

Implementing the Consolidated laser Ranging Data (CRD) Format throughout the ILRS Network

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Introduction

- The CRD format was the result of a multi-year effort to create a flexible, expandable format to support current needs and those of future generations of ranging activities:
 - Technology changes such as kHz ranging and multi-channel detectors require rethinking data format and require new data fields
 - New missions such as LRO and T2L2 require higher precision timing and new data fields

Current CRD status

- V1.00 CRD Document and Sample Code released on ILRS website 30 June 2008
- Announcement from ILRS Central Bureau with call for implementation by stations, analysts, and operations and data centers emailed 13 August 2008
- MLRS CRD data available in v1.00 since 7 July, and is being validated. Several other stations have recently begun to produce CRD-formatted data.
- OCs, DCs, and several ACs are either ready to accept CRD data or will be by the end of 2008

Official Timetable

- BY NOW – Stations and ACs should begin conversion to the CRD format
- October 15 – HTSI is ready to accept data in CRD format, to QC old/new format and to perform Validation “Step 2”
- Dec 1 – Analysis Centers (ACs) will be able to compare data in the old and new formats
- April 15, 2009 – All stations must submit data in the CRD format
- Dec 31, 2009 – Only CRD data will be accepted and archived

Normal Point Validation

- The CRD format represents a major change in format with increased flexibility and expandability
- Due to changes in precision and sequence of records, the addition of new fields, and the variety of ways in which the format can be implemented, resulting normal point content can differ from the old:
 - **Different results between OLD/NEW formatted data does NOT necessarily mean WRONG results !!!**
- Therefore, a formal and thorough validation process is required before CRD data is accepted from a station

Validation Process Step 1 - Stations

- Implement CRD format, producing at least normal points in new format; CRD full rate is needed for LRO and T2L2 and other investigations
- Test CRD files for format compliance
- Test CRD normal point files against old format files
- Test CRD full-rate files against old format files
- *Testing should at least use programs in CRD sample code*
- When station is satisfied with results, proceed to Step 2
 - ILRS has no formal validation procedure for full-rate or sampled engineering data.

Validation Process Step 2

- Station contacts their OC (HTSI or EDC) with the starting date of CRD-formatted file delivery
- Continue sending CRD **and** old format in parallel until notified by their OC
- Data in the old format will be distributed as usual
- CRD submissions will go through 3 phases of testing
- OC or AC may contact station with issues and questions

Validation Process Step 3

- OCs will receive CRD normal points from stations
 - HTSI will confirm format compliance and agreement between formats (Phase I) for their stations
 - Use validation software from CRD sample code v1.0 2008
 - Flow data through ILRS Q/A algorithm during (See ILRS web page)
 - EDC will rely on their stations to perform Phase I validation
- OCs will run short arcs comparing old and CRD format results (Phase II)
 - HTSI will use daily automated prediction generation software package for short arc comparisons (Geodyn)
 - EDC will forward data to HTSI for Phase II tests
- After 2 weeks of satisfactory results, OC will post data internally and notify selected ACs
- ACs will examine old and CRD-format data with its analysis software (Phase III)
- After 2 weeks ACs will notify OCs of results

Sample Results of comparison software – pass fails in Phase I

CRD/CSTG Intercomparison Report for session
Date: 2008/09/18 (262) 17:55:43 UTC
Station: MDOL 7080
Target: ers2 0009502101 6178
23560

The following disagreements were found between the CRD and CSTG normalpoint files

Of 1 pressure measurements,
1 differed by < 0.1 mb;
0 differed by < 1.0 mb;
0 differed by < 10 mb; and
0 differed by more.
Of 1 temperature measurements,
1 differed by < 0.1 K;
0 differed by < 1.0 K;
0 differed by < 10.0 K; and
0 differed by more.
Of 1 humidity measurements,
1 differed by < 1 %;
0 differed by < 5 %;
0 differed by < 10 %; and
0 differed by more.

Of 6 normal point seconds of day,
5 differed by < 0.1 psec ;
0 differed by < 500 nsec;
0 differed by < 1 microsec; and
1 differed by more.

