LDM 6: Turbocharging the IDD

Steve Emmerson
Unidata Program Center

The Internet Data Distribution (IDD) system was becoming increasingly stressed in recent years. As you may recall, IDD performance is generally measured in terms of product latency, which is the difference in time from when a product is inserted into the datastream to when it is received by the local system. At many IDD sites, mean data-product latencies were increasing steadily until they reached one hour—at which point data-products would be lost as the LDM 5-s that powered the IDD attempted to “catch up.” This problem was due to a combination of increased IDD traffic and the design of the LDM 5.

While not much can be done about the increase in traffic, a new version of the LDM has been developed and deployed. Called LDM 6, this version is reducing product latencies to record low levels—mere seconds in many cases.

The differences between LDM 5 and LDM 6 that account for this welcomed increase in performance are summarized in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>LDM 5</th>
<th>LDM 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upstream</strong></td>
<td>Selection of HEREIS message vs. COMINGSOON message</td>
<td>If product size &lt;= 16 KB, then use HEREIS; otherwise use COMINGSOON</td>
</tr>
<tr>
<td></td>
<td>Action after sending HEREIS message</td>
<td>Wait for reply</td>
</tr>
<tr>
<td></td>
<td>Number and size of BLKDATA messages</td>
<td>As many 16 KB messages as necessary to contain the product</td>
</tr>
<tr>
<td></td>
<td>Maximum amount of time between RPC messages</td>
<td>5 minutes</td>
</tr>
<tr>
<td><strong>Downstream</strong></td>
<td>Multiple requests to same upstream LDM</td>
<td>Are consolidated into one request, resulting in one connection</td>
</tr>
<tr>
<td></td>
<td>Action upon receipt of HEREIS message</td>
<td>If new or duplicate product; then reply with OK message; otherwise, reply with RECLASS message</td>
</tr>
<tr>
<td></td>
<td>Reconnection strategy</td>
<td>If nothing in 12 minutes; then reconnect</td>
</tr>
</tbody>
</table>

The following links of interest are:

- [http://my.unidata.ucar.edu/content/software/ldm](http://my.unidata.ucar.edu/content/software/ldm)
- [http://my.unidata.ucar.edu/content/software/idd/rtstats](http://my.unidata.ucar.edu/content/software/idd/rtstats)

Two LDM 6 Training Workshops will be held in Boulder in late October, 2003. For more information or to register, see [http://my.unidata.ucar.edu/content/events/2003TrainingWorkshop/announcement.html](http://my.unidata.ucar.edu/content/events/2003TrainingWorkshop/announcement.html).
IDV 1.0 Released to Unidata Community

Don Murray
Unidata Program Center

June marked the official Version 1.0 release of Unidata’s newest analysis and visualization tool—the Integrated Data Viewer (IDV). This release includes a Java™-based software library and an atmospheric science oriented reference application built upon that library. The release is the culmination of a development process that was outlined in the Unidata 2003 proposal. Software development leading to the IDV began four years ago with substantial input from the community.

The development of the IDV involved several of the Unidata Program Center software engineers in partnership with the members of the MetApps Task Force. The task force provided a conduit for the needs of the community and provided testers for each release. The first beta release of the IDV in September 2002 (release announcement, http://my.unidata.ucar.edu/article.php?sid=7) and subsequent beta releases were used to gather feedback from the general community on the tool’s usefulness and its framework. This feedback was incorporated into the final 1.0 release in June. While this release does not mark the completion of our efforts, it is an important milestone in our ongoing efforts to build a next generation visualization and analysis framework. As we look to the future, a new IDV Steering Committee is being formed to help prioritize the IDV’s development based on the needs of the Unidata community and other interested parties.

The IDV reference application brings together the ability to display and analyze satellite imagery, gridded data (e.g., numerical weather prediction model output, NCEP reanalysis grids), surface observations, atmospheric soundings, NEXRAD Level II and Level III radar data, and NOAA National Profiler Network data, all within a unified interface. It provides many of the standard 2-D data displays that GEMPAK and McIDAS provide as well as 3-D views of the atmosphere. It allows users to interactively probe the data, creating cross-sections, profiles, animations and value read-outs. Computation and display of built-in and user-defined formula-based derived quantities are supported.

