WHITEPAPER

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This short whitepaper describes the analysis and motivation for the design and development of the SAAMFRAM protocol and SAMM_MAIL application.

Challenges with HF digital modes

Scaleability

Some digital modes rely heavily on an architecture based on gateways to send and receive messages. While these work well in good propagation and when traffic is relatively light, when propagation drops to the point where stations are unable to hear if the gateway is in use and the traffic attempting to contact these gateways increases (as could happen in an emergency) traffic collisions go up and efficiency is less than optimal. Although gateways are a usefull addition to the digital HF comms toolkit, there are some limitations.

Station coordination

Coordinating the gateway message traffic, similar to the manner in which air traffic control coordinates the landing and takeoff of planes, is a potential method to enhance the scaleability of the gateways. Message traffic coordination would help reduce the number of stations treading on each other while attempting to send and receive messages via the gateway. Only problem is, the connection based digital HF modes typically utilized for sending the message traffic do not lend themselves easily to functioning in a group or net setting that would be required for coordinating the traffic. This therefore necessitates the use of another mode such as voice or a connectionless digitial HF mode such as JS8 to work alongside the message traffic; essentially a hybrid or multimode setting where two distinct modes are required, one to handle the coordination and one to send the actual messages.

Multimode digital

Voice/phone may be an option during great propagaion but voice does not work well in high noise levels or poor propagation. Voice typically needs to be above the noise floor to be heard clearly whereas digital HF modes,

especially those designed for weak signal communication, can be heard well below the noise floor. In the case of JS8 up to -28dB.

Using voice to coordinate digital traffic would seem to negate many of the advantages of using digital traffic for passing mesasges in the first place and would therefore not make a great deal of sense unless propagation was really good. So this leaves us with something like JS8 connectionless communication in a group setting for message traffic coordination.

Parallel vs Serial scenario

Let use an example. Lets assume the internet is out, which is highly likely in an emergency, and that one station needs to send a message thru a gateway to five other recipient stations. In this scenario, the gateway will need six communication sessions; one to upload the message to the gateway and five other sessions, one for each recipient, to download the messages. Typically this would also tie up a 3kHz wide section of the band for the entirety of these six sessions.

Now contrast this with one station sending a narrow bandwidth signal to multiple other stations in a group setting such as a digital mode HF net in real time. There are multiple advantages to this approach. Messages can be sent in real time, only one communication session is necessary if each of the stations are listening on the same band segment of the net (this effectively mutiplies the bandwidth by a factor of 6 for the example given), confirmation of accurate transmit/receipt of the message can also be given in real time, not to mention the other benefits relating to resilience to QRM/QRN and low power requirements and so on.

Some of you out there may be wondering “but narrow bandwidth signals are too slow” in response I would refer to an old saying in Information Systems Engineering which goes something like this: “never under-estimate the bandwidth of a truck load of backup tapes hurtling down the interstate at 90mph” I think the analogy works quite well to illustrate the point here.

Therefore, a potential solution to this is to use narrower bandwidth signals to actually send the messages as well so that many channels can be utilized on a single 3kHz wide band segment. This use of simultaneous

parallel communication can be enhanced further by the use of an offsets plan that can be distributed to each of the stations so that collisions are kept to an absolute minimum.

“Blackholing”

One other aspect of the gateways that pops up quite frequently in some of the literature documenting actual past disasters points to the concept known as ‘blackholing’ as being a potential issue. This refers to the situation where a message is sent to a gateway but there it stays as if it were sent into a black hole. This can be caused by the outbound internet link from the gateway going down or even by the gateway being overloaded and operating outside its designed operational parameters.

A solution to this is to use multiple stations either peer stations or hub stations that do not rely on the internet or on a single bottlenecked gateway station and for these stations to send the data in real time. When a hub station is ready for more traffic it can send out a ‘ready to forward’ message to advertise its current state. Some simple automation could develop this into a usefull feature for mesh networking.

Signal Loss

Messages are still susceptible to signal drops where part of the signal may not go thru. This becomes more of an issue for longer messages as even a small blip in the signal can necessitate a resend of the entire message. The well known solution here of course is to break up the message into frames and to use ARQ or something similar to confirm successful transmission/receipt. Typically these connection based data transfer modes work between two stations only. To do this efficiently in a group setting will require some enhancements to go round robin thru a list of stations in the group and ask if any of the frames from the last message need to be repeated. So one by one each station is confirmed to have a perfect copy of the original. All this could be done very efficiently. i.e. group mode ARQ.

Joining the dots

So where does this analysis of the situation leave things? Well I think there is a very good case for using narrow bandwidth modes such as JS8 in a net

setting to coordinate message traffic in real time among stations in the group. The message traffic itself could also be JS8 or it could be a higher bandwidth mode such as Contesia 4-500. If it is JS8, an offsets plan could be distributed to each of the stations on the net to ensure they are spread out efficiently across a 3kHz wide band segment to help reduce collisions. Group mode ACK can be used to ensure messages are sent and received efficiently in a group setting with minimal resends. This architecture addresses quite a few of the issues discussed above.