Winlink 2000 . ..A Global Ham Message Transfer and Delivery Network

Rick Muething, KN6KZB   <rmuething@cfl.rr.com>
Vic Poor, W5SMM   <vpoor@spacey.net>
Hans Kessler, N8PGR   <NSPGR@winlink.org>
Steve Waterman, K4CJX   <K4CJX@home.com:>

Abstract:
Early digital modes broke from the traditional "live" interactive QSO and fathered the now familiar store and forward message systems we now take for granted in our BBSs and E-mail. The increased demand for mobility in Ham radio has evolved into the need for a reliable, rapid, global message transfer and delivery network that spans both the Ham radio and Internet domains. This paper describes the implementation of the next generation Ham message and information network that allows mobile users global connectivity to other amateurs, Internet mail users and WEB based information while remaining free of the constraints of the "home" BBS. Winlink 2000 is now a fully operational global network serving thousands of mobile ham users and providing reliable connectivity for both text, and binary data.

Key Words:
Winlink, Winlink 2000, WL2K, Global Messaging, Internet Gateway, Shared Database, Message Mirroring, Binary Attachments, Wireless Connectivity, Packet, Pactor, Network.

Background and Evolution of Winlink

To fully appreciate a concept like Winlink 2000 requires an understanding of the evolution of its recent predecessors APLink, Winlink, and Netlink. In 1983 Vie Poor, W5SMM, developed APLink, a Microsoft DOS based message store and forward program which allowed HF radio BBS exchange using Amtor. APLink allowed mobile hams outside the range of VHF and UHF Packet stations to connect and route messages similar to the growing popular VHF BBSs of the time. The protocol of these early systems was not error-free and required special consideration to make it workable in the demanding BBS application. The authors of these various systems developed the first communications protocol and coordinated their activities through the "digital committee". One of those authors is Jean Paul Roubelat F6FBB who developed the error-free FBB protocol for use in Packet radio. In 1992 Vie re-wrote APLink to operate under the Windows operating system. The new system was called WinLink. In 1994 ownership of WinLink was transferred to Hans Kessler NSPGR who over time gradually refined and enhanced WinLink to the level we know it today. Winlink, however, still limited the mobile ham to text message traffic with other Ham BBS users. In 1996, after a two-year search, Steve Waterman, K4CJX, an active WinLink SYSOP, found Jim Jennings, W5EUT who agreed to develop an interface into the Internet E-mail system. "NetLink" became the mechanism to add Internet connectivity to Winlink by providing an automated Internet 0 Winlink gateway. This NetLink gateway and its NEXUS message format provided mobile hams access to the rapidly expanding Internet E-mail. Jim and Hans added further enhancements to Winlink/Netlink that allowed it to automatically generate weather bulletins based on text based WEB data. Mobile users especially cruisers on the high seas found this not only convenient but a significant safety factor during long passages. Perhaps the biggest shortcoming of this system was the centralization of all functions and message data to a specific Ham BBS (home BBS). If that BBS encountered a problem due to power, equipment, propagation or Internet failure users of that "home BBS" were left without mail service

and access to important WX data. The joy and fun of running a BBS could too easily become a rather demanding job of providing reliable full time service on a volunteer basis. It was from this and the expanding need for increased E-mail, weather, and information services that Winlink 2000 (WL2K) was born.

Introduction to Winlink 2000:
In conventional BBS systems (including Winlink and FBB systems) messages are stored in files or a database that is local to each station. Messages in these systems can remain local to the specific BBS or forwarded to other BBSs and (in some systems) Internet users. Users must declare a "home" BBS to establish an address and route by which reply messages can be returned. Winlink 2000 eliminates this "home BBS" concept for any user station that designates itself as "mobile". To do this requires replicating and synchronizing the message database to all BBSs within the WL2K network. When this is done a mobile station may connect to, pick up, and send messages freely from any station in the network. Reply messages (either from radio or Internet users) are able to always use a consistent unique systemdwide address no matter where the reply is to be picked up. Such a system requires frequent and reliable exchange between all BBSs within the system to insure the database is kept synchronized and fresh. To augment the traditional radio forwarding of message WL2K uses the Internet TCP/IP link as the prime channel for BBS to BBS connectivity. Radio forwarding can be used as a backup if there is a failure in the generally reliable and high bandwidth Internet channel.

