

Comments on “ACP Downlink PHY Layer Protocol Proposal”
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This note contains review comments on “ACP Downlink PHY Layer Protocol Proposal”, authored anonymously, with an apparent date of May 29, 2008.

Overall, this is a nice start to an important document. I look forward to reading the next iteration. Hopefully, these comments will help enhance the next version.

General Comments

- Put your name and date on everything you write. A version number would probably be useful for this document, as well. I like page numbers (and informative headers and footers) because individual pages seem to have a tendency to float around my office independently.
- I suggest that this document provide a *complete* description of the ACP downlink protocol or protocols (not just the physical layer protocol). That is, it should cover all of the protocols used to transport blocks from the ACP payload to the ACP ground station (but generally not the ground-station-to-ground-station protocols).
- I suggest that the objective of this document be to provide enough information that the ACP downlink protocols can be implemented unambiguously, both in the ACP payload and in an ACP ground station.
- I think that the document should contain a one- or two-page overview of the ACP system architecture. This would serve several purposes. First, it would make the document better able to stand on its own; it will make the document easier to read or review. Second, it will either inform the reader about the version of the ACP system architecture this document is written against, or will help detect mismatches in various understandings of the ACP system architecture. Third, I haven't seen a good written description of the ACP system architecture, so this overview might be a good start on such a document.
- An abstract would be really nice. It would enable readers to quickly understand what you are proposing and where the document is about to head.

“Methods of varying E_b ”

- As a matter of style, and to make the document easier to read, I suggest that you state your proposed solution first and then following that with your discussion or justification (rather than the other way around). You might start this section with something vaguely like:

“All blocks will be transmitted by the ACP payload at the same symbol rate. Blocks intended to be received by weaker stations will be repeated, so that these stations can coherently add the energy from the multiple copies of the symbols.”

- I believe that your proposal really must specify how the ACP payload decides which blocks to repeat. It is impossible to evaluate your proposal in the absence of knowing whether some practical solution to this issue exists.
 - You might divide potential solutions into receiver-initiated (where a weak receiver specifies that it wants to receive a particular “flow”) and transmitter-initiated (where the transmitter specifies that a block or flow is to be potentially received by weak stations). This naturally leads to the issue of *how* the receiver or the transmitter invokes this service.
 - You might also divide potential solutions into stateful (those that require the ACP payload to maintain state about which flows are to be received by weak stations) and stateless solutions (those in which the ACP payload maintains no information about which flows or blocks are to be received by weak stations).
 - I suppose you could also divide the potential solution space into flow-oriented (in which all blocks in a flow receive the same treatment) and block-oriented (in which each block is treated separately). Of course, this discussion implies that you define what a “flow” is (probably all blocks that have the same source address and the same receive address and are somehow related, at least temporally).
 - Potential solutions probably include those in which the receiver or the transmitter signals the ACP payload about how a block or a flow is to be treated. The alternative is for the ACP to somehow figure this out without much assistance from the ground.

My suggestion is that the transmitter specifies for each block whether the ACP payload should transmit the block in a fashion that can be received by weak stations. This approach eliminates the need for the ACP to maintain per-flow state (at least for this capability) and eliminates the need for a signaling protocol to specify how a flow should be treated. An alternative description of this approach is that the transmitter specifies for each block the transmit queue in the ACP payload to which this block should be queued (where some queues are for strong stations, some queues are for weak stations, and other queues may be for something else).

- Are repeated blocks contiguous? Apparently they can’t have any other unrelated blocks interspersed between them (although you don’t say so explicitly). May repeated blocks have idle time between them? Must repeated blocks have a certain amount of idle time between them? Can the transmitter choose any answer it wants? Must the receiver be prepared for anything?
- What does an idle link look like? Anything that the ACP payload developers want to program? Or, must some specific idle pattern be transmitted?
- Has the proposed repeated-block scheme ever been demonstrated in practice? Has its detailed behavior been examined in the technical literature? If the answer is no, does the author suggest that we actually implement this before we fly it?

- I think that *this* document really need to specify how addressing will work on the downlink. Splitting the downlink protocol into multiple documents doesn't seem like a reliable way to ensure success.

By the way, my proposal is that each downlink packet contains a 32-bit source address and a 32-bit destination address. These addresses are used by the ACP ground stations, but are generally opaque to the ACP payload.

- Is there provision for blocks that originate from the ACP payload? If so, how are these blocks identified? This is probably part of the [missing] addressing discussion.
- Can ACP ground stations communicate with the ACP payload? This might be beyond the scope of this document. Or, it might not be, depending on the possible interactions between the ACP ground stations and the ACP payload.
- How will the transmitting and receiving ground stations be identified in order to meet regulatory requirements?

By the way, I recommend that addressing and ground station identification use independent mechanisms. That is, I suggest that call signs *not* be used for addressing. I also suggest that the station identification occur periodically, rather than in every block.

- When should an ACP ground station stop accumulating repeated blocks? When should an ACP ground station give up on a block?
- The document states “... synchronization and the information about what is a repetition of the previous data need to be robust enough for the weaker stations to be able to track.” Do you believe that this proposal meets this objective? Or, is this left as an exercise for the reader? (Don't do that...)

“Modulation”

- Again, I suggest that you start this section by stating the proposed solution.
- I suggest that all of the information about the ACP system, such as bandwidth, power, and frequency, be moved to an “ACP System Overview” section.

“Coding”

- Apparently, your proposal is to ignore patent issues. You need to do more than simply add a footnote. Someone has compiled a list of these issues. You might find this on Phil Karn's pages, but I didn't go looking for it.

If case nobody could guess, I think that this issue needs to be resolved before Turbo codes

are included in the ACP system. If we want are going to ignore patent and legal issues, we should do so knowingly (although, based on what I know, this is probably a really bad idea).

- Again, proposed solution first.

“Frame Structure”

- You might want to include suggestions about how a receiver should decode these frames.
- Does it make sense to combine the sync code and the first/repeat flag? That is, would it make more sense to use two different sync codes, one for the first block and the second for repeated blocks?
- Do you want to recommend when a receiver has found a sync code? Or, does each ground station implementer get to decide when they have (probably) found a sync code?
- *Which* 32-bit CRC do you intend to use?

“References”

- I recommend a separate “references” section. Once you cite everything you reference, you will have quite a few references.