Long Distance Packet Mail via Satellite

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INTRODUCTION

The packet radio mail system is a great Electronic Mail system for amateurs. Within a local VHF area, it works fine. However, when trying to send messages farther away, they must be passed via the HF Long Haul system, which has many drawbacks and problems. Why not use satellites to bypass the HF bottleneck for a nationwide long distance mail forwarding system?

BACKGROUND

Soon after I started using packet radio, I was trying to send some messages from my home in New Jersey to my father in the south central United States. Shortly after I started sending test messages to my father, I was told not to "...waste our precious HF bandwidth with repetitive test messages..." and also that it was not possible to send messages larger than 5K through the long-haul message system because of the problems with HF packet.

The goal was to be able to send large (20K) files to him on a routine basis and ultimately be able to send binary files such as word-processor documents, and spread-sheet files, but the HF gateways would not allow this. Now I want to do something about these limitations which, in my opinion, are extremely severe.

I am not saying that the current system is bad. Actually, I like the system when it works, but that is the extent of it. The long haul HF link is the main bottle neck of the entire system. For example, I can get messages from New Hampshire to New Jersey in about 8 hours. But I get messages from Virginia that can take as long as 18 days to get to me. The strange thing about this is Virginia is closer to me than New Hampshire. Another problem is that most of the HF gateways have a file size limitation of 5K, and there are even some that have a file size limitation set at less than 2K! Since the long haul HF packet system is the main bottle neck, let's try some other way around it.

We all agree that some sort of reliable long distance packet communications is needed. Long distance packet communications has been a problem among packeteers for some time. The

HF packet system* has problems that are being worked on. This does not mean we should sit back and wait for them to be fixed. We should be experimenting with other possible means of transmitting packets over long distance.

With the orbiting amateur satellites that we have now and with the geostationary ones that are coming in the future, we can accomplish this goal. Existing satellites, such as OSCAR-13 can handle packet signals. Let us use these capabilities to supplement and eventually replace the HF Long Haul packet system.

IMPLEMENTATION

To understand this proposal, we first must understand how the Long Haul system works. When you send a message from your local BBS to someone, the BBS software checks to see where the person your message is addressed to is located. If it is someone on the local BBS, that is the end of it. If the person is at a BBS that is local to your BBS, it will get forwarded directly to that BBS. If the BBS is somewhat distant, but still accessible via local VHF packet, then the message will be transferred via one or more hops through local BBSs. If the destination is outside the local area, or 'DOMAIN', then the message gets forwarded to the local HF gateway[1]. This HF gateway is what takes care of getting your messages forwarded long distances and this is were the bottle neck is.

The way that most of the BBSs are starting to use to determine where the person is a system called "DOMAIN ADDRESSING". This is the addressing scheme that lists the BBS call, followed by the state etc, i.e. KB2ICI @ K2DLJ.NJ.USA.NA. In most cases, the lowest domain is at the state level, but in some of the larger states like California, there is another level, i.e. K6TS @ K6ABC.NCA.CA.USA.NA. In this case, the NCA is Northern California. This scheme lets us know what DOMAIN to send it to. With this, we can set up a packet forwarding system that uses satellites and NO HF stations.

Packet communications is practical with current satellites; there are even satellites that are dedicated to packet. However, this proposal does not require special packet satellites; it only requires a normal uplink/downlink satellite such as Oscar-13.

It is possible with existing equipment and software to set up a station that will automatically track, acquire signal, account for dopler shift, and make a contact, all unattended. If there were a similar station in some other state, presumably farther away than would reachable by normal VHF packet, we could then transfer packet messages from New York to California. When finished with the transfer to California, the system could then switch to another frequency where it knows there is a station in Florida. It could then transfer packet messages to Florida and

* The HF packet network is running on an STA (Special Temporary Authority) from the FCC because it has been illegal to operate an unattended HF station. This is not the case with VHF and therefore with a satellite system running on VHF/UHF frequencies.

continue for as many different states (domains) as it had messages for. The tracking software has evolved to the point were it also knows what other areas are also in the footprint of the satellite, thus able to know which states (domains) to try to contact at what time in the orbit of the satellite.

If too many of these stations were attempting this all at the same time, we would run into too many collision problems. A system would have to be set up as follows:

Each domain would have only two active stations, one for transmitting messages out of that domain, and one for receiving messages. The station for receiving messages would be the *Domain Receiving Station* and the station for transmitting would be the *Domain Transmitting Station*. These stations do not need to communicate with each other and do not even need to be close to each other. To avoid RF interference it would probably be advisable that they NOT be at the same location.