Fig 1
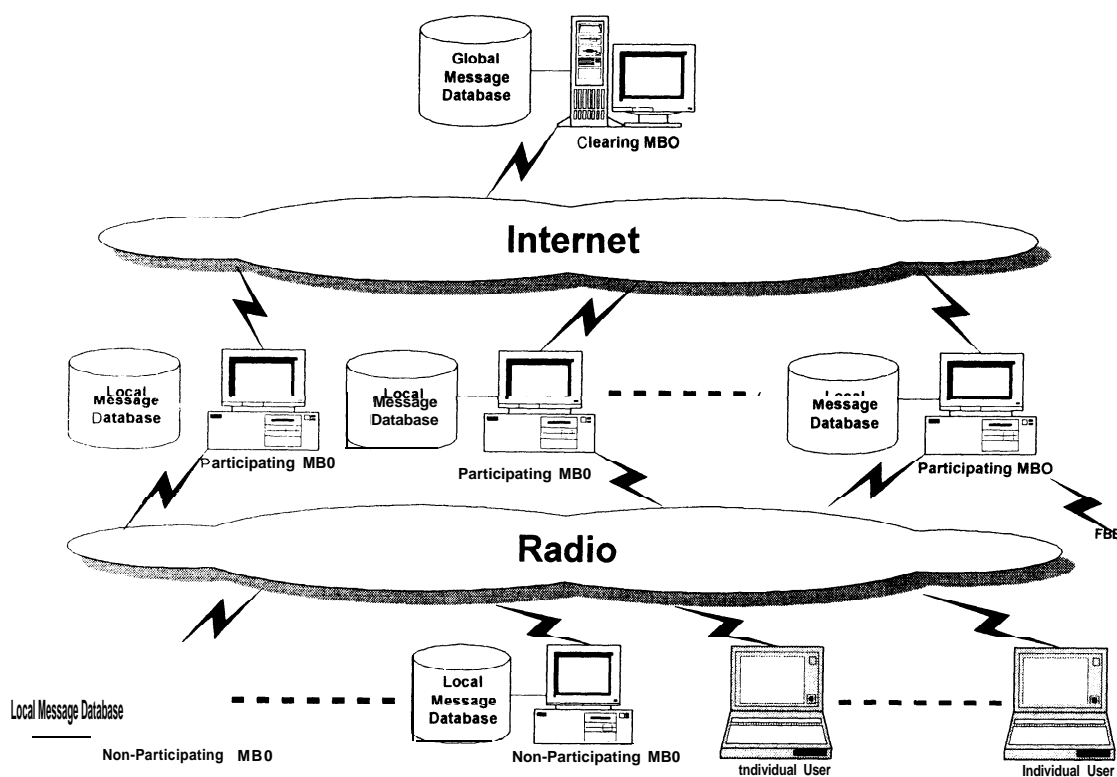
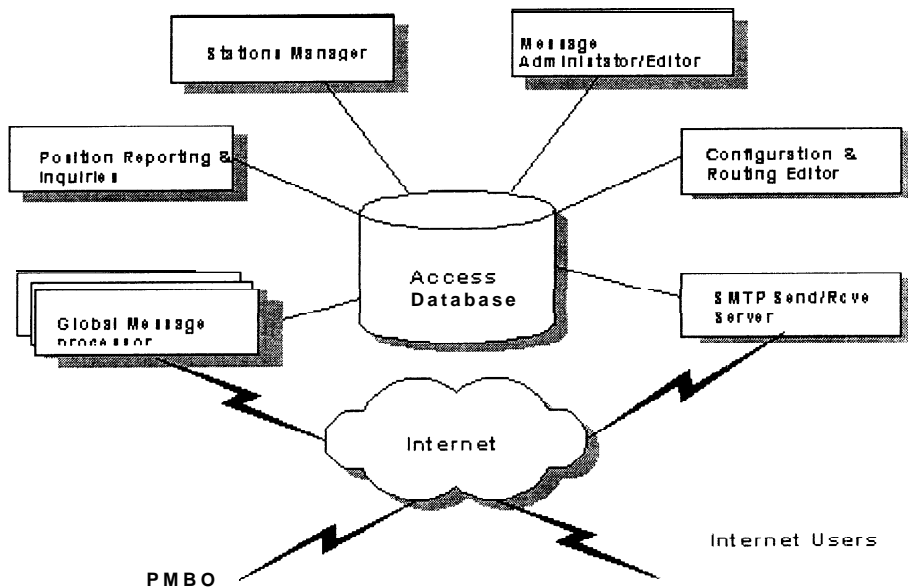**WinLink 2000 - Top Level View**

Winlink 2000 Architecture

The Winlink 2000 system architecture is shown in Fig 1. There are four types of nodes in the system interconnected by Radio or Internet TCP/IP channels: CMBO, PMBO, NPMBO, and USER.

