

CDDIS Data Center Summary for the IVS 2015—2016 Biennial Report

Carey Noll

Abstract This report summarizes activities during the years 2015 through 2016 and the future plans of the Crustal Dynamics Data Information System (CDDIS) with respect to the International VLBI Service for Geodesy and Astrometry (IVS). Included in this report are background information about the CDDIS, the computer architecture, archive contents, and future plans for the CDDIS within the IVS.

1 General Information

The Crustal Dynamics Data Information System (CDDIS) has supported the archiving and distribution of Very Long Baseline Interferometry (VLBI) data since its inception in 1982. The CDDIS is a central facility that provides users access to data and derived products to facilitate scientific investigation. The CDDIS archive of GNSS (GPS, GLONASS, etc.), laser ranging, VLBI, and DORIS data is stored online for remote access. Information about the system is available via the Web at the URL <https://cddis.nasa.gov>. In addition to the IVS, the CDDIS actively supports other IAG services including the International GNSS Service (IGS), the International Laser Ranging Service (ILRS), and the International DORIS Service (IDS), as well as the International Earth Rotation and Reference Systems Service (IERS), and the IAG's observing system, the Global Geodetic Observing System (GGOS).

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The current and future plans for the system's support of the IVS are discussed below.

2 System Description

The CDDIS archive of VLBI data and products is accessible to the public through anonymous ftp (<ftp://cddis.nasa.gov>) and the Web (<https://cddis.nasa.gov/archive>).

2.1 Computer Architecture

The CDDIS is operational on a dedicated server, cddis.nasa.gov. The CDDIS is located at NASA GSFC and is accessible to users 24 hours per day, seven days per week. By the end of 2016, over 260 Gbytes are devoted to VLBI activities.

In 2015, the CDDIS procured a new system for operational support. Transition to the new CDDIS computer hardware was completed in late November 2016. This new system configuration now provides a more reliable/redundant environment (power, HVAC, 24-hour on-site emergency personnel, etc.) and network connectivity for CDDIS; a disaster recovery system is installed in a different location on the GSFC campus. The new system location addresses a long-time concern for the CDDIS, namely, the lack of consistent and redundant power and cooling in its existing computer facility. Multiple redundant 40G network switches are utilized to take full advantage of a high-performance network infrastructure by utilizing fully redundant network paths for all outgoing and incom-

ing streams along with dedicated 10G network connections between its primary operations and its backup operations. The CDDIS transitioned the majority of its operation services to virtual machine (VM) technology for both multiple instance services in a load balancing configuration which allows additional instances to be increased or decreased due to demand and allows maintenance (patching, upgrades, etc.) to proceed without interruption to the user or any downtime. CDDIS now utilizes a unified storage system (100 Tbytes in size) to easily accommodate future growth of the archive and facilitate near real-time replication between its production and disaster recovery sites. A schematic diagram of the new CDDIS architecture is shown in Figure 1.

CDDIS has put into operation a complete rewrite of its file ingest processing software in 2016. This rewrite incorporated numerous disparate programs developed over the years into a single, easily maintained software base which incorporates all the CDDIS requirements for data ingest while also allowing additional flexibility in meeting future metadata requirements. The software was initially modified for incoming GNSS files but will be extended to all incoming files, including DORIS data and products, in the near future.

2.2 File Submissions

One requirement of the new CDDIS computer system involved a change to the file upload process. In the old system, CDDIS used ftp for delivery of data for the archive from both data centers and analysis centers. While this has worked well over the years, transition to the new system provided an opportunity to update this method to a web-based approach that can utilize a different user sign-on/authentication infrastructure. CDDIS developed a web-based application that allows users to use existing scripts without significant modification but also tie authentication into the NASA system. Staff worked with the groups who submit VLBI data and IVS products to CDDIS to transition their procedures to the new file upload system.

3 Archive Content

The CDDIS has supported GSFC VLBI and IVS archiving requirements since 1979 and 1999, respectively.

The IVS Data Center content and structure is shown in Table 1 (a figure illustrating the flow of information, data, and products between the various IVS components was presented in the CDDIS submission to the IVS 2000 Annual Report). As described above, the CDDIS has established a file upload system for providing IVS data, product, and information files to the archive. Using specified filenames, Operation and Analysis Centers upload files to this system. Automated archiving routines, developed by GSFC VLBI staff, peruse the directories and move any new data to the appropriate public disk area. These routines migrate the data based on the filename to the appropriate directory as described in Table 1. Index files in the main sub-directories under <ftp://cddis.nasa.gov/vlbi> are updated to reflect data archived in the filesystem. Furthermore, mirroring software was installed on the CDDIS host computer, as well as all other IVS Data Centers, to facilitate equalization of data and product holdings among these Data Centers. At this time, mirroring is performed between the IVS Data Centers located at the CDDIS, the Bundesamt für Kartographie und Geodäsie in Leipzig, and the Observatoire de Paris.

