A I P S L E T T E R

Volume XXV, Number 2: December 31, 2005

A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

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General developments in *AIPS*

Current and future releases

We now have formal *AIPS* releases on an annual basis. Beginning very recently, we offer a full binary installation method for both the frozen and development versions for MacIntosh OS/X, Solaris, and Linux. All architectures can do a full installation from the source files. The current release is called `31DEC05` and is now frozen. If you took a development copy of this version at some earlier date, you may use the "Midnight Job" (MNJ) to bring it up to date. You need to run a MNJ only once in 2006 to convert your copy of `31DEC05` into the now frozen version. When patches to 2005 are announced, you may apply them with the MNJ. This *AIPSLetter* is intended to advise you of developments in this release.

We have begun a new version, called `31DEC06`, which is now under development by the *AIPS* Group. You may fetch and install a complete copy of this version at any time. Having fetched `31DEC06`, you may update your installation whenever you want by running the MNJ which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take their source-only or binary version of `31DEC06` *AIPS* over the Internet (via *anonymous* ftp). Both versions require you to copy the installation procedure `install.pl` via `ftp`; the source-only version also requires you to copy the 70-Mbyte `31DEC05.tar.gz` compressed tar file.

From `mnj.aoc.nrao.edu`, the MNJ will serve up *AIPS* incrementally — or as a whole — using the Unix tool `cvs` running with anonymous ftp. Binary MNJs also use the `rsync` tool. Linux sites will almost certainly have `cvs` installed; other sites may have installed it along with other GNU tools. Secondary MNJs will still be possible using `ssh` or `rcp` or NFS as with previous releases. We have found that `cvs` works very well, although it has one quirk. If a site modifies a file locally but in an *AIPS*-standard directory, `cvs` will detect the modification and attempt to reconcile the local version with the NRAO-supplied version. This usually produces a file that will not compile or run as intended.

Installing a new version

If compiling locally, new releases must be installed from the tar ball for that release. If using the binary installation, a full new installation must also be done with `rsync`. The `cvs` system requires this. When installing a new *AIPS* release in a system that already has a previous release, we recommend that `install.pl` be used and that the previous release be left in place, at least until the installation has been seen to work. If you do this, then you will not have to re-edit the disk, printer, and tape lists and can simply skip all those pages in the `install.pl` menus. The old `$HOME/.AIPSRC` file may be left in place, but it will need to be edited. The lines giving the `DOWNLOADED` and `UNPACKED` parameters should be deleted and the `CCOMOPT` line should be changed to point to the current release rather than the previous one — the `-I` parameter really should be `-I$INC` but that seems to confuse `install.pl`. Therefore, for now, the `$INC` has to be given in its full path name, which forces a re-edit with each release. If you have made special versions of `UPDCONFIG` and `do_daily.`*host*, you should preserve them under new names and restore them after the install. If you have an odd set of *AIPS* versions, the `$AIPS_ROOT/AIPSPATH.*SH` files may need to be edited after the install to set the desired versions.

For Linux, Solaris Ultra, and MacIntosh systems, a binary installation is available from CDrom, supported by `install.pl`. Alternatively, the frozen version may be installed with the binary installation method now present in `install.pl`. The ftp site for downloading files directly has been eliminated.

Binary installations and updates

GNU has provided compilers for the *AIPS* community at no cost for many years. While remarkably good, these compilers have suffered from both minor errors and from their generality. When some vendor sets out to make a compiler for a very specific architecture, it is possible — not guaranteed — to create a compiler that produces binaries that run faster than those produced by GNU's `g77`. Unfortunately, these vendors have to recover their costs in producing these compilers and so may charge for them at a rate that is difficult or prohibitive for many *AIPS* users. Such is the case with IBM's `xlf` compiler for PPC chips, including the MacIntosh OS/X systems, for SUN's SUNWspro compiler suite, and for Intel's `ifort` compiler. These compilers produce executables that run about 50% faster (30% faster for Intel) than those produced by `g77` on these operating systems and cpus. Fortunately, their licensing agreements allow us to ship executables to our users along with the required run-time libraries. The binaries produced by the Intel compiler are quite large because they contain optimizations for modern PIV cpus, older PIV cpus, and for general computers such as AMDs. The specific optimizations to be used are selected at run time.