The IDV contains unique features not found in other geoscience display and analysis packages. It provides quantitative sampling and data analysis, and new ways to show, save, and share data displays. The IDV provides a set of interactive data probes for dataset exploration. Another feature is the capability to capture QuickTime movies of animations and fly-throughs. The IDV has an integrated HTML display that can be used for HTML-based interfaces to drive the displays and embed fully-interactive IDV displays in course materials.

Another focus of the IDV development was to take advantage of the network in everything from data access to configuration. The IDV can access data from ADDE, DODS/OPeNDAP, HTTP and FTP servers, as well as local files. In conjunction with the THREDDS project, data providers are creating catalogs of their data holdings which can be used by the IDV as pointers to those datasets. Using client/server technologies like ADDE and OPeNDAP, the IDV can subset large datasets into manageable chunks.
Much of the IDV, including the user interface, is configured through a set of XML files. Developers and users can easily tailor the IDV to provide custom applications based on the underlying framework by using their own set of configuration files. Everything from map projections to color tables to the available display components is configurable. These configurations can be local files on the user’s system or located on a remote Web server and loaded in when the application is started. The IDV provides an XML-based mechanism for saving its state, allowing for the ready sharing of interesting collections of data/visualizations, case studies and pedagogic materials over the Internet.

Although the IDV reference application is geared toward the atmospheric science community, the underlying framework supports a broad range of geolocated data. An important part of the Unidata 2008 proposal is broadening the horizons of the Unidata community into other geoscience disciplines. The IDV is already being used by educators and researchers in other areas such as oceanography, air pollution modeling and geophysics.

What does the future hold? The Unidata 2008 proposal defined some important goals for the IDV development. In particular, emphasis will be placed on supporting analysis and visualization for local modeling efforts (e.g., WRF, meso-Eta), incorporating new datasets from the atmospheric and other geoscience communities, developing collaborative tools to make effective use of shared visualizations and developing a framework for end-user assembly and integration of IDV components. Participants at the Unidata Summer 2003 Expanding Horizons workshop expressed their wish of merging Geographic Information System (GIS) data with meteorological data. The IDV already has the ability to read in map boundaries stored in shapefiles which is one of the common GIS formats. Work is underway to access other GIS data types including GeoTIFF files and data from open standards servers like Web Feature Servers (WFS) and Web Coverage Servers (WCS).

The IDV can be used on any operating system that supports Java and Java 3D including Windows, Solaris (SPARC only), Linux, AIX, and IRIX with appropriate hardware and software versions. There is no need to compile the software for different platforms as the same code will run on any supported system. The UPC recommends that the system running the IDV have 512 Mb or more of memory and a 1GHz processor or better. Download the IDV, begin using the newest software from Unidata, and let us know if you have comments or suggestions about it.

Links:
IDV homepage: http://my.unidata.ucar.edu/content/software/IDV
IDV User’s Guide: http://my.unidata.ucar.edu/content/software/IDV/docs/UserGuide

*IDV display of atmospheric parameters of mid-Atlantic coastline ice storm.*
Editor’s Note: This is the first of what will be a regular feature of Unidata Newsletters which will familiarize readers with work of our collaborators.

• JDH

Rahul Ramachandran
Information Technology and Systems Center, University of Alabama in Huntsville

The Earth Science community has long struggled with how to handle all the many data formats that exist in that domain. New formats continue to be created, and the number of formats for legacy datasets is large. So how does a user approach being able to handle all of these data formats? In the past users would need to employ a separate data reader for each format, either within their application or through some server-based functionality. In each case, code that was tightly-coupled with specific data formats would need to convert all of the data into one format for a particular package to understand it. Both approaches are time consuming, waste large amounts of resources, and often result in duplication of data or software.

Researchers at the Information Technology and Systems Center in Huntsville, Alabama, decided it would be better to be able to tell software what it needs to know about how to read any particular data set rather than continue re-writing data readers. This approach has led to the definition of the Earth Science Markup Language (ESML) and the development of associated tools and services (http://esml.itsc.uah.edu).

Specifically, ESML is an XML-based external data syntactic description that anyone can create for any data set. This makes XML a “meta-language”—a language for describing other languages, which is why it is so powerful and ubiquitous.

Unidata uses XML in many of its projects, including IDV, THREDDS, and netCDF. It is license-free, platform-independent, and well-supported by various open source parsing libraries. It is written in plain text; so it is ideal for configuration files, metadata exchange, and other “semi-structured” textual files. It can optionally be checked for syntax errors, which helps in software debugging. And it begins with X, how cool is that?

