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| DCPC Requirements Discussion  by Peter Woolner | |
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| NOAA  National Environmental Satellite, Data, and Information Service |  |
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| 3150 Fairview Park Drive South  Falls Church, Virginia 22042-4519 | |
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# Suggested Content for DCPC Transmissions

* Features I assume are mandatory, in addition to RF parameters:
  + DCPC link must be able to work with any DCP – just add a receiver
  + Ground security is to be provided in a similar way as for DADDS
  + Require G/T of -26 dB/K (3 dBi antenna)
  + Use same addresses as DCPs but transmit without BCH coding
* Features I recommend be included but need work on details:
  + Ability to send a wide variety of commands
    - Simple: Turn-off, Reset, Run diagnostics, etc.
    - Complex: Change many parameters: Address, Channel, Timing, Interval, Content, etc.
    - Very large: Allow for extensive re-programming over DCPC link
  + Make all DCPC transmissions as secure as possible
  + Send commands with different levels of priority
  + Include a time calibration mark (need to decide accuracy, reference point, etc.)
  + Provide a “Stay Awake” list at standard intervals
  + Notify DCPs in advance when a leap second is to occur
  + Include ability to expand for future needs – items not known now
  + Are there any other items users want to have or that vendors want to offer?
* Everyone is encouraged to consider these lists and
  + Suggest additional items with examples of extreme events (How large is “very large”?)

##### Other Decisions Needed for Basic Formatting

* Is the message transmission is to be continuous or not?
  + At 350 bps it will take about 58.749 seconds for 11 frames
    - Transmit nominally 1.251 seconds without data modulation each minute?
      * Provides ability to adjust (e.g. leap seconds, CDA antenna transfers, etc.)
    - Adjust the encoded data rate to 342.66667 bps so 11 frames take exactly 1 minute?
      * Signal will be as stable as possible
* What needs to go in the 446 bytes that are available?
  + Some number of commands, each with a specific address
    - Could be an individual or group address
    - Needs to include a form of authentication
  + Should command length be fixed or variable?
  + Include a time hack?
  + Include leap second notification?
  + A fixed length header to identify the content of the rest of the frame
* Assignment of precedence
  + Are some commands more important than others?
  + Need to define precedence or send in strict order of arrival
* Stay awake list – I consider this important but this will limit the command rate (cph)
  + I recommend a 10:1 Sleep/Wake ratio for receivers as a minimum

Stay Awake List Problem

* How many separate commands should be planned for one hour?
  + e.g. 10 commands per frame x 5 frames per minute x 60 minutes per hour = **3000** cph
* How long will it take to send 3000 addresses so all other DCPs can go back to sleep
  + If only 22 bits used to send address plus group/individual identifier:
    - 22 bits x 3000 addresses / 3504 bits in frame = 18.84 frames
    - At 5 frames per minute 19 frames will take 3 minutes 48 seconds
    - Sleep/Awake ratio = (60 - 3.8) / 3.8 = **14.8:1** (approx)
* Is sending many concatenated addresses acceptable?
* Is sending addresses without BCH acceptable?
* System could send 21,900 short commands per hour but this would limit it to 3000 cph
  + I suggest this be considered an acceptable rate

# RF Parameters for the DCPC Link (p/o GOES-R Requirements)

Uplink Frequency: 2032.825 MHz or 2032.775 MHz

Uplink EIRP 76 dBmi

Uplink Polarization: Linear N-S

Uplink C/No 67 dB/Hz

Downlink Frequency: 468.825 MHz or 468.775 MHz

Peak Satellite EIRP: 47.0 dBmi

Downlink Polarization: RHCP

Satellite Axial ratio: 1.0 dB

Ground Axial Ratio: 6.0 dB

Required C/No 38.0 dB/Hz

Modulation: OQPSK and DSSS

Modulation Coding: NRZ-M

FEC Coding: RS(255,223) I=2 interleaved RS codewords per frame

Coded Data Rate: 350 bps (with RS code bits and 32 bit Frame Header)

DSSS Chip Rate: 22.225 kHz

DSSS Chip Codes: (TBD)

PN Code Length: 127

Shaping Filter: SRRC with α = 1.0

Frame Sync Marker: 1ACFFC1D

Total Frame Length: 514 bytes (4112 bits)

OQPSK = Offset Quadrature Phase Shift Keyed

DSSS = Direct Sequence Spread Spectrum

SRRC = Square Root Raised Cosine