OSI: A PLAN COMES TOGETHER

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ABSTRACT

This paper will provide an overview of the current state of services available on the Amateur Packet Radio and then offer solutions to the problems and limitations found. This will include an outline of a communications architecture for distributed computer systems using the Open Systems Interconnection Reference Model (OSI-RM). We will also provide a description of systems required to support the data transport and application needs of the Amateur Packet Network user. These OSI-based systems have been designed to inter-operate with each other and with other systems not part of the Amateur Packet Network. This-architecturally consistent approach addresses the operational objectives of Service, Managibility, and Performance. It has the further advantage of world-wide acceptance.

CURRENT STATE

The network support requirements of the "AVERAGE" Radio Amateur are nearly impossible to scope out. However, there are a few activities which are found to be of interest. These are:

Keyboard-to-Keyboard

Keyboard-to-Computer

Computer-to-Computer

Roundtable/Net

Bulletin Broadcast

DX'ing

Let us now examine these specific areas with an eye toward improvement.

Keyboard-to-Keyboard

Keyboard-to-Keyboard QSOs are difficult to obtain because of the lack of a reasonable calling mechanism. The "HEARD" list of many Switches and BBSs provide this function, but without specific knowledge of the status of a particular station.

What is needed is a network server which provides a gathering point for stations available for such QSOs.

Keyboard-to-Computer

The Keyboard-to-Computer activity is probably the best developed. Current message/file serverssuch as the Packet Radio MailBox System (PRMBS by KA2BQE) and the MBL Bulletin Board System (by WA7MBL) have added new user modes and services. These services include remote directory, file, and user log requests. Despite these advances, there are additional improvements to be made. These systems have not addressed the requirement for BINARY and error-free, block-oriented (FULL PACKET) data transfers. Some work has been done by KA2BQE and N2DSY of RATS to deal with the these requirements, but the solutions are only of a stop-gap nature. KA2BQE has written the BTOA and ATOB binary-to-ASCII and ASCII-to-binary programmes. These allow the contents of a binary file to be converted to and from ASCII for transmission in a standard BBS message envelope. KA2BQE and N2DSY have also worked on the parameter setting for BBS TNCs. These TNCs send sequences of FULL PACKETS instead of a packet per line. The transmission of packets is based on full packet buffers or a timeout. This approach works fairly well except when another user attempts connection to the already busy BBS. This causes a TNC message "*** connect request from: W2XYZ" to be inserted into the data stream. This has been resolved through the use of a "silent" TNC-2 EPROM written by N2WX. This is a fully functional version fo the TNC-2 software that has ALL messages removed. The BBS obtains the callsign of the station by entering command mode and using the "c" command. Before this was available these text messages had to be manually removed with a text editor. Another enhancement would be the support of multiple simultaneous users. This has been added to the PRMBS package by NN2Z, but it still only allows for two users on separate ports.

What is needed is a message/file server which can support binary files, full packets and multiple users.

Computer-to-Computer

This mode of operation started as a BBS-to-BBS function, but in the last year this activity has included a rapidly growing number of users. This growth has been fueled by the large numbers of Asian MS-DOS machines available on the U.S. market. Many Amateurs are receiving electronic mail that is directly forwarded to their systems by their "HOME" BBS. This helps reduce user demand on the BBSs during prime evening hours. Another activity is file transfer between users. These transfers are often interrupted by other users of a congested channel. The result is a restart from the beginning of the file.

The file transmission restarts greatly affect the efficiency of our BBS-to-BBS forwarding and local area networks. It also Wastes the user's time.

What is needed is a robust, automatic system for the unattended transmission of files. This system must have the capability of resuming interrupted forwarding sessions and it must be common to both users and servers.

Roundtable/Net

The roundtable or net operation is a venerable activity of Amateur Radio and it is by far the most poorly supported by packet radio. Some groups operate in "unconnected" mode and use the LAN Digipeater to relay packets to all members of the group. For reliablilty each user monitors the channel to see if the digipeater retransmitted the packet. If the packet is not relayed, the user retransmits (and therefore re-types) the message. This is far from reliable. Another approach was tried by N2WX in his Gator Switch. Each user connects to the switch, then "joins" the roundtable by issuing an appropriate command. The switch copies received data packets to each link corresponding to the members of the roundtable. Thls was thoroughly tested in GATORNET and the RATS Digiplex System and was found to be too extreme. The channel would bog down when acknowldgements would collide as they were sent by each station. This approach did however ensure a reliable, if not slow, method of group communication.