What is XML?

John Caron
Unidata Program Center

XML, which stands for “eXtensible Markup Language,” was created by the World Wide Web Consortium, aka W3C, (see http://www.w3.org/XML), the standards body for the Web. XML is a set of rules for defining the meaning of information in text files. It does this through “markup tags” similar to those used in HTML. Unlike HTML, XML allows the user to define what tags can be used, and what the meanings of those tags are. This makes XML a “meta-language”—a language for describing other languages, which is why it is so powerful and ubiquitous.

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file. ESML files do not contain any data and no modification of existing data files is necessary to use ESML. ESML libraries can be incorporated into software that allow applications to use ESML descriptions to dynamically interpret how to read the described data format (see figure 2).

For example Atmospheric Science researchers at the National Space Science and Technology Center at Huntsville, Alabama (http://www.nsstc.org), are using ESML in a project to demonstrate a multi-sensor approach to examine the radiative effects of clouds and aerosols. This effort is using ESML in an application that collocate data from Moderate Resolution Imaging Spectrometer (MODIS), a multi-channel satellite imager, currently used to detect aerosols and provide a global picture of aerosol distribution and thickness, with broadband measurements from the Clouds and the Earth’s Radiant Energy System (CERES) onboard Terra.

Being XML based, ESML is compatible with current trends toward web services and applications, and can be easily customized for special uses (see figure 3). For example, work currently is underway to add links in ESML descriptions to external semantic descriptions of data sets. This will eventually allow applications to not only interpret the format of the data but to understand what the data means or how it might be useful based on the terminology of the domain.

While ESML functionality is currently being incorporated into Earth Science research and applications, efforts are also underway to add links to ESML descriptions in large data catalog systems. Eventually scientists and other users will be able to seamlessly access and use data from almost anywhere for research and other uses.

ESML data interchange technology is available as an open source project (sourceforge.net) and users are encouraged to participate by suggesting improvements or changes to the existing components (https://sourceforge.net/project/showfiles.php?group_id=72129).

Figure 2: ESML allows applications to generically handle data formats.

Figure 3: Example of ESML description for simple data format.
Once again the Unidata Users Committee and the UPC staff have collaborated to stage a successful Users Workshop. The workshops are a traditional mix: part lecture, part hands-on lab, part fun. This year’s was no exception. The workshop, *Expanding Horizons: Using Environmental Data for Education, Research, and Decision Making*, attracted some 60 participants to Boulder during the last week in June. Chairs Mark Laufersweiler, Michael Morgan, and other committee members worked for several months to assemble a program that would be informative and useful for the existing community as well as a potentially broader one. As the title implies, *Expanding Horizons* focused on environmental data, how it might be used with Unidata software and tools, and current usage of the datasets and tools in an increasingly diverse community.

Opening Plenary sessions celebrated Unidata’s past, described its present, and anticipated its future. The program’s 20-year history was traced by its long-time former director David Fulker. Its new director, Mohan Ramamurthy discussed present initiatives, and the session concluded with a look to the future as presented by Cliff Jacobs, UCAR/NCAR’s National Science Foundation sponsor.

Subsequent days’ plenaries covered GIS-oriented topics: what does GIS mean in Unidata’s context; how has GIS evolved at NCAR; how is GIS data used in teaching, research, and decision-making; and how do meteorologists use GIS data.

Hands-on lab sessions were lively and highly interactive and participants had the opportunity to circulate through each of nine labs to learn about or receive an initial exposure to GIS applications. A new feature called “Meet the Developers” allowed participants to interact with Unidata’s software developers in one-on-one discussions.

On the fifth and final day a panel led by Rich Clark, Users Committee Chair, and including Jordan Powers (NCAR/MMM), Tim Spangler (UCAR/COMET), Mohan Ramamurthy, Olga Wilhelmi (NCAR/ESIG), and May Yuan (University of Oklahoma) yielded brisk exchanges among panel members and participants. The session resulted a set of action items to assist the UPC in developing and promoting GIS use within its community.

