

# Update on New HRIT DCS File Format

Presented by  
**Microcom Design, Inc.**

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## New HRIT DCS File Format - Background

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- Original LRIT/HRIT File Format specified in 2003-2005.
- New format proposed in September 2017.
- New format accepted and approved in March 2018.
- Implementation began in September 2018, with testing performed in October and November.
- Dual streams became active on December 10<sup>TH</sup>:
  - Legacy format files on Virtual Channel 31.
  - New format files on Virtual Channel 32.
- New HRIT DCS file format:
  - Reduced message header size (41 versus 70 bytes)
  - Improved DCS message quality statistics.
  - Format specification document and sample files posted on DADDS website.



# New and Legacy File Format Comparison

<i>Field Name</i>	<i>Bytes</i>	<i>Format</i>
Block Identifier	1	Integer Unsigned
Block Length Message	2	Integer Unsigned
Sequence Number	3	Integer Unsigned
Message Flags/Baud	1	Bit Mapped
Message ARM Flags	1	Bit Mapped
Corrected Address	4	Hexadecimal
Carrier Start	7	BCD
Message End	7	BCD
Signal Strength X10	2	Integer Unsigned
Frequency Offset X10	2	Integer Signed
Phase Noise X100	2	Integer Unsigned/Bit Mapped
Good Phase X2	1	Integer Unsigned
Channel/Spacecraft	2	Integer Unsigned/Bit Mapped
Source Code	2	ASCII Characters
Source Secondary	2	TBD
Message Data	Var	ASCII or Pseudo-Binary
Block CRC	2	Binary

<i>Field Name</i>	<i>Bytes</i>	<i>Format</i>
Delimiter	2	0x02 0x02
Message Flags	1	Bit Mapped
Message ID Code	1	ASCII
Corrected Address	8	ASCII Hex
Start (Frame) Time	11	ASCII Decimal (Second Rounded)
Msg ARM Code	1	ASCII Char (G,?,M,T,W, etc.)
Signal Strength	2	ASCII Decimal
Frequency Offset	2	ASCII Special
Modulation Index	1	ASCII Character (N,H,L)
Data Quality	1	ASCII Character (N,F,P)
Channel	3	ASCII Decimal
Spacecraft	1	ASCII Character (E,W)
Source Code	2	ASCII Characters
Message Length	5	ASCII Decimal
Message Data	Var	ASCII or Pseudo-Binary
Carrier Start	14	ASCII Decimal
Delimiter	1	ASCII Space (0x20)
Message End	14	ASCII Decimal

- New: 41 bytes of overhead                      Old: 70 bytes of overhead
- Uses binary fields as much as possible.
- Block identifier and length will allow for backward compatible future variations and/or new features (e.g. system messages).



# Changes Made after New Stream was Active



- Once the New File Format Files were being sent in the HRIT transmission, Microcom began updating its DigiRIT LRIT/HRIT receiver to address them.
- In late December 2018, Microcom realized that two pieces of information were overlooked in the original specification.
  - No EOT received at end of DCS message.
  - Phase Modulation Index (Normal, High or Low)
- Microcom notified NOAA of the oversight in January 2019.
  - Microcom was authorized to update the specification and update the HRIT DADDS dissemination process.
  - Work was completed in early February.
- Information was added to existing fields so as to not impact overall header size.
  - No EOT flag added to Message Flags/Baud field.
  - Modulation Index flag bits incorporated with Phase Noise field.
- Revision 1 of specification, along with sample files, posted on DADDS websites in mid-February.



## New Format Highlights

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- 3-byte sequence number to identify message gaps.
- Abnormal Received Message (ARM) flag byte to identify message problems without having to send inefficient and multiple informational messages.
- Millisecond resolution Carrier Start and Message End Date/Time stamps.
- Improved Message Quality Statistics:
  - Signal Strength to 0.1 dB.
  - Frequency Offset from channel center to 0.1 Hz.
  - Phase Noise in degrees RMS to 0.01°.
  - Good Phase Percentage rounded to 0.5 %.
- DRGS Source Code and future Secondary Source.
- Special Missed Message Block for efficiency.
  - Eliminates header fields (e.g. message quality stats) that are not applicable to a missed DCS message.