The code to implement the binary installation and binary updates via the MNJ is comparatively simple. Every night, a `cron` job run on the master *AIPS* machine in Socorro, does the necessary magic to make the daily cvs snapshot of *AIPS*, builds the tar-ball, orders the three architectures at the AOC to do ordinary text MNJs, and then `rsync`'s the binaries and text to a special area on the computer used for public `ftp` access to NRAO in Socorro. The installation script must be fetched from the AOC anonymous ftp area to your desired `$AIPS_ROOT` area and then executed with

```
perl install.pl -n
```

With the `-n` option, the script will skip fetching and unpacking the tar-ball and the compiler queries and usage. It does a variety of `rsync` commands to fetch a complete copy of the *AIPS* version including libraries and all executables. It marks the installation as a binary one by creating a special 0-byte file in `$SYSLOCAL`. The MNJ then detects this file and replaces the compile steps with `rsync` operations on the binary areas. The `cvs` utility is still used for updating the source code and other text areas.

There are some limitations with binary installations. The AP size will be 20 Megabytes which is a good size for most machines and problems, but too small for the largest-memory computers and biggest problems. Furthermore, without a matching compiler, it will be difficult to develop any local programs as additions to the standard *AIPS* package.

Improvements of interest to users in 31DEC05

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. There have been a number of changes in 31DEC05. In the last six months, we have developed new tasks CLCOP to copy CL table data between IFs, REAMP to rescale fluxes in uv data, SPIXR to fit spectral indices to image cubes, and CCRES to remove and restore Clean components from images. Two new VLBAUTIL procedures were written to download from the web and apply to VLBI data measurements of the ionosphere and earth orientation. A service program REUSE was written to convert public catalog *AIPS* installations to user-private installations. The new verb QINP allows users to resume looking at INPUTS at the last page they were examining. 31DEC06 already has a change in UVCON to model interferometers which have position-dependent primary beam patterns. This change was judged too significant to put into nearly frozen code.

31DEC04 and 31DEC05 use a new numbering scheme for magnetic tape logical unit numbers that is incompatible with previous versions. Thus all tape tasks and the server TPMON must be from one of these two releases. Other than this, 31DEC05 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

UV data calibration

Calibrator models

In the 30JUN04 edition of the *AIPSLetter* we announced the availability of VLA flux calibrator models for the 3 highest frequency bands observed with the VLA in *AIPS*. Here we announce the availability of flux calibrator models at all bands from K through L for 3C48 and 3C286, in addition to the models at K, Q and U for 3C138 and 3C147. Models for 3C138 and 3C147 at the lower frequencies should become available over the next year. To see what models are available in *AIPS* type CALDIR; to load a model use the task CALRD.

Now that most VLA primary flux calibrators have models, their use should be the default way to obtain amplitude calibration for the VLA. See the *AIPS CookBook* for details. The VLA primary flux calibrators are resolved at most frequencies and configurations. Even in the configurations and frequencies where they are not resolved (*e.g.*, L band in D array) there are many confusing sources, so in *all situations* a model will make the flux calibration more accurate. Note that multiple facets were required to image the calibrators and confusing sources at the lower frequencies. We have found, however, that the Clean components from the exterior facets may be included in the CC table of the primary facet with no loss of accuracy in calibration. When using the models, there is no need to limit the *uv* range or antennas in CALIB, making automated data reduction even easier.

When working with the calibrator models, we discovered a serious problem with the way models are computed from images. In order to handle coordinate rotation, the central pixel and the reference pixel of the image are both relevant to model phase computation. Before mid November 2005, *AIPS* had no mechanism to retain the central pixel information when images are changed in size, *e.g.*, by SUBIM. All calibrator models were corrected on November 1, 2005 to have their central pixel be the original central pixel even though the images have been reduced significantly in size. Prior to that date, the calibrator models would get the correct amplitude calibration but would introduce a position shift into the phases. Fortunately, the primary amplitude calibrators are rarely if ever used to to provide phases for the target sources.

The VLBA and the Earth Orientation Parameters

When VLBI data are correlated, the position of the Earth's North pole and the offset between Earth rotation time and clock time must be known. Unfortunately, these parameters must be calculated using measurements taken on the day in question, so the best estimates are not determined for several weeks after the fact. Given the cost of VLBI recording media, the data must be correlated using predicted EOPs rather than the final, good estimates. Compounding this basic problem, it was found recently that the VLBA correlator had a systematic error in selecting the Earth Orientation Parameters (EOP) estimate it used, causing a very preliminary estimate to be used from May 2003 to August 2005. Fortunately, the parameters that were used are recorded in the previously unused `CT` table. `FITLD` was revised to handle this table more carefully and to add to it information on the *uv*-data time range to which each entry applies.