Unidata (sponsored by the National Science Foundation), and the UCAR COMET program (sponsored by NOAA) jointly funded the workshop.
NetCDF-4: Merging Models and Fusing Formats

Russ Rew
Unidata Program Center

Work on the successful NASA proposal to merge Unidata’s netCDF and NCSA’s HDF5, two widely-used scientific data access libraries, began in the summer of 2003. Developers at Unidata are collaborating with their counterparts at the National Center for Supercomputing Applications (NCSA), University of Illinois-Urbana/Champaign.

The project will work towards creating netCDF-4, using HDF5 as its storage layer. Using netCDF-4 in advanced Earth science modeling efforts will demonstrate its effectiveness. If successful, this project will facilitate open and free technologies that support scientific data storage, exchange, access, analysis, discovery, and visualization. Technology resulting from a successful netCDF-4/HDF5 merger would benefit users of Earth science data and promote cross-disciplinary research through the provision of better facilities for combining, synthesizing, aggregating, and analyzing datasets from disparate sources to make them more accessible.

The addition of two new staff developers jumpstarted the project within the UPC. They are pictured at right. On the right is Robert Lee, a student assistant, who worked through the summer. Robert returned to Carnegie-Mellon as a student at summer’s end. Ed Hartnett, on the left, joined Unidata after years at NASA and in the private sector. Russ Rew, the project manager, stands behind the two.

The netCDF-4 team is currently implementing the netCDF-3 interface using HDF5 as a storage layer. When complete, this translation layer will allow researchers using netCDF-3 to transparently switch to HDF5 format, while retaining the simple and terse netCDF interface. The switch to HDF5 will yield several immediate benefits, including the ability to create and access very large files and the ability to use the wide range of tools available for manipulating HDF5 data.

We will keep you informed of this project’s advances. Let us know if you have comments or suggestions by contacting support@unidata.ucar.edu.

Committee News

The Program Center welcomes three new members to the Unidata Users Committee. Elen Cutrim (Western Michigan University), Tom Mote (University of Georgia), and Michael Voss (San Jose State University) have graciously accepted three-year appointments to the committee. They replace departing committee members, Bill Fingerhut, Tony Rockwood, and Rich Clark. Rich’s tenure on the committee began in 1997, and since 2000 he has been its chair. Changes in the program center and the wider Earth Sciences community have been standard fare during Rich’s service, and he has been able to accommodate all of them with apparent ease. We are grateful to all of the departing members.

At this time, we are also pleased to announce that Jim Steenburgh, pictured, has agreed to serve as the committee’s chair. Jim, a University of Utah faculty member, has served on the committee since his first appointment in 1998. He is an active community member having participated as a speaker in the 2000 Users Committee workshop, Shaping the Future: Unidata Users as Leaders, and he participates actively in community e-mail forums.

Other committee members are Chuck Graves (St. Louis University), Anton Kruger (University of Iowa), Mark Laufersweiler (University of Oklahoma), Michael Morgan (University of Wisconsin), and Donna Tucker (University of Kansas). All of these individuals make important contributions to the Program Center and thus to the entire community, and we thank them mightily for their hard work.

Jim Steenburgh in his office at the University of Utah.
ESIP Federation Meets in Boulder

Unidata/ESIP Staff

UCAR and Unidata welcomed the Earth Science Information Partners (ESIP) to Boulder in late July. The gathering’s purpose was threefold: to hold the federation’s 11th business meeting, to conduct seminars around the meeting’s theme of “Earth Science for Society,” and to hold technical workshops wherein members could demonstrate the latest tools they have developed to make Earth science data more accessible.

The ESIP Federation was initiated and implemented by NASA to help make Earth science information and datasets available to a broad community. Membership at this time includes government agencies, universities, nonprofit organizations and private industry. A Foundation, recently initiated by the Federation, serves as its organizational arm and provides services such as accounting, insurance, fund development and management, and research-project management. The Foundation sponsors Federation activities, but is not, itself, a membership organization.

Forty-one recipients (thirty-five new members) of NASA Research, Education, and Applications Solutions Network (REASoN) grants brought fresh insight to workshop proceedings while providing further opportunity for forming partnerships with existing members.

A new member orientation opened the workshop on July 28 at the UCAR Mesa Lab. Dave Jones, President of the ESIP Federation and Dick Wertz, Executive Director of the Foundation for Earth Science provided them with background and organizational information.