What is needed here is a reliable mechanism for getting packets to the LAN server and a method for reliably getting packets to ALL members of the roundtable.

Bulletin Broadcast

This is another venerable activity which is not supported by packet radio. Many groups have examined ways of acheiving multi-point dissemination of information. The same basic mechanism is quite handy for alerting Amateurs to band openings and disasters. Some folks have taken to using the "LCALLS" and "BUDLIST" parameters for this purpose, but It causes problems for hormal activities. Many of the reliability issues of this mode of operation are common to the Roundtable ahd Net operation mentioned above.

What is needed here is a server and a method for signalling stations and reliably transferlng data to the destination stations.

DX'ing

This is the grand-daddy, the true motherhood and apple pie aspect of Amateur Radio (second only to CW, hi ! hi !) and you guessed It, packet radio doesn't support it particularly well. When we dropped the Vancouver protocol (V-l) and moved to AX.25 Level 2, packet operators here ln New Jersey were able to connect to systems in Canada and In Maryland. Then came ALL THOSE USERS ! It was spoiled...gone forever... Well that's not quite true...We now have wormholes and Fuji (or is it OSCAR ?) and other bridges, but they are pleasant patches in the fabric of the network. NET/ROM and AX.25 Level 3 (level 2.5 ?) nodes are all over the place, but NET/ROM alters callsigns and SSIDs; and AX.25 Level 3 switches issue connect strings not recognized by the new versions of PRMBS and MBL BBS software. These nodes also provide newfound connectivity (YEA !) and enormous network loading (BOO !) Somewhere out there, we have some IP users who want the responsibility for error recovery to the the private reserve of each end system and not shared with the network. We now have a mad scramble by everyone concerned to build new software functions or gateways between all these disjointed systems.

What is needed is a uniform set of communications procedures based on common, internationally recognized protocols.

COSI ARCHITECTURE

The RATS-COSI (Connected Open Systems Interconnection} approach is based on the internationally recognized communications protocols recommended by the CCITT [International Telegraph and Telephone Consultative Committee) and the IS0 (International Organization for Standardization). These bodies provided much of the original source material that went into the AX.25 Amateur Packet,-Radio Link-Layer Protocol. When the members of AMRAD and RATS met to hammer out the AX.25 Protocol they had the foresight to choose a protocol suite which would evolve in a controlled manner and provide the basis for a complete protocol set for the users of the Amateur Packet Network. Inter-operability with other Amateur and commercial networks and international acceptance were major factors in the selection of the CCITT X.25 (or IS0 8208) protocols. This has proven to be a daring and rewarding choice. It has not been without its difficulties.

Since the group first met, the CCITT and IS0 have moved rapidly to align their documents and refine the protocols in the OSI Reference Model. Inconsistencies and gaps have been filled. The most important work has been in the definition of the upper layer protocols. This now provides a consistent structure and method for applications to communicate with corresponding systems.

The COSI Architecture defines four basic LAN servers:

- Message/File
- Network Access
- Roundtable
- Broadcast

The various server functions may be combined into a single unit, but some thought should be given to channel loading when these functions are provided.

The RATS Digiplex system is in the process of evolving to the COSI Architecture. The protocols required to support this 7 layer model have matured to the point where systems based on all layer functionalities may now be developed. Companion papers provide detailed protocol specifications for the Session, Presentation, and Application layers. These will complement previous work that defined the protocols for the

Physical, Link, Network and Transport Layers.

The communications protocols used in the RATS-COSI communications architecture are outlined in the Figure "COSI Communications Architecture". These protocols provide a common method for systems to communicate.

The level 1 [Physical Layer] protocol will vary according to the speed and band used but for the purposes of clarity most users will use the Bell 202 modem to audio frequency shift an NBFM carrier (VHF/UHF).

The level 2 (Link Layer) protocol used is a the AX.25 Link-Layer Protocol. Details may be found in the ARRL publication: "AX-25 Amateur Packet-Radio Link-Layer Protocol, Version 2". Further information may be found in the COSI Implementer's Guide.