The task `CLCOR` was given a new `OPCODE='EOPS'` to read a text file containing the latest EOP parameters and to correct phases for any differences between them and the parameters used at correlation. A procedure called `VLBAEOPS` was added to the `VLBAUTIL RUN` file. It can fetch the latest EOP data from the USNO over the web and then use them in `CLCOR`. This correction should be run on all VLBA data that require accurate phases, particularly phase-reference observations. For details see VLBA Test Memo 69 by R. C. Walker, V. Dhawan, W. Brisken, J. Benson, L. Kogan, and J. Romney from `http://www.vlba.nrao.edu/memos/test/`.

Other VLBI changes

In addition to `VLBAEOPS` mentioned above, a number of other changes were made to the `VLBAUTIL RUN` package. New procedure `VLBATECR` downloads the electron content data from the web that applies to the data set and then runs `TECOR`. These two procedures make clever use of the `SYSTEM` verb to fetch and apply information from the web. Procedure `VLBALOAD` now allows data to be taken from disk and `VLBAMPCL` defends itself against a common form of user input.

`SNSMO` is the task recommended for smoothing VLBI solutions since it does a better job of handling delays and rates with their effects on phase. However, `SNSMO` adopted the heavy-handed assumption that all rates should be the same and so averaged all polarizations and IFs producing identical output rates. This was changed to have `SMOTYPE 'VLBI'` average over polarization to avoid changing apparent instrumental polarization, but to keep IFs separate. A new `SMOTYPE 'VLRI'` was added to retain the previous averaging over IFs.

`FITLD` was changed to recognize that a station named "Y" with a sensitivity of 1.0 is actually the phased VLA. In that case, the recorded $T_{\rm sys}$ is actually $T_{\rm sys}/T_{\rm ant}$, a fact that is signaled by setting the antenna temperature to -1.0 in the `TY` table. Prior to this correction, very wrong amplitude calibrations would be found for the phased VLA. Errors corrected in `FITLD` include a date comparison that could cause the task to skip data files rather than loading them, uninitialized extension file version numbers in numerous subroutine calls, and a rearrangement of code to allow proper file management when trying to close down gracefully after an error occurs.

Other *uv*-data changes

FLAGR and `FINDR` were changed to regard a failed solution (when finding antenna-based amplitudes, phases, weights) as grounds for deleting the data. This simple fix seems to have made this into a quite useful flagging task using essentially only default adverb values.

CLCOP is a new task to copy the calibration for one polarization into that for the other. It can swap them and even write a 2-polarization file from a 1-polarization input file.

REAMP is a new task to rescale amplitudes and weights.

RESEQ was completely rewritten to allow complicated antenna renumbering operations.

FILLM was changed to get the correct bandwidth for modes 8 and 9 which is $50/2^8$ MHz. The previous value (half as large) led to wrong reference channels, bandwidths, and other minor errors.

CALIB was changed to count "failed" solutions differently. Previously, missing data were counted as failed which is more than a little confusing.

CPASS was changed to accept error returns from the fitting subroutines. It will quit on one of the errors, but will write the solutions into the `BP` table even when the fitting routines say they did not converge. It is not clear that this task has ever worked.

Imaging

Managing box files

IMAGR has a rather complicated set of adverbs plus BOXFILE options which may be used to define facets, resolutions, and Clean boxes. There are several tasks which have been written to help manage these parameters, primarily the BOXFILE content. Initially, these tasks were fairly simple but they have been changed to handle most of the options that are used in IMAGR. BOXES was written to add Clean boxes to a BOXFILE which defined the facets, but with the addition of NFIELD, RASHIFT, and DECSHIFT the facets may be defined in other ways. FIXBX was written to correct the boxes of one BOXFILE which defined its facets to those facets defined in another BOXFILE. But, with the addition of NMAPS, NOISE, PBSIZE, NBOXES, CLBOX and NGAUSS to describe old imaging parameters (along with INFILE) and NFIELD, RASHIFT, and DECSHIFT to describe new imaging parameters *along with BOXFILE) the faceting may be described completely with adverbs. CHKFC was initially written to test the BOXFILE output of SETFC, but can now define the facets and boxes with NFIELD, RASHIFT, DECSHIFT, NBOXES, and CLBOX.