CMBO

The CMBO is the Clearing Mail Box Operator: This BBS provides the prim.ary link to the Internet for E-mail services and connectivity to the other PMBOs. The CMBO does not connect directly to end users (it does not support radio channels) and executes the specific WL2K functions outlined in Fig 2.

Fig 2

Station: Manager
Message Adm inistator/Editor
Position Reporting & Inquirie :
Configuration & Routing Editor
Access Database
Global Me ::age proce::or
SMTP Send/Rcve Server
Internet
Internet Users
PMBO

W inlink 2000 - Clearing MB0 Tasks

PMBO

The PMBO or Participating Mail Box Operator runs the PMBO specific Winlink 2000 code modules and keeps a local copy of the shared WL2K database (Fig 3). The PMBO provides wireless connection services to the end user and also connectivity (via radio or Telnet) to other Non Participating MBOs (NPMBOs). The wireless links currently include multiple Pactor and Packet channels but are not limited to these modes. Telnet ports provide a convenient and reliable method to move traffic to other systems like FBB that support the Telnet protocol via TCP/IP links. Each PMBO also runs the Inquiry Server that provides on demand weather, local bulletins and other WEB based information in reply to end user Inquiries.   Messages picked up by users at one PMBO are signaled by control messages via the CMBO to other PMBOs to clear those messages from the database keeping the PMBO databases in close synchronization. All functions including database repair and backup a.re automated to allow the PMBO and CMBO to run in unattended mode. Most PMBOs scan multiple frequencies in Pactor I and Pactor II as well as VHF/UHF Packet.