The level 3 (Network Layer) protocol is the AX.25 Packet-Layer Protocol a conforming implementation of CCITT X.25/ISO 8208. For more information see the COSI Implementer's Guide: AX.25 PLP Network Protocol Specification for the Amateur Packet Network". This layer provides a path through a network of switching nodes. It multiplexes each user's data onto a Virtual Circuit.

The level 4 (Transport Layer) protocol is the AX.224, Class 1 Protocol a conforming subset of CCITT X.224, 1984. See the COSI Implementer's Guide: "Proposal: Recommendation AX.224 Transport Protocol Specification for the Amateur Packet Network". This layer is responsible for providing reliable data streams between corresponding systems operating in an Open System environment.

The level 5 (Session Layer) protocol is AX.225 a conforming subset of CCITT X.225, 1984. See the COSI Implementer's Guide: "Proposal: Recommendation AX.225 Session Protocol Specification for the Amateur Radio Network". This protocol provides the capability to control the connection, interruption and resumption of connections used by corresponding application programmes in an Open System environment.

The level 6 (Presentation Layer) protocol is AX.226 a conforming subset of CCITT X.226/ISO 8823. Specific Presentation Contexts have been defined for systems operating in the Amateur Packet Network. These are outlined in the COSI Implementer's Guide. See: "Proposal: Recommendation AX.226 Presentation Protocol Specification for the Amateur Radio Network".

The level 7 (Application Layer) protocols are AX.ros and the RATS Transaction Protocol (RTP). AX.ros is based on the CCITT X.ros/ISO 9272/2. This protocol provides applications with a method for communicating the invocation of remote operations on correspondent Open Systems. This Application Service Element provides the framework for the operations defined in RTP. RTP is a basic set of operational primitives that can be used to manipulate data objects in an Open System. AX.ros and RTP are described in a section of the COSI Implementer's Guide entitle&: *"Application Service Elements for Open Systems Operatang in the Amateur Packet Network".

The protocols defined for use in the Presentation and Application Layers are based on the CCITT/ISO ASN.l encodings.

COSI SYSTEMS

PRMBS and PMBx

These "C" language based message/file server (PRMBS) and the computer-based user packages (PMBx) share a common software base including the user and communications interfaces. PRMBS is a "public" or shared server package. :PMBx supports one master instead of a community of users and is simpler to configure and manage than a normal BBS. PMBx greatly reduces prime time user logins to the "public" message/file server. The PMBx package also allows users to exchange messages and files directly.

The current RATS Digiplex Message/File server is -the MS-DOS based PRMBS package written by KA2BQE. Many new features are already in released versions. The rest will be added during the fall o-f 1987. These will include:

Multiple simultaneous users

Binary transfer

Priority message handling

NTS support

Multiple callsigns for interservice gateways

Distribution lists

Distributed conferencing

Interruption/resumption of data transfer

Machine-to-Machine Protocol (COSI-base&, with ROSE and RTP)

COSI-Switch

RATS has been experimenting with several switches written by N2WX. The latest is a "C" language based system. After having examined these switches in our network several changes have evolved. The most significant is a new support method for Level 2 users accessing the Level 3 switch. This approach allows the Level 2 user to type:

"C DestinationCallsign V SwitchCallsign, DestinationNodeAddress"

or

"C KA2BQE V N2DSY-3, 609010"

This approach allows the RATS Digiplex System to offer implicit addressing. This scheme has exte'nsions to allow for access/egress digipeaters, and international connections. The COSI-Switch also has the advantage of not modifying the SSID of the orignating or the destination stations. Further the multiplexing scheme is based on the CCITT X.25 and IS0 8208 Packet Level Protocols.

COSI-Net

This system offers local services to the LAN. These services include management of roundtable or net activities. The user accesses this server and then selects the net

function. Each packet from the user will be acknowledged. Then the server will transmit the data in a UI frame that has a source callsign indicating the net or group name. The server's callsign is included in the digipeater callsign field. The H-bit is set. The users operate their TNCs with MCON ON and the LCALLS set to the net or group name. The server will prefix all user data with the sender's callsign and a sequence number. No active retransmission recovery will be provided. This is not a major problem because reliability problems are usually found on the uplink path. The remaining errors will be easily detected by any station observing a gap in the numeric sequence. A request for re-transmission may be manually solicited from the source. Future versions of this roundtable manager will interoperate with the COSI-Term and provide automatic recovery procedures.