Miscellaneous matters

CCRES is a new task to add or subtract Clean components from an image. Unlike RSTOR, there is no requirement that the components lie on cells or that the image be a power of 2 in size.

RSTOR was revised to subtract as well as add Clean components to an image.

IMAGR was corrected. The user's MINPATCH value was lost when cleaning a small window and not restored when next cleaning a large window.

Single-dish imaging was changed. SELSD and GRIDR were removed along with the concept of "projected" coordinates in the *uv* location. Galactic and Ecliptic as well as the usual celestial coordinates are now allowed in SDIMG. A path to import GBT data into *AIPS* for imaging is available in Green Bank.

Analysis

Spectral index

With the development of the EVLA, interest in spectral-index issues has grown. IMMOD was changed to allow the addition of up to four model images per execution. UVMOD was changed to allow different spectral-indices for each of the up to four model objects. MCUBE was changed to allow the user to force the creation of a SEQ.NUM. axis ignoring some axis coordinate that differs in an irregular way. This axis is called FQID when the coordinate is frequency and the values of the coordinate are stored in a FQ table attached to the output image cube. The coordinates of any type that are ignored on such an axis are stored in the history file.

A new task named SPIXR was written. It reads a transposed cube (frequency axis first) and fits to it an image of spectral index and, optionally, spectral index curvature using least squares. Early testing of this task indicates that issues of spatial resolution and blanking will be important in its use. It is intended to use the output of SPIXR as an optional input to IMAGR to correct for spectral index while doing bandwidth synthesis imaging of continuum sources.

Miscellaneous

CCEDT was overhauled so that its less known option of automatic box splitting might actually work. Corrected handling of boxes for images of less common types.

RMSD was given the option to output the local mean value instead of the local rms.

SAD was given the option to read an image of the rms.

Plotting

TVCPS was generalized to read one image from disk for each image plane that is visible. This will allow large images to be written to the output PostScript file for hue-intensity and three-color displays.

SNPLT was corrected to select IFs correctly when plotting `PC` tables.

Point plotting was further clarified, making a consistent set of symbols across all tasks using the standard list of available symbols.

General items

QINP is a new verb. It resumes the previous `INP` or `INPUTS` with the last page viewed. Thus, after viewing a page and changing the adverbs on the page, the user may re-view that page without having to start back at page 1.

SYSTEM is a powerful verb that invokes a command to the operating system. It was enhanced with additional adverbs to allow for very long commands.

APROPO will now include all task, verb, adverb, and procedure names as well as the words in the one-line comments of the help files

Miscellaneous matters for programmer types

Dynamic memory now uses `LONGINT` as the data type for the array offset parameter. This translates to `INTEGER*8` on 64-bit computers where it has been tested. The trick of using the pseudo-AP routines with dynamic memory will not work on some of these computers because the 1000s of variables which are pointers into the pseudo-AP have not been translated to `LONGINT`s.

REUSE is a new service program. It translates an *AIPS* system that was set up with public (multiple user) catalogs into a system with separate catalogs and files names for each user. `FILAIP` was changed to make the error of having public catalogs very unlikely.

install.pl was changed for the changes in `FILAIP` and to recognize AMD 64s making corrections in `FORTOPT` and in the `XAS Makefile`.

Dæmon mysteries

Two mysteries have arisen affecting the *AIPS* dæmons. The first affects the message and Tektronix servers. They are run as programs inside an `xterm`. At at least one site, we found that the command has to be invoked as

```
xterm -e '$LOAD/MSGSRV.EXE ' &
```

with quote marks and a blank character ahead of the close quote. At most sites, this grammar is apparently acceptable if not required. But, at all Solaris and some Linux sites, this grammar causes the command to fail. Does anyone out there understand what is going on?

The second mystery concerns the performance of the *AIPS* TV `XAS`. Compared to RedHat 9 and previous systems, the performance appears to be compromised under RedHat Enterprise. It is acceptable, but noticeably slower, using `tv=local` Unix sockets. Using Inet sockets, the communication to `XAS` appears to be very erratic, with rapid response for short intervals followed by no response for comparable intervals. This occurs only when the computer is actually looping back to itself; the communication between computers appears to be as fast as ever. Any suggestions?????

