU-R SM.1048. BASMS is a multi-function computer program providing spectrum managers automated support for:

–   record keeping for all radio service licences and related technical and administrative information;

–   frequency assignment and interference calculations for fixed, mobile and broadcasting services above 30 MHz;

–   frequency coordination for both national and international applications;

–   recording and notifying licence fee data;

–   generating frequency licences.

BASMS is a stand alone computer system using MS-DOS. It is designed for ease of use and maintenance by a single user. Multiple copies of BASMS can be used within an administration to facilitate the performance of various spectrum management functions. Program design emphasizes those functions that are most frequently required by a spectrum manager. These functions are supported with fundamental techniques and procedures that have wide application and that are easily learned and used by support personnel who may lack formal training in spectrum management.

A block diagram showing the functional relationship between BASMS and spectrum management is given in Fig. 5. This figure indicates that BASMS can be used to support most functional requirements defined in the ITU Handbook on National Spectrum Management.

2   Capabilities

Record transactions:

–   creation of records;

–   editing/modification;

–   deletion;

–   validation;

–   inquiry.

Frequency assignment and interference calculations:

–   provides for interference calculation and frequency selection for a new assignment above 30 MHz:

    –   point-to-multipoint (broadcasting and land mobile),

    –   point-to-point (fixed services).

–   provides the following propagation models:

–   free space (Recommendation ITU-R P.525),

–   smooth Earth (Recommendation ITU-R P.526),

–   point-to-multipoint services in VHF/UHF (Recommendation ITU-R P.370).
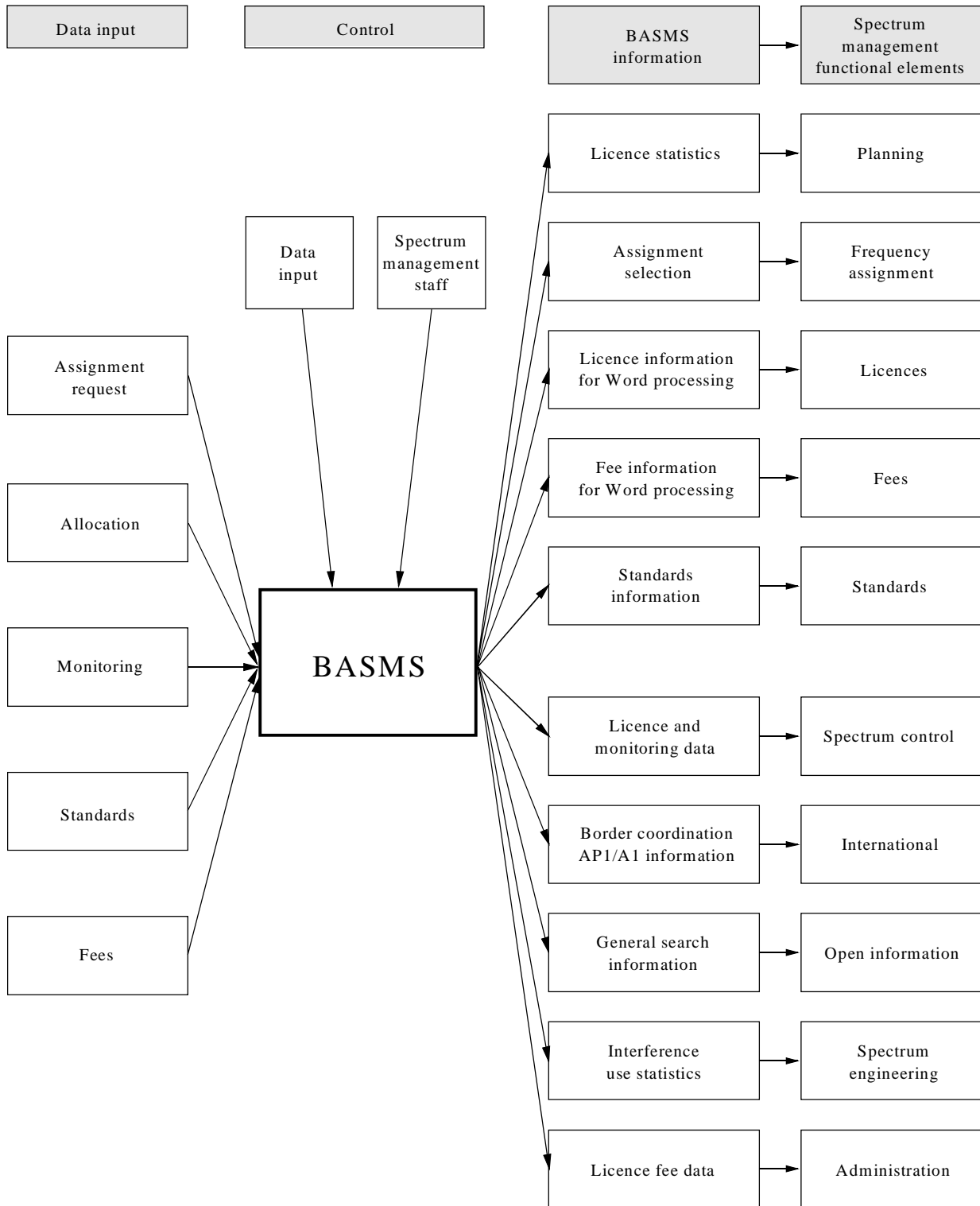
Frequency licences:

–   provides data required to produce frequency licences.

Border coordination:

–   identifies applications and stations requiring coordination.