# Legacy File Format – Pictorial View

DAMS-NT Client r1-60 [Client Test] - [[DigiRIT DCP] [192.168.54.101][4001] Connected]

File Client Window Help

DCP Data (ALL) | DigiRIT Status/DCP Summary

ACTIVE 52,299 << Row 1 of 2500 >>

Slot	Mode	Chan	Baud	PlatformID	Carrier Time	End Time	Msg Dur	Len	Ingest Time	Latency	GDP	PHN	SS	FO	MI	DQ	FLG	ARM
31	---	113E	300	15DDC52C	19/079 17:50:50.509	19/079 17:50:58.446	7.937	270	19/079 17:51:12.070	13.624	---	---	51	+0	N	N	00	---
31	---	37E	300	51809748	19/079 17:50:50.701	19/079 17:50:58.371	7.670	258	19/079 17:51:11.072	12.701	---	---	37	+0	N	N	00	---
31	---	112w	300	F001E38A	19/079 17:50:52.626	19/079 17:50:58.708	6.082	198	19/079 17:51:11.072	12.364	---	---	35	+0	N	N	00	---
31	---	88w	300	CE942122	19/079 17:50:56.294	19/079 17:50:58.694	2.400	62	19/079 17:51:11.072	12.378	---	---	44	+0	N	N	00	---
31	---	72w	300	3351527C	19/079 17:50:54.291	19/079 17:50:57.652	3.361	96	19/079 17:51:11.072	13.420	---	---	43	+0	N	N	00	---
31	---	206w	300	BCC15C4C	19/079 17:50:56.314	19/079 17:50:57.741	1.427	25	19/079 17:51:11.072	13.331	---	---	34	+0	H	N	00	---
31	---	150w	300	3369F052	19/079 17:50:54.311	19/079 17:50:57.610	3.299	96	19/079 17:51:11.072	13.462	---	---	42	+0	N	N	00	---
31	---	148w	300	3361A488	19/079 17:50:54.303	19/079 17:50:57.468	3.165	89	19/079 17:51:11.072	13.604	---	---	43	+0	N	N	00	---
31	---	133E	300	1669452C	19/079 17:50:56.594	19/079 17:50:57.723	1.129	14	19/079 17:51:11.072	13.349	---	---	48	+0	N	N	00	---
31	---	159E	300	33660644	19/079 17:50:54.279	19/079 17:50:57.620	3.341	95	19/079 17:51:11.072	13.452	---	---	38	+0	N	N	00	---
31	---	153E	300	17F222E6	19/079 17:50:51.275	19/079 17:50:57.603	6.328	207	19/079 17:51:11.072	13.469	---	---	41	+0	N	N	00	---

DCP MSG DATA | DAPS/DDS | DAMS-NT | HEX-ASCII | APPLY VIEW | FULL MSG

```

20/03/19 17:45 303 327 1.5 7.9 18.52 27 3.75 770 0 13.6 842
20/03/19 17:30 220 319 2.9 5.2 18.04 32 3.75 771 0 13.6 825
20/03/19 17:15 86 357 0.0 7.2 18.10 33 3.75 771 0 13.6 801
20/03/19 17:00 140 338 1.3 9.4 17.30 35 3.75 771 0 13.6 765

```

Client Test [CPU Usage: 0%]      MEMORY [Total: 22,085 KB] [Allocated: 20,181 KB] [Overhead: 1,903 KB]      ALLOCATIONS [Total: 77,371] [Allocs/Sec: 1,197]

WINDOWS [CPU Usage: 0%]      MEMORY [Commit Size: 32,288 KB] [Working Set: 37,212]      UP TIME: 01:35:00      UP SINCE: 19/079 16:16:14      PC UTC: 19/079 17:51:15

- Minimal Message Quality Statistics:
  - Good Phase (GDP), Phase Noise (PHN), and ARM flags not present.
  - Signal Strength to integer dB.
  - Frequency Offset reported in DAPS compressed format with 50 Hz resolution (+/- X, X\*50).