Fig 3
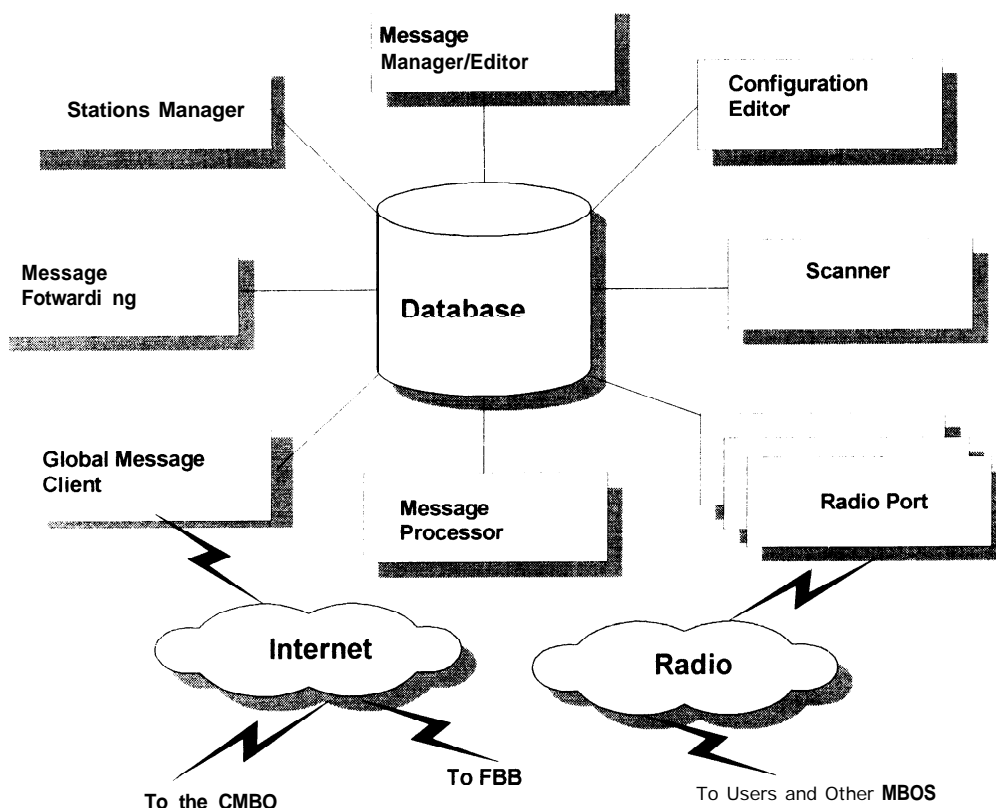


WinLink 2000 - Participating MB0 Tasks

NPMBO

% I%1 BO nodes connect to the WL2K system via conventional radio or Telnet forwarding using the standard FBB protocol. WL2K provides token routing tables that allow directing any radio or Internet messages to specific NPMBOs based on regional location and the NPMBOs message routing cqability. NPMBOs can also forward plain-text E-mail messages to and from the Internet by using the Yt<XIJS message format through any PMBO.

USER

i.T5erc (mobile or fixed) connect to the WL2K system either directly via a PMB0 or indirectly via a mess&e forwarding NPMBO. The message mirroring (database replication and synchronization) of the PlGBO assures that mobile users may pickup and send mail from any PMBO. A WL2K specific client (user interface program) is required to connect to the PMBO for full WL2K functionality. This expanded functionality (summarized in Table 1) includes multiple To and Cc addresses, mixed radio and E-mail addresses, binary attachments and position reporting. Limited WL2K functionality (text messages including NEXUS formatted Internet messages) is available to users through existing FBB compatible clients (traditional BBS systems) via either PMBOs or NPMBOs. Jim Corenman, KE6RK, has expanded his very popular client program AirMail to include full functionality with WL2K. This easy-to-learn user program interfaces with most popular TNCs and provides all the functionality of

standard E-mail clients including address and message management in addition to radio specific functions such as automated radio control. AirMail also provides a NMEA GPS interface to allow automated position reporting through WL2K allowing radio and Internet users to easily get position reports from mobile hams. Figure 4 is a screen capture of AirMail's message index along with text and graphical weather data downloaded on demand from WL2K's Inquiry Server.

