

ADSL

Standards, Implementation, and Architecture

Charles K. Summers

Series Editor-in-Chief

Saba Zamir

CRC PRESS Advanced and Emerging
Communications Technologies SERIES

OCLC #41090835
12/20/00
dynix 1183815
1/25/01

? AF?
621.382
SUM
1999

Library of Congress Cataloging-in-Publication Data

Summers, Charles K.

ADSL: standards, implementation, and architecture / Charles K. Summers.

p. cm.— (Advanced and emerging communications techniques)

Includes bibliographical references and index.

ISBN 0-8493-9595-X

1. Data transmission systems. 2. Telecommunications—Standards. 3. Modems.

4. Telephone switching systems, Electronic. I. Title. II. Series.

TK5105.S86 1999

621.38—dc21

99-26897

CIP

\$69.95
10/00

For n
children Che

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming, and recording, or by any information storage or retrieval system, without prior permission in writing from the publisher.

The consent of CRC Press LLC does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from CRC Press LLC for such copying.

Direct all inquiries to CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

© 1999 by CRC Press LLC

No claim to original U.S. Government works

International Standard Book Number 0-8493-9595X

Library of Congress Card Number 99-26897

Printed in the United States of America 2 3 4 5 6 7 8 9 0

Printed on acid-free paper

TABLE 2.1
ADSL Standards Bodies and Standards

Standards Body	Working Group	Standard	Purpose
ADSL Forum	Many, including UAWG SNAG	TR-00x	Industry Advisory Papers
ANSI T1	T1E1.4	T1.413, Issue 2	Basic ADSL Standard
ETSI	TM6		Close interworking with ANSI
ITU-T	Study Group 15	G.992.1 G.992.2 G.994.1 G.995.1 G.996.1 G.997.1	International Standards

2.4.2.1 ADSL Forum and UAWG

The ADSL Forum (<http://www.adsl.com/>), formed in 1994, has been in the forefront in publicizing ADSL and acting as a working group to explore architectural issues not yet covered by the standards bodies. It also acts as a "prod" to the standards bodies to get them working on standards. Most of the technical issues, addressed by the industry participants of the forum, deal with interworking. There are four subgroups that are particularly active. These are the UAWG (mentioned above), the System Network Architecture Group (SNAG), the Management Information Base (MIB) group, and the test group which coordinates test environments between forum participants and other manufacturers of equipment. Many of the issues being looked at by the ADSL Forum are also of interest to the Asynchronous Transfer Mode (ATM) Forum (<http://www.atmforum.com/>).

2.4.2.2 ANSI

The American National Standards Institute (<http://web.ansi.org>) oversees various committees composed primarily of industry technical people. The committee T1 and, more specifically, the subcommittee T1E1 is associated with ADSL standards. The T1E1 subcommittee has the responsibility of overseeing standards work for interfaces, power, and protection for networks.

Each subcommittee may be broken down into working groups. The T1E1.4 working group is actually the group responsible for DSL access, including ADSL. DSL access includes physical layer standards and transmission techniques for interfaces. The T1E1.4 working group was responsible for the T1.413 ADSL standard, which will be covered in detail in the next chapter. T1.413 was published in 1995. A new version (T1.413, release 2) is now available, in draft form, which incorporates some of the UAWG simplification issues.

2.4.2.3 ETSI

ETSI (<http://www.etsi.fr>) is also Transmission and Multiplexing (T) which roughly corresponds to T1E1 that international issues are addressed.

2.4.2.4 TU-T

The International Telecommunication Union (ITU-T) was the last body to get involved with ADSL. ITU-T did join ADSL standardization in 1999. This was an international desire to incorporate recommendations, such as I.325 and I.326, which fall into physical layer protocol categories. Recommendations G.DMT which is largely a result of the work of the UAWG, G.992.1, G.992.2, G.994.1, G.995.1, G.996.1, and G.997.1 for handshaking protocols.