The public file system in Table 1 on the CDDIS computer, accessible via anonymous ftp, consists of a data area, which includes auxiliary files (e.g., experiment schedule information, session logs, etc.) and VLBI data (in both database and NGS card image formats). A products disk area was also established to house analysis products from the individual IVS Analysis Centers as well as the official combined IVS products. A documents disk area contains format, software, and other descriptive files.

4 Data Access

During the 2015-2016, over 2700 distinct hosts accessed the CDDIS on a yearly basis to retrieve VLBI related files. These users, which include other IVS Data Centers, downloaded over 1.8 Tbytes (2.1 M files) of data and products from the CDDIS VLBI archive in 2016.

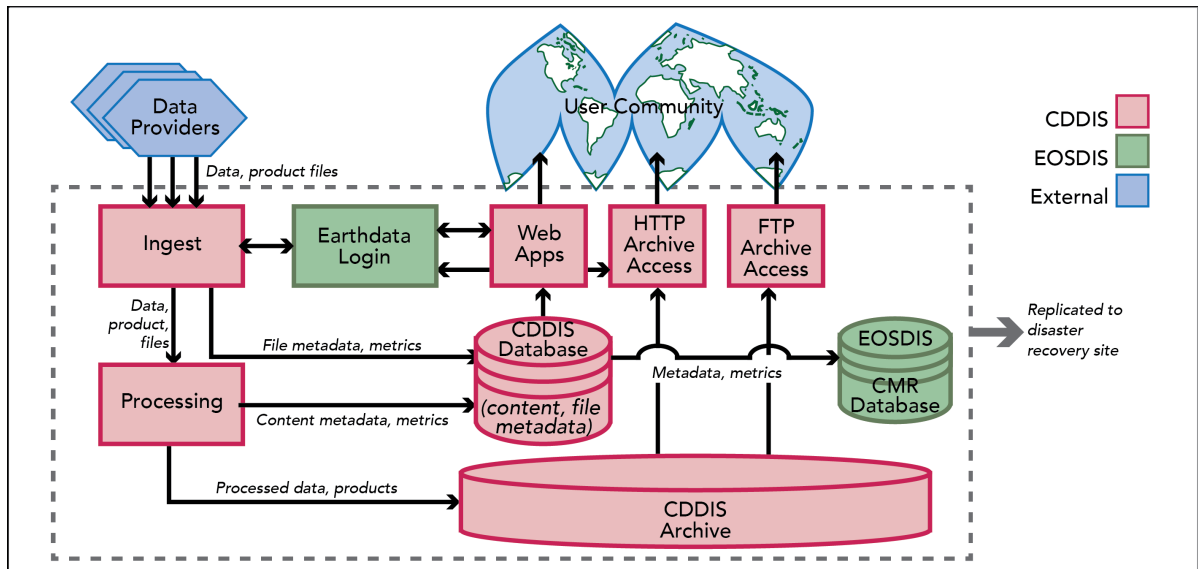


Fig. 1 System architecture overview diagram for the new CDDIS facility installation within the EOSDIS infrastructure.

Table 1 IVS data and product directory structure.

Directory	Description
Data Directories	
vlbi/ivsdata/db/yyyy	VLBI database files for year yyyy
vlbi/ivsdata/ngs/yyyy	VLBI data files in NGS card image format for year yyyy
vlbi/ivsdata/aux/yyyy/ssssss	Auxiliary files for year yyyy and session ssssss; these files include: log files, wx files, cable files, schedule files, correlator notes
Product Directories	
vlbi/ivsproducts/crf	CRF solutions
vlbi/ivsproducts/eopi	EOP-I solutions
vlbi/ivsproducts/eops	EOP-S solutions
vlbi/ivsproducts/daily_sinex	Daily SINEX solutions
vlbi/ivsproducts/int_sinex	Intensive SINEX solutions
vlbi/ivsproducts/trf	TRF solutions
vlbi/ivsproducts/trop	Troposphere solutions
Project Directories	
vlbi/ITRF2013	IVS contributions to the ITRF 2013 efforts
vlbi/ITRF2014	IVS contributions to the ITRF 2014 solution
vlbi/ivs-pilotbl	IVS Analysis Center pilot project (baseline)
Other Directories	
vlbi/ivscontrol	IVS control files (master schedule, etc.)
vlbi/ivsdocuments	IVS document files (solution descriptions, etc.)
vlbi/raw	Raw VLBI data
vlbi/dserver	dserver software and incoming files

5 Future Plans

The CDDIS staff will continue to work closely with the IVS Coordinating Center staff to ensure that our system is an active and successful participant in the IVS archiving effort. CDDIS staff will further work with

the IVS CC to integrate VLBI data and product files into the updated operations software recently installed on the new CDDIS system.

The CDDIS has established Digital Object Identifiers (DOIs) for several of its GNSS data sets; website landing pages have been established for these

published DOIs. DOIs for additional items, including VLBI data and products, are under development and review prior to registering and implementation.