Another service offered by the server will be distributlon services for alerting and bulletins. This is similar to the roundtable manager, but is single user. This system provides an error checked connection for uplink data and a broadcast UI-frame with the user data left unchanged. The source callsign is shown to be that of the orginator. The digipeater field is contains the callsign of the server. The H-bit is set.

COSI-Stack

COSI-Stack is the heart of each of these systems. The "stack" is a collection of OSI protocols which, provide communications services to users/user-applications. COSI-Stack is the software implementation of the OSI communications protocols outlined above. The software used in these servers is written in the "C" language for machines based on the Zilog Z-80 and Intel 8088 family of processors. The portability of this language allows the re-use code written for a particular system. We also derive the benefit of compatibility; when our source is upgraded it is incorporated into all the systems with a simple compilation of the changed module and re-linking for the target machine. This is extremely important because the maintenance of compatibility among multiple systems could be a chore if many machine-specific changes were required on each system.

COSI-Term

This is a basic user package for MS-DOS systems. Its major features include:

Automatic reconnect and resume;

Binary transfer;

Simultaneous file send/receive;

Simultaneous keyboard and file transfers;

ROSE and RTP support.

The package will be incorporated into the PMBx package.

SOFTWARE

We have a variety of systems already in use and development is continuing. The pace of software development is more rapid. Some systems are already available, some will be distributed around the time of the conference, and still others during the fall. Most source code is available and included with the executable modules. Those modules not currently available in source will either be made available at a later date, or will be replaced by modules whose source can be distributed.

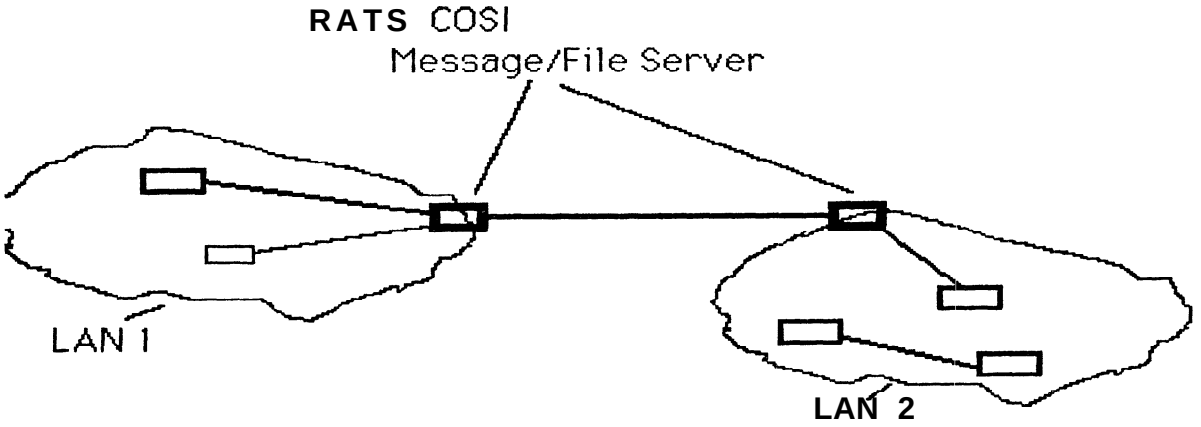
All modules are copyrighted, but are distributed for non-commercial use. Commercial use is possible, upon the conclusion of a licensing agreement. The agreements are designed to help provide the resources for enhancing the Amateur Packet Network. Organizations contemplating commercial use may consider offering products or services in lieu of funds. We all earn a decent living; we aren't interested in financing offices, secretaries, trips, etc. WE'RE BUILDING A NETWORK !

DOCUMENTATION

The Radio Amateur Telecommunications Society recognizes that OSI protocol expertise has been sparse, and therefore READABLE documentation virtually non-existent. We have begun to document the protocols, the implementation agreements/details and some system functional requirements. These documents comprise the RATS COSI Implementer's Guide. Interest in our work has been received through professional channels so the guide will be circulated in both the Amateur and professional communities. The Amateur community should take note. The Guide will evolve over time and updates and additions will be circulated via the nets.

