INTELLIGENT COMMUNICATION INTERFACE

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Abstract

Information Technology (IT) users located in remote areas, or shipboard users, have need for two-way access to private or public switched telecommunications networks and services.

The overall objective of the project, which will last three years, will therefore be to develop and demonstrate a working prototype system, making use of existing maritime coast stations, terrestrial radio facilities, to enable remote users to automatically access subscribers to the public switched networks and vice versa.

In the present project, this is limited to HF, MF and VHF radio links (such as those used by the Maritime Mobile Service) and facsimile and PC to PC data services.

1. Introduction

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The project proceeds on four main areas of work:

i) Specification of a communication interface to allow fully automatic two-way access between remote users and the public network for long range radio.
ii) Definition and development of a remote user system that will register a link request and automatically set up a link to the required network user. The process for setting up the link will automatically select the path and determine the frequency and data bit rate to use.
iii) Definition and development of a public network gateway that will detect calls and set
up a link from remote users to the required network user. The setting up of a link to the remote user will require prior knowledge of its facilities, location and watchkeeping or some means of acquiring this information.

iv) Development of new techniques to enhance and optimize the performance of data communications over long range HF radio links. This involves investigating techniques to provide real time channel evaluation and computation of optimum transmission parameters such as bit rate.

2. State of the Art

The main public networks which offer public correspondence services to remote users are for maritime mobile and land mobile services although some smaller scale public correspondence services also exist for aeronautical users.

The maritime mobile service is by far the most widespread internationally standardized system using a combination of terrestrial radio at MF, HF and VHF frequencies and satellite systems. In general, apart from radiotelex, the terrestrial service is still a manually connected service whereas the satellite service is largely automatic.

The land mobile service primarily consists of VHF and UHF (cellular) short range systems which are mainly operated as national services, although the Pan-European GSM system (due to enter service in the early 1990's) will offer a standardized system throughout Europe. Apart from military applications there are very few long distance land mobile services available.

The international regulations which dictate the use of frequencies for radio communications are the ITU Radio Regulations and these are particularly restrictive with respect to maritime frequencies. The recommendations of the CCIR generally define the technical characteristics of equipment to be used.

The introduction of fully automatic operation in the Maritime Mobile Service is hampered by four main factors: in the maritime radiotelephony bands the ITU Radio Regulations prohibit the emission of idle-channel signals on working channels; there is a general shortage of maritime frequencies which results in all frequencies being shared by one or more coast stations; MF and HF frequencies, in particular, can be subject to interference and unpredictable propagation conditions; and, when using the HF bands for any service, there can be considerable difficulties involved in automatically determining the optimum frequency band to use.

The Digital Selective Calling (DSC) system, which provides a means of signalling over the radio path to allow the subsequent transfer of public correspondence communications has now been internationally agreed. Although primarily designed for alerting operators on ships and at coast stations the inclusion of the public switched network number would enable it to form the basis for an automatic signalling system. Such an automatic system is already defined by a CCIR recommendation for use at VHF but such use at MF and HF needs further development.

Facilities for data communications and facsimile services in the maritime terrestrial service are generally not provided at the present time and are not internationally standardized. Under good propagation conditions these services can sometimes be operated on VHF channels using standard radiotelephony equipment and CCITT V series data modems but for optimum performance, signal regeneration at least, is needed at the coast stations. Trials of data communications using the MF band have been reported to CCIR using HF data modems which offer data speeds of up to 2400 bit/s by employing parallel transmission using several frequencies within a voice bandwidth channel.

However, HF data modems are currently almost exclusively used for specialized land-mobile and military purposes and no international standard exists for general
commercial services. More recent developments have indicated that HF data modems using serial transmission have some advantages but these are currently very expensive due to the complex decoding required.

The information carrying capacity of the HF channel varies with time over a wide range and present day data communication systems make use of the concept of Real Time Channel Evaluation (RTCE) with the aim of adapting the system resources to the prevailing channel conditions.

Although simple in nature, the practical implementation of this concept has not yet been solved. There is a general consensus on the two steps involved in RTCE: "path sounding", where many channels are tested in order to determine their noise and interference levels, and "channel probing" intended to get a coarse measure on a few channels of the ability of each to carry information.

Coding and in-band diversity techniques have been proven as powerful methods to reduce the residual error rate. Coding is more versatile than diversity because it is a purely digital processing technique. As far as the final aim of coding is concerned three different approaches can be conceived: forward error correction (FEC), automatic repeat on request (ARQ) and hybrid systems.

3. Workprogram

The workprogram, which covers a three year period, has been divided in four workpackages relating to the main technological issues involved in the research, as indicated below:

A. Communication Interface Specification
B. Remote System
C. Public Network Interface
D. Optimization of Transmission Parameters

A. Communication Interface Specification

This workpackage is common to every part of the user-to-user communication system whatever may be the requirements of a specific element of the communication link. Its objectives are to define the basic specification needed to supply a fully automatic two-way access from the public switched networks to and from users in remote locations which may not be linked by conventional means. These objectives are to be defined in the following two tasks:

A1: define the overall functional and operational requirements for the gateway to the public network taking into account facsimile and PC to PC transfer services, the relevant standardization and the possibility to reach a remote user through a coast radio station.

A2: define the corresponding requirements for the remote user system when a link is established through the public network gateway.

B. Remote System

The objectives of this workpackage are to define the remote system (its components and the corresponding specifications and system architecture); to select a subset which restricts the implementation tasks to be done within this project to that needed to verify the found hypothesis; to implement that subset; and to carry out a specification test. This work must be done with the constraint that the remote system is to be contained
within a restricted volume, that its price should be low by this specific market standard and that it will support several concurrent applications.