G.lite has now been informal during the next meeting of ITU-T in June 1999. It is currently available. The standard is not expected to be guaranteed. The versions of G.lite as G.992.1, G.992.2, G.994.1, G.995.1, G.996.1, and G.997.1 recommendations at present are

G.992.1 (G.dmt)	Asymmetric
G.992.2 (G.lite)	Transceiver
G.994.1 (G.hs)	Splitterless
G.995.1 (G.ref)	Line (All)
G.996.1 (G.test)	Handshaking
G.997.1 (G.ploam)	Line (DSL)
	Overview
	Recommendation
	Test procedure
	Transceiver
	Physical layer
	(DSL) ITU-T

2.5 THE xDSL FAMILY OF

The ADSL Forum refers to the protocols as "xDSL Technologies." Although pure analog

Purpose

Industry Advisory Papers

- 2 Basic ADSL Standard
Close interworking with ANSI
International Standards

in 1994, has been in the forefront up to explore architectural issues acts as a "prod" to the standards of the technical issues, addressed with interworking. There are four the UAWG (mentioned above), the Management Information Base test environments between forum t. Many of the issues being looked the Asynchronous Transfer Mode

://web.ansi.org) oversees various nical people. The committee T1 associated with ADSL standards. of overseeing standards work for

nto working groups. The T1E1.4 for DSL access, including ADSL. transmission techniques for interle for the T1.413 ADSL standard, er. T1.413 was published in 1995. s, in draft form, which incorporates

2.4.2.3 ETSI

ETSI (<http://www.etsi.fr>) is also broken down into groups and subgroups. The Transmission and Multiplexing (TM) group contains the working subgroup TM6 which roughly corresponds to T1E1.4. TM6 often works with T1E1.4, making sure that international issues are addressed.

2.4.2.4 TU-T

The International Telecommunications Union (ITU, <http://www.itu.int>) is sometimes the last body to get involved with a new technology. However, the fact that the ITU-T did join ADSL standardization efforts in 1998 is an indication of the growing international desire to incorporate such services. The ITU-T generates technical recommendations, such as I.325 mentioned above. The present set of ADSL-related recommendations being worked on by the ITU-T are named by 'G' prefixes, as they fall into physical layer protocol categories. Recommendations currently under study are G.DMT which is largely a rewrite of T1.413, G.lite which incorporates much of the work of the UAWG, G.test which concerns test specifications for xDSL, G.OAM concerning operations, administration, and maintenance aspects of xDSL and G.HS for handshaking protocols to allow startup negotiation.

G.lite has now been informally accepted by the ITU-T and will be voted on during the next meeting of ITU-T Study Group 15 to be held in Geneva, Switzerland in June 1999. It is currently available via special user's groups, such as the ADSL Forum. The standard is not expected to change much in that process although nothing is guaranteed. The versions of G.DMT, G.OAM, G.HS, and G.lite will be released as G.992.1, G.992.2, G.994.1, G.995.1, G.996.1, and G.997.1. Specifically, the ITU-T recommendations at present are:

G.992.1 (G.dmt)	Asymmetrical Digital Subscriber Line (ADSL) Transceivers
G.992.2 (G.lite)	Splitterless Asymmetrical Digital Subscriber Line (ADSL) Transceivers
G.994.1 (G.hs)	Handshake procedures for Digital Subscriber Line (DSL) Transceivers
G.995.1 (G.ref)	Overview of Digital Subscriber Line (DSL) Recommendations
G.996.1 (G.test)	Test procedures for Digital Subscriber Line (DSL) Transceivers
G.997.1 (G.ploam)	Physical layer management for Digital Subscriber Line (DSL) Transceivers

2.5 THE xDSL FAMILY OF PROTOCOLS

The ADSL Forum refers to the protocols covered in this section as "Copper Access Technologies." Although pure analog modems are also included in this category, we