# New File Format – Pictorial View

DAMS-NT Client r1-60 [Client Test] - [[DigiRIT DCP] [192.168.54.101][4001] Connected]

File Client Window Help

DCP Data (ALL) | DigiRIT Status/DCP Summary

ACTIVE 51,594 << Row 1312 of 2500 >>

Slot	Mode	Chan	Baud	PlatformID	Carrier Time	End Time	Msg Dur	Len	Ingest Time	Latency	GDP	PHN	SS	FO	MI	DG	FLG	ARM
32	CS1	31E	300	CE392412	19/079 17:40:50.292	19/079 17:40:54.713	4.421	137	19/079 17:41:07.913	13.200	100.0	1.74	46.8	-1.9	N	N	30	---
32	CS1	67E	300	8030C406	19/079 17:40:50.378	19/079 17:40:54.627	4.249	130	19/079 17:41:07.913	13.286	97.0	3.80	36.5	13.9	N	N	30	N
32	CS1	175E	300	4542D4DE	19/079 17:40:45.396	19/079 17:40:54.552	9.156	315	19/079 17:41:07.913	13.361	100.0	1.94	44.0	5.2	N	N	30	N
32	CS2	144W	300	43438394	19/079 17:40:49.598	19/079 17:40:54.323	4.725	149	19/079 17:41:07.913	13.590	100.0	1.38	45.0	-0.8	N	N	30	N,T
32	CS1	164W	300	DD6792D4	19/079 17:40:50.304	19/079 17:40:54.115	3.811	114	19/079 17:41:07.913	13.798	100.0	1.78	46.5	-0.8	N	N	30	---
32	CS2	29E	300	170D008C	19/079 17:40:50.285	19/079 17:40:54.316	4.031	120	19/079 17:41:07.913	13.597	100.0	2.15	39.8	-2.1	N	N	30	N
32	CS2	73E	300	CE163018	19/079 17:40:51.934	19/079 17:40:54.300	2.366	58	19/079 17:41:07.788	13.488	97.0	3.58	38.4	1.0	N	N	30	---
32	CS2	157E	300	17E191F8	19/079 17:40:50.282	19/079 17:40:54.129	3.847	113	19/079 17:41:07.788	13.659	99.5	2.84	36.8	0.6	N	N	30	---
32	CS2	148W	300	3363341E	19/079 17:40:50.280	19/079 17:40:53.849	3.569	102	19/079 17:41:07.788	13.939	100.0	1.86	40.0	-0.8	N	N	30	---
32	CS1	147E	300	335DD5F4	19/079 17:40:50.274	19/079 17:40:53.967	3.693	109	19/079 17:41:07.788	13.821	100.0	1.93	44.5	17.5	N	N	30	---
32	---	161E	300	CE4642CA	19/079 17:38:45.000	19/079 17:38:50.000	---	---	19/079 17:41:07.788	---	---	---	---	---	---	---	---	M

DCP MSG DATA    DAPS/DDS    DAMS-NT    HEX-ASCII    APPLY VIEW    FULL MSG

```

:PC 10 #15 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 :PR 700 #1440 0.00 0.00 :WL 10 #15 1.92 1.86 1.93 1.89 1.91 1.90
1.94 1.90 :BL 13.21

```

Client Test [CPU Usage: 0%]    MEMORY [Total: 20,774 KB] [Allocated: 18,820 KB] [Overhead: 1,954 KB]    ALLOCATIONS [Total: 61,876] [Allocs/Sec: 968]

WINDOWS [CPU Usage: 0%]    MEMORY [Commit Size: 30,547 KB] [Working Set: 35,635]    UP TIME: 01:27:26    UP SINCE: 19/079 16:16:14    PC UTC: 19/079 17:43:40

- Improved Message Quality Statistics:
  - Good Phase (GDP) Percentage
    - (Good: 85-100%, Fair: 70-85%, Poor: 0-70%)
  - Signal Strength to 0.1 dB.
  - Frequency Offset to 0.1 Hz
- ARM Codes and Missing Messages





