

SECTION 1 INTRODUCTION

1.1 BACKGROUND

On April 23, 2003, the Federal Communications Commission (Commission or FCC) adopted a Notice of Inquiry (NOI) seeking information on several aspects of Broadband over Power Line (BPL) systems as well as associated changes that may be needed to accommodate BPL systems in Part 15 of the Commission's rules.¹ The NOI described "access" BPL systems as a backbone network of devices that use low and medium voltage electrical power lines for transmission of broadband data to, from, and within the geographic area of BPL network users.² "In-house" BPL systems were described as using low voltage wiring and electric power outlets for networking within the user's premises, and for connecting end-user devices to the access BPL network. Because BPL systems unintentionally radiate emissions at radio frequencies, the NOI focused several questions on Part 15 provisions that control the risk of interference to radio reception. In its comments to the Commission, the National Telecommunications and Information Administration (NTIA) summarized Federal Government usage of the 1.7-80 MHz frequencies of prime interest to BPL developers, identified associated interference concerns, and outlined the studies it planned to conduct to address those concerns.³

Over five-thousand comments and replies were filed with the Commission in response to the NOI. These comments provided substantial technical details of BPL system design and operating features as well as analyses of potential interference and the underlying factors that may cause interference. Working independently of, but in coordination with the Commission's Office of Engineering and Technology (OET), NTIA designed its study approach to add substantially to the information filed in response to the NOI. Considerations and findings of Phase 1 of NTIA's study are reported herein. Phase 2 of NTIA's study will evaluate potential interference from mature deployments of BPL systems via ionospheric signal propagation and further assess risks of local interference under various candidate BPL rules, including rules suggested in NTIA's Phase 1 study.

1.2 OBJECTIVES

The objectives of this technical study are to define interference risks from operation of BPL systems under field strength limits and associated compliance measurement procedures specified in Part 15 of the Commissions rules, identify interference risk mitigation techniques

¹ *Inquiry Regarding Carrier Current Systems, including Broadband over Power Line Systems*, Notice of Inquiry, ET Docket No. 03-104, April 28, 2003 ("BPL Inquiry").

² The Commission further expanded the definition of access BPL to include high voltage electrical power lines carrying greater than 40,000 Volts. See *Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems*, Notice of Proposed Rule Making, ET Docket No. 04-37, February 23, 2004 ("BPL NPRM"), at ¶32.

³ Comments of the National Telecommunications and Information Administration, BPL Inquiry, August 13, 2003.

that may be employed by BPL manufacturers and system operators and, if appropriate, recommend modifications to Part 15 provisions that will reduce the interference risks.

1.3 APPROACH

Phase 1 of NTIA's study addresses issues deemed most important to formulation of a regulatory framework that would limit risks of local interference from outdoor elements of BPL systems. NTIA reviewed publications and comments submitted in response to the FCC NOI to characterize existing and potential future BPL systems and deployments (Section 2). NTIA also reviewed relevant domestic and foreign studies and regulations to help refine NTIA's analysis approach and to prevent unneeded redundancy (Section 3). Technical and operating parameters of potentially affected Federal Government radiocommunications systems were compiled and representative systems were identified for consideration in the analyses (Section 4). NTIA analyzed BPL signal radiation and propagation and summarized key findings from NTIA's measurement and computer modeling efforts to date (Section 5). The report discusses environmental Radio Frequency (RF) noise levels insofar as ambient noise is an important factor in the evaluation of interference. Recognizing these considerations and assuming that BPL systems comply with existing Part 15 provisions, NTIA evaluated the risks of interference to representative Federal Government systems (Section 6). NTIA then developed recommendations for clarification and modification of existing Part 15 compliance measurement procedures to reduce the potential for underestimating the peak field strength (Section 7). NTIA identified techniques for preventing and mitigating BPL interference (Section 8). NTIA applied the results of these studies in recommendations regarding the Part 15 field strength limits and compliance measurements relevant to BPL systems, identified areas where further investigation by BPL proponents may lead to means for reducing interference risks and facilitating rapid elimination of interference, and outlined the focal points for NTIA's Phase 2 studies (Section 9).

1.4 SCOPE

This study considers BPL systems utilizing fundamental frequencies in the 1.7 - 80 MHz frequency range.⁴ In this Phase 1 study, NTIA defines risks of interference from BPL systems to local radio reception assuming BPL systems comply with existing Part 15 field strength limits and compliance measurement procedures. Issues not addressed in Phase 1 include the following:

- Regulatory framework, including the suitability of Part 15 for accommodation of BPL.
- Aggregation of interfering signals from BPL systems via ionospheric propagation. This is of concern insofar as skyward emissions from hundreds of co-frequency BPL systems deployed over a large area theoretically could produce a significant composite interfering signal level at a very distant receiver. This phenomenon would not be possible until BPL technology is widely deployed.

⁴ The BPL Inquiry identified the 1.7-80 MHz frequency range to be of principal interest for BPL operations. BPL Inquiry at ¶15.

- Potential BPL emissions at frequencies other than the fundamental frequencies employed by the BPL system. In other words, BPL out-of-band emissions and intermodulation products were not a focal point.
- Radio systems typically used by non-federal entities, except to the extent that their technical and operating parameters are similar to those of Federal Government systems.
- BPL transmission over indoor low voltage wiring, noting that this is a focal point of the Commission's studies.⁵
- Potential interference or damage to BPL systems from local radio transmissions.

NTIA's Phase 2 study will assess the interference risks due to aggregation and ionospheric propagation of interfering signals from BPL systems. NTIA has developed BPL deployment models in the Phase 1 study to support the analysis of BPL signal aggregation and propagation (Appendix F); however, these models will be refined and applied in the Phase 2 Study. In its Phase 2 study, NTIA will also evaluate the effectiveness of proposed Part 15 measurement refinements and provide additional clarifications as appropriate.

⁵ Comments of the Office of Engineering and Technology (*Initial results of FCC tests related to in-house Power Line Communications (PLC)*), BPL Inquiry, September 16, 2003.