Dave Jones’s welcoming remarks on Tuesday marked the official opening of the workshop. He emphasized the importance of better understanding our home planet. President Jones stated that the Federation achieves this by collecting and processing Earth science data while determining how best to communicate the results of those activities. Using video conferencing technology, opening day presenters included a number of representatives from NASA headquarters. The following URL provides information on subsequent days’ presentations.

http://www.esipfed.org/business/library/meetings/11th_fed_meeting/

The workshop was organized around five science themes or domains:

• Air: Atmosphere, Sun-Earth Interactions
• Land: Surface, Solid Earth
• Water: Hydrosphere, Oceans, Cryosphere
• Life: Human Dimensions, Biosphere
• Earth Systems: Multidisciplinary, Climate

Posters in Monday evening’s session reflected the range of those five themes while serving as the starting point for discussions within each of the domains; providing networking opportunities; educating participants on work within the community; and identifying possibilities for future collaboration. Presenters numbered close to forty with several members of Unidata’s community among them.

In addressing the workshop on Thursday July 31, Unidata Program Director, Mohan Ramamurthy, emphasized the synergistic nature of ESIP’s and Unidata’s roles. ESIP seeks to “develop a scientific understanding of the Earth system and its response to natural or human-induced changes and improve prediction capabilities for climate, weather, global air quality and natural hazards.” [ESIP mission statement] Ron Birk’s opening remarks noted the integration of NASA products as inputs into decision support systems (to facilitate management and policy decisions). Unidata’s mission is providing “data, tools, and community leadership for enhanced Earth-system education and research.” [Unidata Mission Statement] The program center facilitates data access, provides tools, supports faculty and staff, and builds and advocates for its community [Unidata mission statement]. The presentation confirmed the strong synergies that exist between the UPC and the ESIP community.

At this time, Unidata’s membership in the federation has provided the Unidata/THREDDS community with numerous partnering opportunities. In turn, Unidata’s membership in ESIP has resulted in some of its members having adopted Unidata’s Internet Data Distribution technology. Other ESIP partners have developed closer ties to the National Science Digital Library as a result of Unidata’s membership, while still other partners have demonstrated interest in Unidata/THREDDS’ cataloguing techniques.

Unidata is pleased to be a part of the ESIP federation and anticipates fruitful collaborations in the future with other federation members.
Unidata-Wisconsin Datastream Changes

Tom Yoksas
Unidata Program Center

A long-awaited revision to the Unidata-Wisconsin (UNIWISC) Datastream is scheduled to occur in late September. The datastream is being expanded so that it will include a combination of the following:

• a temporal increase in broadcast of both GOES-East (currently GOES-12) and GOES-West (currently GOES-10) images from hourly to half hourly
• an increase in the number of wavelength channels being sent for each satellite
• an extension of the GOES-East spatial coverage to include South America
• an increase in GOES-East water vapor imagery resolution from 8 km to 4 km
• the addition of SSEC/CIMSS Wildfire ABBA products for North and South America

These changes will mean that users of one of the most widely used IDD datastreams will have access to more channels with significantly more data more often, and will be able to view western hemisphere meteorological phenomena below the equator.

In practical terms, users will, if they elect to receive all of the new products, experience a significant impact (up to 56 MB more data per hour of data saved locally) on their network bandwidth and disk space use. A Unidata technical staff review of community capabilities revealed significant increases in computing and network capabilities since the last time the Unidata-Wisconsin datastream content was modified.

We are confident that the great majority of community sites will be able to accommodate the increased data volume without having to augment existing resources.

The Unidata-Wisconsin datastream contains image sectors from the visible (0.65 µm), water vapor (6.5 µm for GOES-East/6.8 µm for GOES-West), and thermal infrared (10.7 µm) GOES imagers. Figures 1 and 2 illustrate the effective spatial coverage of the current GOES-East and GOES-West, respectively, sectors.

Figures 3 and 4 illustrate the spatial coverage for the proposed GOES-East sectors. Figure 3 shows the coverage when GOES-East is being operated in the North American Extended scan model and Figure 4 illustrates the composite of the North American Extended and Southern Hemisphere scans that we are proposing to send.

Please contact the UPC (support@unidata.ucar.edu) if you have questions or concerns about the changes. Technical staff will be able to help you accommodate the increased data volume, provide ideas about the ways it might be used, and address your questions and concerns.

Figure 1.

Figure 4.

Figure 2.

Figure 3.
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UCAR
P.O. Box 3000
Boulder, CO 80307-3000

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