Patch Distribution for 31DEC04

As before, important bug fixes and selected improvements in 31DEC04 and 31DEC05 can be downloaded via the Web beginning at:

http://www.aoc.nrao.edu/aips/patch.html

Alternatively one can use *anonymous* ftp to the NRAO server ftp.aoc.nrao.edu. Documentation about patches to a release is placed on this site at pub/software/aips/*release-name* and the code is placed in suitable subdirectories below this. As bugs in 31DEC06 are found, they are simply corrected since 31DEC06 remains under development. Corrections and additions are made with a midnight job rather than with manual patches.

The patch system has changed because we now have binary installations. We now actually patch the master copy of the frozen version. This means that a MNJ run on 31DEC04 after the patches listed below will fetch the corrected code and/or binaries rather than failing. Similarly, patches announced for 31DEC05 during the next year will be available via MNJ as well as ftp. Installations of 31DEC04 and 31DEC05 after the patch date will contain the corrected code.

The 31DEC04 release is no longer available for installation. It had a few important patches most of which were released in April when we changed the patch system. For correcting existing 31DEC04 releases, the patches are:

1. OTFUV, OTFIN to handle both byte orders of 12m OTF data *2005-01-06*
2. CXPOLN procedure, CXCLN task need modern image names *2005-04-22*
3. TVFLG and SPFLG required improved error handling and modern FLAGVER default *2005-04-22*
4. WIPER function FLAG AREA aborted on wrong button push *2005-04-22*
5. FIXBX could handle complicated cases but not simple ones *2005-04-22*
6. POSSM used wrong units in output text file *2005-04-22*
7. CL2HF aborts under Linux *2005-04-22*
8. TCOPY used wrong (old) tape LUNs *2005-04-22*
9. BPASS gets wrong solutions when channel 1 of of the first source was flagged *2005-04-22*
10. BOXES could handle complicated cases but not simple ones *2005-08-16*
11. CALIB looses track of the SN table when writing a FG table *2005-08-16*
12. FITLD wrongly concluded data were too early and did not handle cal transfer correctly for the phased VLA *2005-08-16*

Recent *AIPS* and related Memoranda

The following new EVLA Memorandum is available from the NRAO web pages (http://www.aoc.nrao.edu/evla/memolist.shtml)

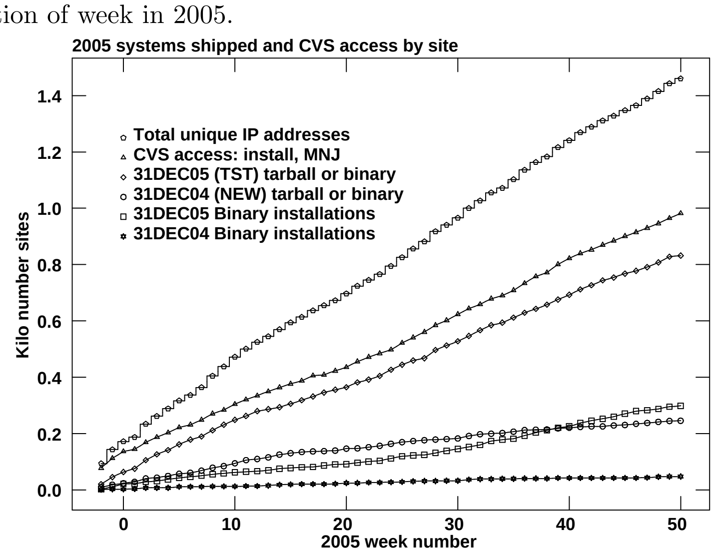
96 Imaging at Wide Field of View for a Plane Array
Leonid Kogan
9/20/2005
We consider the array located at a plane. The coordinate system we chose has U, V axes at the array plane, and W axis perpendicular to the array plane. W components of the baselines are equal zero and therefore expressions describing the Fourier transform pairs: IMAGE $<->$ VISIBILITIES do not include the W component of the vector directed to the current point at the source. As a result this Fourier transform is becoming two dimensional at the whole semi sphere of the sky. This is obviously true for a snapshot observation. The method to connect different time snapshot observations is given.