Fig 4
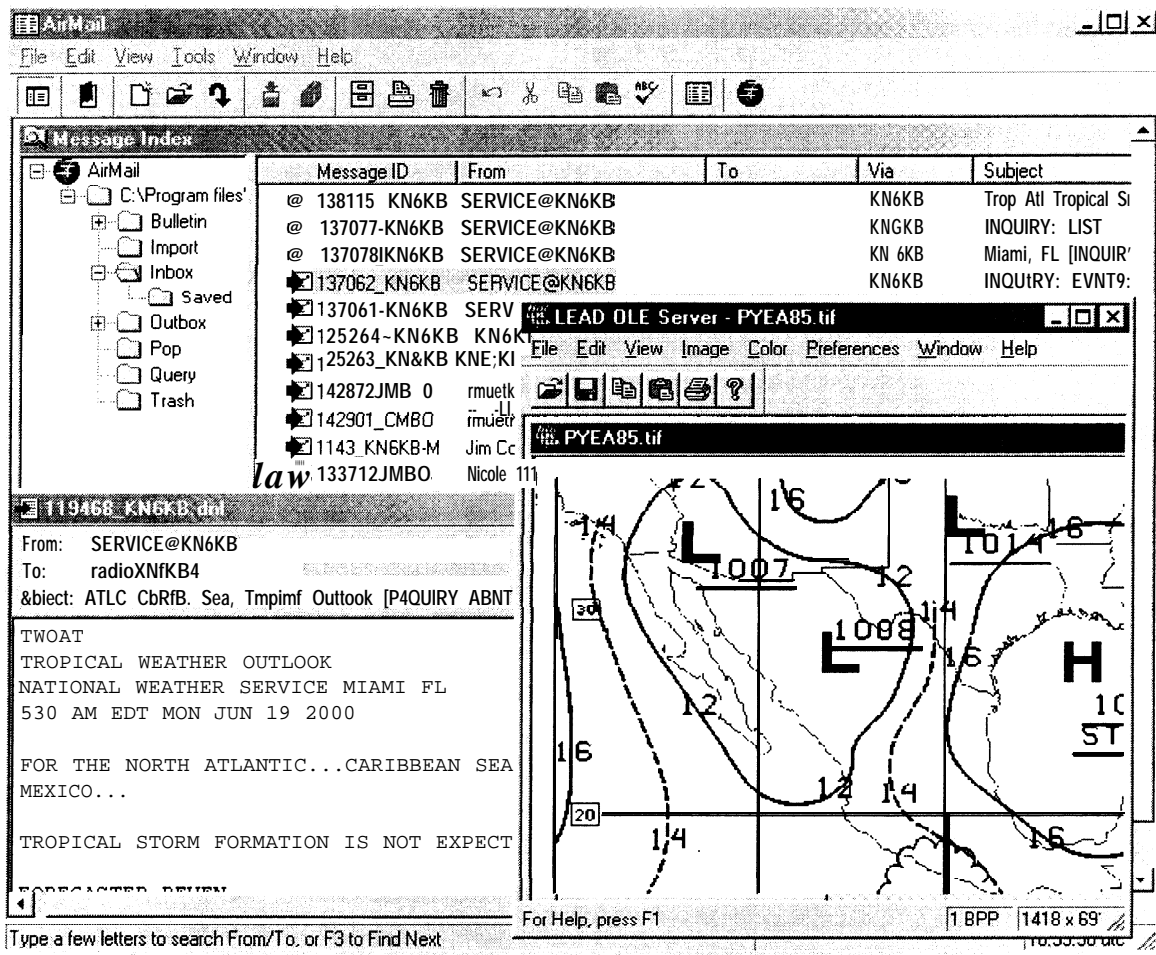
WL2K Implementation

During the early planning stages of Winlink 2000 the system architects an.ticipated the need to build a flexible scalable system that would provide the high reliability and performance needed in a BBS by capitalizing on the newer 32 bit operating systems and database management tools. The ability to use standard database engines and query languages (SQL) was a significant aid in developing a large and robust shared database system. The current WL2K system is written in Visual Basic 6 for use under Windows 98 and Windows 2000. For cost consideration it uses the Microsoft Jet database engine though it can be readily scaled to a true SQL server for larger implementations if needed. There are a total of 20 separate modules used by the PMBO and CMBO about half of which are utility and database management tools. Multiple instances of the communication drivers are supported which

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allow a single PMBO to operate multiple radio and telnet channels concurrently. Third party Active X controls were selected to aid in implementing specific Internet Servers and Clients as well as image compression of WEB graphics and support functions such as spell checkers. Standard commercial products are also used in each PMBO to protect against accidental or malicious virus files. The total WL2K effort was done on a purely volunteer basis by the authors over a period of approximately 2 years. Initial on-the-air testing began in October 1999 and by August of 2000 a total of 17 PMBOs and 93 NPMBOs world wide were interfacing to over 1600 Hams and handling in excess of 2000 messages per day with typical message turnaround times on the order of minutes.

Summary of WL2K Features
Table 1 summarizes the major enhancements and additional features of WL2K compared to Winlink and conventional BBS systems.

- Mobile users (no home BBS required)
- Position reporting and tracking (Automatic with AirMail)
- Position inquiry from Radio or Internet (current and track)
- True E-mail functionality with attachments and forwarding
    Mixed radio and E-mail addresses with multiple recipients
    User set attachment size limits
    Automatic virus screening
    Junk E-mail protection (lockout)
- Expanded, interactive Bulletin handling (WX, Help, Info etc)
- Forwarding of amateur messages to Internet accounts for inactive
  or inoperative radio users

Table 1   WL2K Feature Summary

Future Enhancements for WL2K
Because the system is based on a productive development language like VB and uses standard database management mechanisms expansion to other channels and services is easily embraced. This could include expanded wireless HF, VHF, and UHF protocols as well as amateur satellite connectivity. Due to the intimate connectivity of WL2K with the Internet we anticipate allowing users to access the shared database through a secure Internet connection (WEB browser) as an adjunct to the standard radio channels. Finally, access to reliable and immediate weather and other WEB text, HTML, and image data combined with the robustness of a distributed system make WL2K well suited to support future emergency and disaster communication needs.

For More Information
For additional information on the WL2K system you can visit the WEB sites listed below or E-mail to the authors.
http:!/winlink.org/k4cjx Steve Waterman's home page containing the latest status of the WL2K Network
www.airmail2000.com   Jim Corenman's Web site describing AirMail and related programs. The latest version of AirMail can be downloaded from the site.