DOMAIN RECEIVING STATION

Each state (domain) would have ONE receiving station on a fixed frequency. Ideally each domain would have its own frequency to reside on, but this would not be required. A few frequencies with all of the domains spread among them should be quite adequate. Each domain would have an assigned frequency and adjacent domains would not be on the same frequency. At a later date more frequencies could be added and not all domains would have to be on the same satellite. Also, a station could be set up to track a primary and a secondary satellite. When the first one is not available, it could be tracking the secondary satellite.

This station would be solely responsible for receiving traffic (packet messages) into that domain. It would track its satellite as long as it was in view listening on its assigned frequency. If anything was heard, it would respond. Stations for other domains also within the footprint of the satellite could be on the same frequency. The messages would be transferred to the receiving station and then passed on to other systems via normal VHF packet channels for distribution to the final destination. This system would NOT transfer any messages out of the domain.

DOMAIN TRANSMITTING STATION

Each domain would have ONE Domain Transmitting Station. This station would collect messages for other domains and save them. When a satellite came into view, it would try to contact another station that was also currently in the satellite's footprint. Once contact was made, all of the messages for that domain would be sent. Then it would try for the next domain that is also under the satellite's footprint. The other stations under the footprint would be constantly changing as the satellite moves. Therefore, it should be possible to contact several different domains on a single pass of a satellite.

The transmitting station would have

to have full control of the radio to be able to switch frequencies and maybe even satellite transmission modes i.e. mode L (1269/435 MHz) and mode S (435/2400 MHz). Mode B (435/145 MHz) will work fine for experimentation, but may not have enough band width for full implementation.

By implementing this concept, and using normal satellite transponders, such as OSCAR-13, New Jersey could be sending mail to Texas, Texas could be sending mail to Florida, New York to Ohio, etc., all at the same time, on the same satellite, on different frequencies.

FUTURE EXPANSION

As the implementation grew, it might become necessary to allocate one frequency for each domain, but that should not be too difficult especially on modes L and S. The speed of communications could be increased dramatically for larger amounts of messages without everyone having to get a new TNC. Only the domain stations would need the faster TNCs for more efficient passage of data.

The ideal set-up for this whole system is with geostationary satellites. If the system were implemented as described, geostationary satellites would be a natural transition. The domain transmitting station would still have to have movable antennas to be able to point at different geostationary satellites and to be able to talk to those stations that are still on the orbiting satellites. A receiving station, which only uses one satellite and one frequency would be able to be constructed with non-moving antennas pointed at the geostationary satellite it was assigned to.

OTHER PROPOSALS

Of the six MicroSats launched this past January, three are configured for store and forward packet. These are UoSAT-OSCAR-14, PACSAT-OSCAR-16, and LUSAT-OSCAR-19. Gateway stations using these store and forward orbiting BBSs have been proposed.[2] Using store and forward packet satellites is fine, however it has many drawbacks. First and foremost, it requires specialized satellites. We all know that satellites are not cheap. Also, these specialized satellites can only be used for packet, and can only be used on one frequency at a time. This limits the number of packet QSOs going on at any given instant. Also, they have to take a message in and at a later time send that message back out to someone else, thus reducing by half the theoretical through-put. The satellite BBS systems have a finite amount of storage and can easily fill up. While they will be closely monitored to prevent overflow, large amounts of traffic could make these systems unacceptably slow or cumbersome.

These satellites in low earth orbit do have their benefits, mainly a lot of people can access it with only a small investment in additional equipment. However, this proposal is focusing on the long distance back bone and as stated above, should only have two stations in each domain.

HARDWARE REQUIREMENTS FOR A STATION

The major components of a station would be as follows:

Satellite communications

- Computer controllable satellite radio
  i.e. Kenwood TS-790A,
  Yeasu 726, 736, Icom 970
- Satellite TNC as required for satellite packet
- Computer controllable rotor
- Computer for tracking satellite and frequency control of radio (this could be the same computer used for the packet operation)

Domain VHF Packet communications
(local packet operation)

- VHF Packet radio
- VHF Packet TNC
- Computer for message handling (This computer must also talk to the satellite radio and the satellite control computer to coordinate the communications.)

CONCLUSIONS

A long haul packet forwarding system can be set up on satellites, totally bypassing the HF system which has some severe limitations. By limiting the number of stations per domain and a little bit of thought into frequency allocation we can set up a system that will allow any domain to send mail to any other domain within North America. Access to Europe and Asia would also be possible from some locations. This system will be able to be implemented slowly and the implementation of only a few stations will make a significant impact. It will have a very smooth transition into the future as we get geostationary satellites in place.

REFERENCES

[1] "Packet Radio's Long-Haul Mail System" Ed Juge, W5TOO CQ *The Radio Amateur's Journal,* Volume 46, Number 2, February 1990. Page 13

[2] "PACSAT Expectations and Preparations" John Branegan, GM4IHJ *The* AMSAT *Journal,* Volume 13 Number 1, March 1990