Chapter 1 – INTRODUCTION

1.1 SCOPE

This Report concerns radio services that operate in the range 1.6 MHz to 30 MHz called the High Frequency (HF) band, although it consists of the upper end of the conventional medium frequency band (MF: 0.3 MHz to 3 MHz) and the whole of conventional HF band (3 MHz to 30 MHz).

The HF band is an excellent means for direct near and far distance radio communications and its equipment is easily and rapidly deployable. It permits fully military-controlled command links across short and long distances (tactical/strategic) with secured transmissions, no subscriber costs and easy frequency co-ordination.

In recent years, the potential for unintentional radio interference to be caused by the operation of a range of signalling systems that may be mass-deployed has become of interest to national regulators, spectrum users and the network operators wishing to deploy them. Regulatory effort has largely concentrated upon the identification of suitable measurement methods and limits to be applied to the unintentional emissions from single systems, such that interference to radio reception may be controlled. There remains however the more general question concerning the widespread impact on the radio spectrum that mass deployment of such technologies may have.

PowerLine TeleCommunications (PLT, PLC) and various forms of Digital Subscriber Line (xDSL) transmissions use the existing mains electricity or telephone wiring including in-premises cables for telecommunications with data rates higher than 1 MBit/s. As these lines were not designed for such broadband transmissions, they will cause unintentional RF emissions which may adversely affect the established radio noise floor directly, or by cumulative propagation from many such sources. The existing HF background noise possibly may be increased via ground wave and/or sky wave propagation. The intensity of the cumulative PLT noise depends on the communications signal power injected into the lines, the electrical characteristics of the lines (balance, match, screening), the structure of the networks and the lengths of single lines with respect to the HF wavelengths, as well as on the density and area coverage of the new broadband data access systems.

Increase of the existing HF noise floor by widespread use of PLT and/or xDSL will bring up problems for Military Radio Users as well as for HF Communication Intelligence (COMINT) in all NATO countries. The signal-to-noise ratio thus may be reduced for tactical and strategic HF radio as well as for fixed sensitive COMINT sites. First measurements and estimations show that disturbing emissions from wire-line telecommunications networks may increase the HF radio noise level just near to the lines as well as at very great distances (up to several thousand km) and thus may have an international disturbing effect.

Exact calculations of HF radio noise emissions from the new broadband wire-line telecommunications networks were impossible because of missing models for these transmission systems. Therefore methods have been investigated to find procedures, models and tools applicable for being able to determine the influence of PLT and xDSL on reception of HF radio signals. These are described in this report.

1.2 HISTORY OF THE WORK

At its February 2001 meeting the Communication Network Sub-Committee (CNSC) noted a brief by the chairman of the HF Radio Ad Hoc Working Group (HFR AHWG) on the potential threat to HF radio users posed by new data systems using PLT and DSL [1]. CNSC's letter on its concerns over these new data systems was sent to NHQC3S. After discussion of these concerns, the IST Panel was asked for

assistance, and at its October 2001 meeting, the Panel decided to create the Exploratory Team IST-ET-022 on "HF Interference, Procedures and Tools", supported by four nations: Canada, Germany, Norway and the United Kingdom.

The Exploratory Team met twice in FGAN-FKIE (GE). The results of the kick-off meeting on 21 August 2002 were updated documents TAP and ToR and a first draft of the PoW. During the second meeting on 11-12 March 2003, TAP and ToR were reviewed and the draft of the PoW including its work schedule was discussed in detail.

The RTB approved the IST-50/RTG-022 on its fall meeting 2003. RTA sent the invitation letter to all NATO and PfP Nations. Three more nations, Georgia, Italy and Slovakia, declared their willingness to participate and nominated experts.

The inaugural meeting of the IST-050/RTG-022 was held at RTA in Paris, France on 29-31 March 2004, with the participation of Canada, Georgia, Germany, Norway and Slovakia. Subsequently, eight more meetings were held in various locations: August 2004 at FFI in Kjeller, Norway; January 2005 at FGAN-FKIE in Wachtberg, Germany; April 2005 at RTA in Paris, France; September 2005 at CRC in Ottawa, Canada; November 2005 at FFI in Kjeller, Norway; March 2006 at FGAN-FKIE in Wachtberg, Germany; June 2006 at CRC in Ottawa, Canada; and October 2006 at RTA in Paris, France.

On the matter of participation in the RTG's work, United Kingdom and Italy were unable to carry through their initial commitment, and their representatives never attended a meeting nor contributed any material to the work, despite repeated requests. Therefore, their membership in this RTG was declared null and void, for all practical purposes. As for Slovakia, their expert had a career change after the second meeting, and was unable to participate any further. Unfortunately, he was not replaced and the RTG-022 carried on with the remaining members.

1.3 OBJECTIVES

The Task Group addressed itself to the HF radio emission effects of the new broadband cable transmissions. It investigated and found means that allow calculation of cumulative field strengths of HF noise radiated by PLT or xDSL. This will enable NATO and its nations to determine the threat to military HF radio communications and COMINT systems from PLT and xDSL and to take the appropriate steps. It should be noted here that the determination of the nature and the severity of any possible detrimental effect upon the military systems was outside the RTG's expertise and ToR.

The work included investigations in the following areas:

- PLT and xDSL networks and their characteristics regarding HF radio noise emission;
- Methods to measure the emissions from PLT and xDSL networks;
- Propagation path loss models appropriate to HF spectrum;
- Procedures and means to model PLT and xDSL systems; and
- EMC analysis methods with respect to cumulative effects.

The Research Task Group chose to concentrate its work on the PLT issue rather than xDSL because:

- PLT will produce the most problems regarding HF interference since power lines have less symmetry and will have impedance discontinuities.
- A great number of PLT In-House systems are expected to be deployed. For example, more than 350000 In-House PLT modems had been sold in Germany by the end of 2004.

- VDSL variants covering the whole HF range are still in the definition phase. Eventual implementation of these systems may not be in sufficient numbers to raise potential interference issues, in the time frame of this RTG. Therefore, RTA is urged to consider a further RTG to deal with the VDSL impact on HF spectrum, if found necessary. The other versions of xDSL have no documented HF interference-causing problems.

1.4 OVERVIEW OF THE STUDY

Chapter 1 Is the introduction to present the background of PLT and xDSL and the objectives of the IST-050/RTG-022 studies.

Chapter 2 Gives an overview on HF radio, its propagation characteristics and users, as well as limiting factors existent and emerging.

Chapter 3 Describes the effects of PLT and xDSL networks contributing to HF radio noise and its technical characteristics, explains different methods used for PLT and xDSL and technical realizations, and finally defines representative PLT and xDSL systems for modelling.

Chapter 4 Deals with interference limits existing or proposed for wire line transmission systems.

Chapter 5 Provides methods of measuring HF radio noise emissions from PLT and xDSL.

Chapter 6 Describes HF propagation models useful for calculation of HF radio interference from distant sources.

Chapter 7 Deals with modelling of PLT and xDSL systems as HF noise sources.

Chapter 8 Describes a method to calculate cumulative HF radio interference from PLT and xDSL, and presents results for selected case studies.

Chapter 9 Presents the conclusions and the recommendations of the IST-050/RTG-022.

Chapter 10 Lists the selected bibliography, from among some 400 documents reviewed/studied by IST-050/RTG-022 over the course of its work timeframe.