SUMMARY

The Radio Amateur Telecommunications Society is dedicated to the development of OSI protocols and networks. We have addressed the basic operational modees through the application of a consistent architectural implementation: Open Systems Interconnection Protocols. Knowledge of OSI protocols is a relatively new expertise and it has taken the past few years build up interest, and expertise. We are now turning these into useful tools for the Amateur Community.

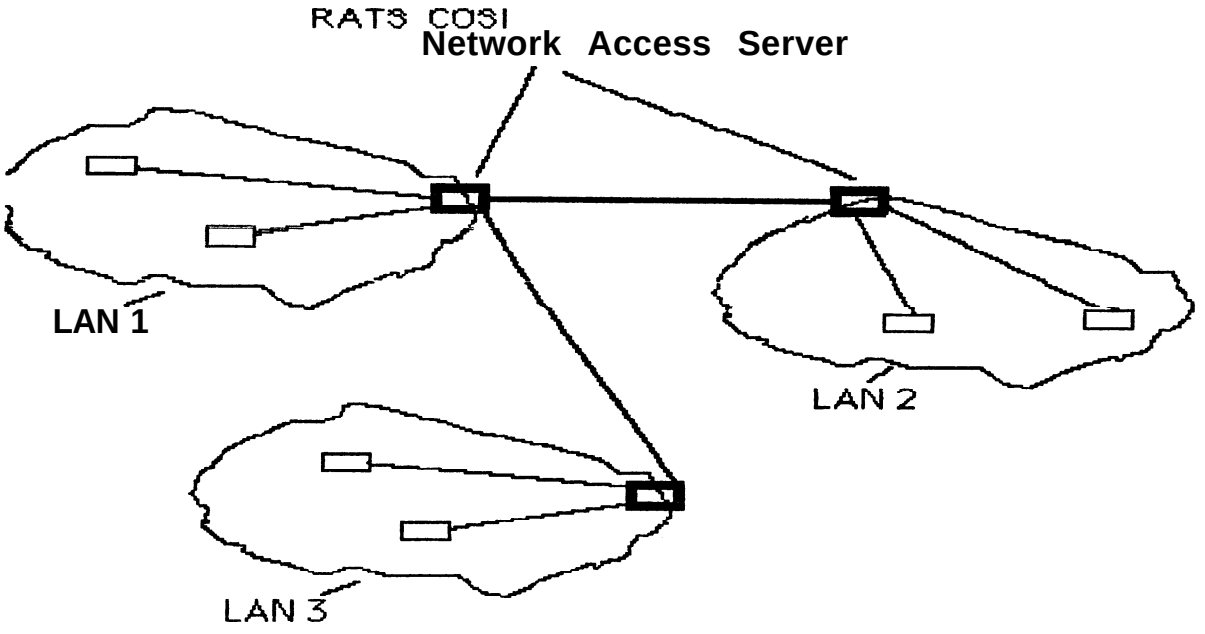


Message/File Server

PMBx User

Keyboard User

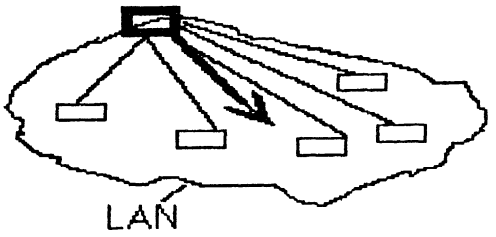
Application	**ROSE, RTP, ASN. 1**	**7**
Presentation	**X.226**	**6**
Session	**X.225** BCS	5
Transport	**X.224 TP-1**	4
Network	**x.25 PLP**	**3**
Link	X.25 HDLC/AFT	**2**
Physical	RS-232/V.35	1



Network Access Server

Keyboard User

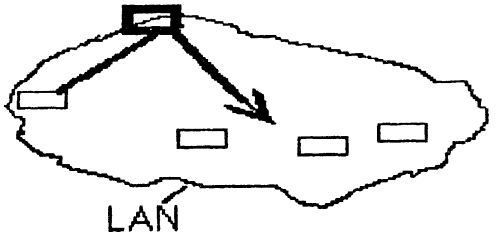
RATS COSI
Roundtable Server



Network Access Server

Keyboard or Computer User

RATS COSI
Broadcast Server



Network Access Server

Computer User