## Transition Comments

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- Both legacy and new file format currently active on both GOES-East and GOES-West.
- LRIT on GOES-15 was terminated in February.
- Both streams will be transmitted until May 20, 2019.
  - Allow time for manufactures to make and test updates
  - Allow time for users to deploy updates.
- File type detection:
  - On segregated virtual channels during dual streams.
  - Legacy files have filename of pM-YYDDDHHMMSS-Q.dcs
    - YYDDDHHMMSS is the file date/time in UTC Julian format.
    - Q is an ASCII letter (A to Z) used in the event two files are generated at the same time.
  - New files have filename of pH-YYDDDHHMMSS-Q.dcs
    - H designates the new HRIT file format.
  - Both will use current HRIT Header DCS file type of 130 (0x82).
  - Internal Type field in legacy (DCSD) and new file formats (DCSH).





## Transition Termination – May 20, 2019

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- Only new file format will be transmitted on HRIT.
- NOAA proposing that the New File Format files will remain on Virtual Channel 32, unless the DCS user community has strong desire to make switch to Virtual Channel 31.

*Discussion on desired DCS Virtual Channel to utilize after transition period is complete.*



## Summary of File/Protocol Changes

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- At present only DCS HRIT file format has changed.
  - The header information for each message that is included before the actual DCP message data is the predominate change.
  - The DCP message data is included as received, including with the parity bit intact.
- Officially, the format of the other DCS message dissemination protocols has not changed; DAMS-NT, ~~DOMSAT~~, DDS (aka LRGS/OpenDCS).
- However, to allow DigiRIT users to ultimately ingest and process the better message statistics, Microcom, in conjunction with Cove Software, developed a proposed enhancement to the DAMS-NT protocol.
  - The proposed enhancement has been shared with NOAA and it was decided to present it to the user community here.
  - The proposed enhancement was carefully designed to ensure backward compatibility; i.e. DAMS-NT Clients that have not been updated will ignore the additional information.



## Proposed DAMS-NT Protocol Changes

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- The additional message quality statistics are appended in ASCII after the DCS Message data and Carrier Times field; essentially in, or before, the “Vendor-Specific Additional Data” section.  
extendedstats ::= slvl SP phns SP gdph SP freq SP type [SP armf] CRLF
- Added new Missed Message Block with ...
  - Fixed Start Pattern of MM+CRLF
  - 51-byte header (including Start Pattern)
- Preserves the basic DAMS-NT DCS Message Protocol:
  - 55-byte header remains intact with minor, backward compatible extensions:
    - Still allows definable Start Pattern, but recommends it be SM+CRLF, and prohibits use of MM+CRLF in DCP Message Header.
    - Adds additional flag bit in Message/Error flags to indicate Extended Stats are present (similar to Carrier Times flag).
  - Allows use of DCP Message Interface only.
    - Event, Real-Time Status and Configuration Interfaces are optional.
    - Requirement of Real-Time Status and Configuration Interfaces was eliminated for EDDN, and these are rarely, if ever, used.



## Adoption of Proposed DAMS-NT ICD Changes

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- While Microcom has proposed the DAMS-NT ICD changes, and asked Cove Software to review the recommendations, it is up to NOAA and the DCS community to formally approve and adopt the changes, and/or suggest modifications.
- Microcom has already implemented these proposed changes in its DigiRIT HRIT receiver, but at this time it should be considered Vendor-Specific Additional Data.
  - Inclusion of Extended Statistics can be enabled and disabled.
  - Inclusion of Missed Message Blocks can be enabled and disabled.
- During a meeting in early March, NOAA expressed interest in taking the lead on the proposed changes.
  - Microcom provided draft of proposed specification changes.
  - Microcom asked to summarize changes at TWG.
  - Draft of proposed changes distributed via email.



## Proposed DAMS-NT Changes – Next Steps

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- NOAA, DCS Users, and DCS Manufacturers to collectively determine path forward.
- If adopted, should DAMS-NT Servers be updated at WCDA, NSOF, EDDN, etc. to allow improved message statistics to become part of the DDS protocol for LRGS/OpenDCS?

*Discussion on proposed DAMS-NT Changes.*