FIGURE 5

Functional relationship between BASMS and spectrum management

0668-05

Notification to Radiocommunication Bureau:

– creates AP1/A1 form with appropriate data.

Licence fees and fee collection:

– provides data for billing and keeps status records.

Monitoring data:

– provides data to assist monitoring.

Equipment approval process:

– provides basic required data.

Report generation:

– Licence printing;

– record summary;

– record detail;

– transaction activity report;

– expiry and renewal notice.

3 Hardware requirements

BASMS requires a computer system with at least the following specifications:

– 80386 processor,

– 6 Mbytes random access memory,

– 120 Mbytes hard disk drive with a minimum of 15 Mbytes available for installation,

– math co-processor,

– 3.5 in floppy disk drive,

– VGA colour monitor,

– Hewlett Packard Laser Jet ll compatible printer (required to print AP1/A1) or a printer compatible with Epson MX printer,

– CD-ROM drive (for use with IFL disk).

BASMS will require approximately 15 Mbytes of space on your hard drive. This estimate does not include data files. Space required for data files will depend on the size of user's data files.

BASMS requires at least 580 kbytes of RAM memory below the DOS 640 kbyte level (low memory) and 6 Mbytes of total RAM, including extended memory.

GLOSSARY

APs	Appendices to the RR
ASCII	American Standard Code for Information Exchange – a numerical code used to represent letters, numerals and symbols
BR	Radiocommunication Bureau
CD-ROM	A type of data storage medium (a disk) that uses optical technology to read the data. Typically these disks are write-once read-many. Each disk can store 600 MBytes of data
CEPT	European Conference of Postal and Telecommunications Administrations
Circular letter CR/26	A circular letter from the BR addressing the introduction and operation of electronic notification for terrestrial systems
Coordination boundaries	A boundary used for the purposes of coordinating a particular service. This may be the same as the territorial boundary or it may lie inside or outside a territorial boundary and may be dependent on the service and any related international agreements

Computer virus	A software program designed to affect and possibly catastrophically damage data held on a computer system and/or the computers operating system
Data	A representation of facts, conceptions or instructions in a formalised manner suitable for communication, interpretation or processing by human beings or by automatic means
Data dictionary	A set of rigorous data definitions defined for a specific purpose
Data format	The term format explicitly applied to data and meaning the formalised manner in which the data is stored or represented
Data sharing	Exchanging data between users and, in the context of EDE, countries so that the data is for many purposes common to a number of users
DBMS	Database management system
Designator	A key character, word or phrase used to indicate the beginning or end of a specific data list
Diskette	Magnetic storage medium, commonly used to refer to the 3.5 in 1.44 MByte floppy disk
DTM	Digital terrain model
EDE	Electronic data exchange
ETSI	European Telecommunications Standards Institute
Format	A general term describing the structure or other details defining how information is stored or represented. It can be used for individual data values or for a complete data file, equally it could apply to the structure of a letter or other text document
FTP	File transfer protocol – a standard for transferring files electronically
GIS	Geographical information system
Gopher	A type of user interface whose operation is based on a client/server architecture and permits the user to select information or information sources from a displayed menu
IDWM	The ITU Digital World Map
IFL	International Frequency List published by the BR
IMSL	International Mathematics and Statistics Library
Interactivity	The degree of response and interconnection available between EDE systems
IPR	Intellectual Property Rights
Internet	A public electronic network for providing access to electronic information
ISO	International Organization for Standardization
IT	Information technology – a phrase used to describe all computer and communications systems
ITUDOC	One of the ITU's open services available in TIES
LAN	Local area network
LFL	Local frequency list

MIME	Multipurpose Internet Mail Extensions – the new (1992) Internet E-mail standard
MS-DOS	The most commonly available operating system for the IBM-PC compatible microcomputer
Natural language	A spoken language, e.g. English, French, etc.
Object oriented techniques	Any technique that utilises the principles of object theory
Path profile	The topographic data along a line around the Earth's surface between two points represented in two dimensions
Preface to the IFL	Preface to the International Frequency List, produced and distributed by the BR, it describes the data used in the notification forms
Proforma	An empty form indicating the size and structure of the data required
PSTN	Public Switched Telephone Network: the global telephone network
Q code (QTE)	Abbreviations and signals to be used in radiotelegraphy communications as listed in RR Appendices 13 and 14
Raster data	Spatially related data stored in a regular self indexing array
RDD	Radiocommunication data dictionary – a set of rigorously defined data models describing the information needed by administrations and the BR in order to communicate electronically details of radio systems
Repository	Store
Resolution	The smallest difference in value permitted by a given format. Normally only significant for a single data item. A small resolution does not necessarily mean high accuracy
RR	Radio Regulations
RTF	Rich text format
Site shielding	The use of local topographical features to reduce or eliminate, interference from or to a radio system
SQL	Structured query language
System	The computer hardware, its operating system and the data it holds
TCP/IP	The addressing system used on the Internet
TIES	Telecom Information Exchange Services provided by the ITU
Transfer standard	A file format optimised for the transfer of information, not necessarily suitable for direct use by computer applications
UNIX	An operating system used on minicomputers and larger computer systems originally developed at Bell Laboratories, United States of America
VDA	Visual data analysis
Vector data	Spatially related data where all the coordinates are given explicitly
WAN	Wide area network
WIC	Weekly Information Circular published by the BR
World-Wide-Web	A group of information resources accessible over the Internet
X.400	An E-mail transfer standard
X.500	An E-mail transfer standard with a more simplified addressing system than X.400