This objective is to be reached through the execution of the following tasks:

B1: define the remote site specification, architecture and select an implementable subset.
B2: define the user interaction subsystem and implement the required subset.
B3: define the message handling subsystem and implement the required subset.
B4: specify the message transmission subsystem and implement the required subset.

B1. Remote site specification

Communication interface requirements being known, the objective of this task is to define the system which will provide the remote user with an access to the communication interface being specified.

B2. User interaction subsystem

How a user may access the communication interface must be determined and it is the objective of this task to do so.

The user interface must take into account the multilingual environment, the radio environment of the system and the nature of the transmitted messages.

B3. Message handling subsystem

Basic handling functions to be implemented are described in the X.400 Series of the CCITT recommendations. Software packages are being sold for computer and terrestrial line communication environment, but an important effort is to devoted to the adaptation of those functions to the specific environment considered in this project.

Within this subsystem will be the process that determines the pathway and also its characteristics. Therefore, a lot of information is to taken into account, e.g. location of the mobile at the time of the communication, the location of the correspondent, which gateway to be used to reach the public network depending on the offered services, the tariffs, the local time, etc.

B4. Message transmission subsystem

The Message Transmission Subsystem is understood as the real-time part of the system that will automatically carry out operations that are defined to be the Intelligent Communication Interface, that is:

- initiate the link
- access the network subscriber
- transfer the information (e.g. message, data, voice, etc.)
- maintain the link
- terminate the call.

C. Public Network Interface

This work package aims at developing and demonstrating a prototype public network interface, making use of existing maritime coast stations to enable remote users to automatically access subscribers to the public switched networks and vice versa for PC to PC transfer and facsimile. A subset will be selected which restricts the implementation
tasks to be done within this project to those needed for demonstration purposes. This
will demonstrate communications which are currently available between land-based
subscribers. Existing internationally agreed standards will be employed where available
and no technical changes to the public switched networks will be considered but for the
radiopath, suitable specifications for PC to PC transfer and facsimile will need to be
established and proved.

The workpackage has been divided into five tasks:

C1: Specification and architecture
C2: Public Network User Subsystem
C3: Remote User Access to Public Network
C4: Traffic Handling Subsystem
C5: HF Modem Interfacing

C1. Specification and architecture

This task’s objective will be to convert the Statement of Requirements (task A1) into
a system specification. In order to achieve this, it will be necessary to evaluate standard,
currently commercially available data modems (eg. HF data modems and CCITT V.series
modems) and facsimile machines, to determine the preferred options, and to determine
the basic interfacing requirements to convert their protocols to those commonly used on
the public switched networks.

C2. Public network user subsystems

The objective of this task will be to define the detailed specification of the subsystem
components and to implement them on a suitable system at a coast station (or stations)
which will provide a basic system enabling subscribers in the public switched networks
to automatically access the appropriate coast station(s) and route PC-to-PC transfer and
facsimile calls to the required remote users.

C3. Remote user access to public network

This task should result in the detailed specification of the subsystem components and
implementation of a pilot system at the coast station(s) for automatically routing PC to
PC transfer and facsimile calls from remote users into the public switched networks.

C4. Traffic handling subsystem

The objectives of this task are to define the detailed specification of the overall pilot
coast station system, to implement, for demonstration purposes, and to connect the
Public Network User and Remote User Access subsystems developed in tasks C2 and
C3 to the existing coast station systems. A traffic handling system within the coast station
will be required together with interfacing to enable standard facsimile machines and
CCITT V.series modems to be used on the public switched networks.

C5. HF modem interfacing

The objective of this task is to specify and implement the necessary interfacing of an
HF data modem (identified in task C1) to the pilot coast station system (developed in
task C4).
D. Optimization of transmission parameters

This workpackage is intended to propose an HF data transmission system able to establish and maintain such kind of links when required by the Intelligent Communication Interface. In order to do it, we have divided the workpackage into three tasks:

D1: Transmission Techniques with Real Time Channel Evaluation
D2: Proposal of new systems for a reliable HF link
D3: Proposal of a global system architecture

D1. Transmission techniques with real time channel evaluation

We begin with a research on different communication system approaches for HF, frequency selection procedures, and computation of communication parameters through real-time channel evaluation.

D2. Proposal of new systems for a reliable HF link

Once the above mentioned task has been completed, it will be necessary to choose among the identified alternatives. This will be done taking into account the requirements imposed by the services to be offered and other constraints like those dictated by present day technology and site-dependent specifications of the remote station where one terminal of this data transmission system must be inserted. It is foreseen to test different solutions by computer simulation and by means of a channel simulator. In both cases it will be necessary to build the appropriate hardware and software tools.

D3. Proposal of a global system architecture

The knowledge gained at that moment will allow us to propose a global system architecture. Therefore it will be necessary to make prototypes of some subsystems in order to assemble a working prototype able to calculate the optimum working frequency and to maintain the link through channel evaluation. Tests on this global system will be done on the same laboratory test bed used during the execution of the above mentioned task, before it can be tested with the prototypes delivered in other workpackages.

4. Members of the Consortium

Four groups will contribute to the project, three as partners and one as associated partner:

Prime contractor: SAIT ELECTRONIC S.A.
Brussels, Belgium

Partners: British Telecom International
London, U.K.

Universitat Politecnica de Catalunya Barcelona, Spain

Associated Partner: Universidad Politecnica de Madrid
Madrid, Spain