Of 6 normal point time of flight,
1 differed by < 1 psec ;
4 differed by < 5 psec;
0 differed by < 10 psec; and
1 differed by more.

Of 6 normal point bin rms,
5 differed by < 1 psec ;
1 differed by < 5 psec;
0 differed by < 10 psec; and
0 differed by more.

Of 6 normalpoints, the number of returns,
6 differed by < 1;
0 differed by < 5;
0 differed by < 10; and
0 differed by more.

Of 1 calibration system delays,
1 differed by < 1 psec ;
0 differed by < 5 psec;
0 differed by < 10 psec; and
0 differed by more.

Of 1 calibration delay shifts,
1 differed by < 1 psec ;
0 differed by < 5 psec;
0 differed by < 10 psec; and
0 differed by more.

Of 1 calibration rms,
1 differed by < 1 psec ;
0 differed by < 5 psec;
0 differed by < 10 psec; and
0 differed by more.

Of 1 session rms,
1 differed by < 1 psec ;
0 differed by < 5 psec;
0 differed by < 10 psec; and
0 differed by more.

s25y08d262t1755#6178.npt: failed

Of 6 normal point seconds of day,
5 differed by < 0.1 psec ;
0 differed by < 500 nsec;
0 differed by < 1 microsec; and
1 differed by more.
Of 6 normal point time of flight,
1 differed by < 1 psec ;
4 differed by < 5 psec;
0 differed by < 10 psec; and
1 differed by more

Sample Results of comparison software – same pass Phase II GEODYN results

1 RESIDUAL SUMMARY BY STATION

NUMBER	MEAN	RMS	NO.-WTD	WTD-MEAN	WTD-RMS	TYPE	CONFIGURATION
6	-0.9333	1.0324	6	-0.9333	1.0324	2W RANGE	MLRS1CRD 9502101
6	-0.9412	1.0403	6	-0.9412	1.0403	2W RANGE	MLRS1 NP 9502101

A failed pass with the comparison software does not necessarily mean that CRD data is not good.

Post-validation

- At end of validation (~ 30 days) OC will confirm to the station that data in old format can be discontinued
- All CRD data from the validation period and thereafter will be stored in the ILRS archives by the DCs in CRD-specific directories
- A web page is maintained on the ILRS website showing station validation status and progress
- Until 31 December 2009 the OCs will convert CRD normal points for validated stations into the old format and store them in the ILRS archives

- ILRS Data Centers
- Official ILRS Products
- Official ILRS Products Description
- Predictions
- Normal Point Data
- Full-Rate Data
- Consolidated Laser Ranging Data (CRD) Format

CRD Conversion Status

Site	ID	Code	Coding	Testing	OC Validated	AC Validated	Operational
Golosiiv	1824	GLSL					
Lviv	1831	LVIV					
Maidanak 1	1863	MAID					
Maidanak 2	1864	MAIL					
Komsomolsk	1868	KOML					
Mendeleevo	1870	MDVL					
Simeiz	1873	SIML					
Riga	1884	RIGL					
Katsively	1893	KTZL					
McDonald	7080	MDOL	X	X	P		
Yarragadee	7090	YARL					
Greenbelt	7105	GODL					
Monument Peak	7110	MONL					
Haleakala, HI	7119	HA46					
Tahiti	7124	THTL					

TROS	--	--					
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Notes:	
Codes:	X Completed
	P In process
Ftp archives:	
CDDIS	ftp://cddis.gsfc.nasa.gov/pub/slr/data/npt_crd ftp://cddis.gsfc.nasa.gov/pub/slr/data/fr_crd
EDC	ftp://ftp.dgfi.badw-muenchen.de/slr/data/npt_crd ftp://ftp.dgfi.badw-muenchen.de/slr/data/fr_crd

Responsible Government Official: [Carey Noll](#)
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Conclusion

- The ILRS community will immediately begin converting its processes to produce and use laser data in the CRD format.
- To minimize the chance that converting to a more complex and demanding format will adversely affect analysis results, a formal data validation procedure has been put into place.
- With an ambitious plan to complete conversion by the end of 2009, **starting early is essential**