AX.25 Amateur Packet-Radio Link-Layer Protocol

Preface

Note: This preface is not a part of the protocol.

This is the first edition of AX.25 Amateur Packet-Radio Link-Layer Protocol (Version 2.0, October 1984) published by the American Radio Relay League. It was approved by the ARRL Board of Directors in October, 1984. The ARRL was designated the international clearinghouse for information relating to packet radio with a view to encouraging common standards and regulations on behalf of the International Amateur Radio Union (IARU) by their Administrative Council at their meeting in Paris during July, 1984.

Earlier implementations of this protocol were based on a paper given at the Second ARRL Amateur Radio Computer Networking Conference in March 1983. Changes introduced since that paper are bracketed ([ ]).

Major sections within this specification have been organized and numbered in a manner similar to that of International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25.

This document defines a protocol to be used between two Amateur Radio stations in a point-to-point communications environment. It specifies only link-layer functions. Other than certain interface requirements to and from other layers, this protocol is not meant to specify any other layer.

This protocol recognizes that the Amateur Radio operating environment is unique, and takes this into consideration. A key feature is the inclusion (at this layer) of repeater stations and repeater linking. These repeater stations simply extend the RF range of Amateur Radio stations. Since they do not impose any flow controls, data switching, or routing, their inclusion at this layer does not imply any network-layer functions. It is anticipated that repeater stations will be phased out (or at least their number greatly reduced) when a true network layer becomes operational.

History

Over the years there have been several link-layer protocols suggested for amateur packet radio. The first link-layer protocol to achieve widespread use was created by Douglas Lockhart, VE7APU, of the Vancouver (BC) Amateur Digital Communications Group (VADCG). It was based on the IBM SDLC protocol and implemented on a packet-radio controller board designed and built by VADCG. This protocol was used for the first few years of amateur packet-radio activity. One of the limitations of the VADCG protocol was that it used a single octet (8 bits) for the station address. This restricted the number of stations to 254 or a smaller number, depending on how the addressing scheme

was implemented. It also required that someone had to assign these arbitrary addresses to each amateur in a local area.

In early 1982, the Amateur Radio Research and Development Corporation (AMRAD) began a study of the link-layer protocols in commercial use at the time. The intent was to recommend a protocol that would not suffer from major limitations in a few years, after packet radio had grown. The result of this study was a recommendation for the use of a slightly modified version of the CCITT X.25 level 2 LAPB protocol standard, which could be considered a subset of the American National Standards Institute (ANSI) Advanced Data Communications Control Procedure (ADCCP), balanced mode.

In June, 1982, a series of meetings was held by AMRAD and the Radio Amateur Telecommunications Society (RATS) of New Jersey. An exploratory meeting was held at Bell Laboratories. Two definitive meetings in which the prototype of AX.25 protocol was developed took place in Vienna, Virginia. Involved at those meetings were Gordon Beattie, N2DSY; Jon Bloom, KE3Z; Dave Borden, K8MMO; Terry Fox, WB4JFI; Paul Rinaldo, W4RI; and Eric Scace, K3NA. Both link- and network-layer protocols were defined at that time. Since both layers were based on the CCITT X.25 recommendation, it was decided to follow the pattern set by AT&T (BX.25 for Bell X.25) and call this new protocol AX.25, for Amateur X.25. The link-layer protocol was then documented by Terry Fox and circulated to other packet-radio experimenters for comment. The network-layer proposal was held for further study. Eric Scace was able to provide invaluable insight into CCITT X.25 as he was one of its authors.

The next step in the evolution of AX.25 was taken in October of 1982. Thomas Clark, W3IWI, president of The Radio Amateur Satellite Corporation (AMSAT), hosted a gathering of most of the leaders in amateur packet radio at that time. AMRAD, AMSAT, the ARRL Ad Hoc Committee on Amateur Radio Digital Communication, Pacific Packet Radio Society (PPRS), St. Louis Amateur Packet Radio (SLAPR), and Tucson Amateur Packet Radio Corporation (TAPR) were represented. The AMRAD version 1.1 AX.25 link-layer protocol was slightly modified and adopted at this meeting.

Had AX.25 remained merely an agreeable concept, this document would not exist today. It is due to yeoman efforts in software development of the AX.25 protocol implementations that packet radio flourishes today. Shortly after the October, 1982, meeting at AMSAT, AX.25 packet signals began to appear. The rapidity with which AX.25 was integrated into the TAPR TNC board was due to the unstinting efforts of the TAPR software development crew, primarily such stalwart packet-radio enthusiasts as Dave Henderson, KD4NL; Margaret Morrison, KV7D; and Harold Price, NK6K. The original VADCG board was soon running AX.25 as well, thanks to Hank Magnuski, KA6M, who modified the original Lockhart software to execute the new protocol.

The first public release of the AX.25 link-layer protocol was in a paper given at the Second Amateur Radio Computer Networking Conference, in March, 1983. Some corrections and changes have been made since then by the ARRL Ad Hoc Committee on Amateur Radio Digital Communication. In July, 1983, West Coast packet groups met to form WESTNET -- to link packet-radio repeaters from San Diego to San Francisco. The WESTNET group decided to extend the AX.25 link-layer address field to accommodate up to eight repeaters. This modification was accepted by the ARRL Committee at their November, 1983,

meeting in Washington, DC. Unresolved at that meeting was the handling of the poll/final bit. When the Committee met again at Trenton, NJ, in April, 1984, Phil Karn, KA9Q, proposed a solution to the poll/final bit problem. His proposal was published in QEX and packet-radio club newsletters, and later adopted by the Committee.

It is fitting, given the history of collective effort by packet-radio pioneers, that this document is the work of many. Special thanks are due to Chuck Green, NØADI; Lyle Johnson, WA7GXD; Phil Karn, KA9Q; Paul Newland, AD7I; Harold Price, NK6K; and Eric Scace, K3NA, for their perceptive and helpful comments.

ARRL Ad Hoc Committee on Digital Communication

This protocol was finalized and approved for submission to the ARRL Board of Directors by the Ad Hoc Committee on Digital Communication. Committee approval of this protocol does not necessarily imply that all committee members voted for its approval. At the time it approved of this protocol, the Committee was comprised of:

Paul L. Rinaldo, W4RI, Chairman
Marshall Quiat, AGØX, Board Liaison
Dennis Connors, KD2S
Terry Fox, WB4JFI
Lyle Johnson, WA7GXD
Douglas Lockhart, VE7APU
Wally Linstruth, WA6JPR
Henry S. Magnuski, KA6M
Paul Newland, AD7I
Eric L. Scace, K3NA

Contents