The following new VLBA Test Memorandum is available from the NRAO web pages (`http://www.vlba.nrao.edu/memos/test/`)

69 Inappropriate EOP on the VLBA Correlator
R. C. Walker, V. Dhawan, W. Brisken, J. Benson, L. Kogan, & J. Romney
10/06/2005
A bug has been found in the job generator for the VLBA correlator that caused it to use predicted rather than measured Earth Orientation Parameters (EOP) between May 2003 and August 2005. The errors introduced often are sufficiently large to adversely affect phase referencing observations and other observations that rely on an accurate correlator model. The nature of the problem and its impact are discussed in this memo. Correcting data is straightforward using the new EOPS option in the AIPS task CLCOR. Users just wishing to make corrections without worrying about the gory details can consult Section 2, or simply follow the CLCOR help file. It has become apparent while dealing with this problem that even occasional projects from outside the time period of the bug have been correlated with poor EOP. Usually this is because their job scripts were prepared too close to the observe date. So any user depending on an accurate correlator model may wish to check their EOP.

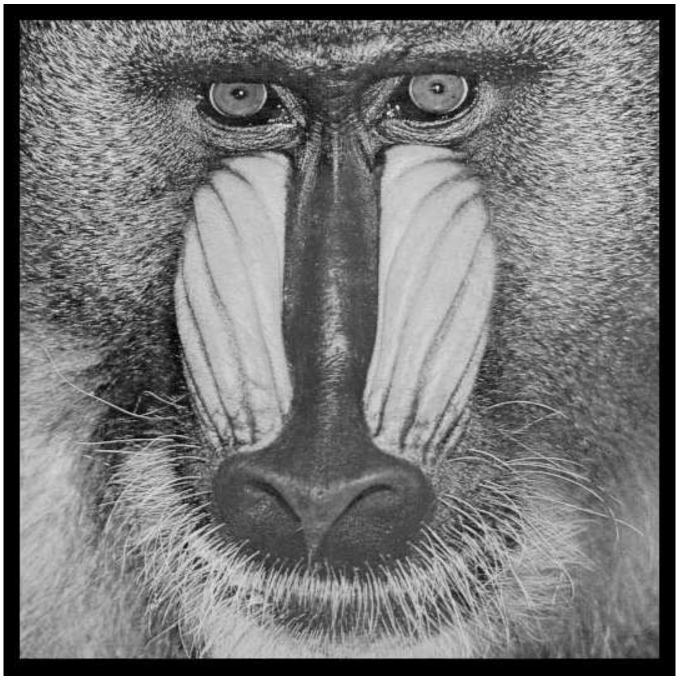
AIPS Distribution

We are now able to log apparent MNJ accesses, downloads of the tar balls and `rsync` accesses. We count these by unique IP address. Since dial-up connections may be assigned different IP addresses at different times, this will be a bit of an over-estimate of actual sites. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers are probably an under-estimate of the number of computers running current versions of *AIPS*. We have abandoned the registration system as obsolete and onerous. In 2005, a total of 246 different IP addresses downloaded the frozen form of `31DEC04` and 832 IP addresses downloaded `31DEC05` in tarball or binary form. Fully 982 IP addresses accessed the NRAO cvs master. Each of these has at least installed `31DEC05` and 252 appear to have run the MNJ on `31DEC05` at least occasionally. The total number of unique IP addresses in these three lists was 1460. 48 sites accessed `31DEC04` in binary form, while 299 sites used the binary form of `31DEC05`. The attached figure shows the cumulative number of unique sites, cvs access sites, tar-ball/binary download sites and binary access sites known to us as a function of week in 2005.



Since the registration system, always under-utilized, has now been abandoned, we are left with analysis by IP address. The table below lists the IP addresses for 2005 by the final qualifier for shipments of the `31DEC05` tarball, the `31DEC04` tarball, and access to the cvs site. The numbers in the cvs column include those sites that install `31DEC05`, run a midnight job for `31DEC05`, or run a final "catch-up" MNJ for `31DEC04`. The comments come from what appears to be a semi-official list of Internet codes. Sorting is on the "unique" column, which counts unique IP addresses over the other three columns:

Code	31DEC04	31DEC05	cvs site	unique	Comments
edu	55	199	283	382	US Educational
net	14	68	90	131	Network
uk	11	58	51	82	United Kingdom
jp	20	50	44	78	Japan
com	9	32	34	54	US Commercial
org	1	10	52	54	Non-Profit Organization
au	7	28	26	46	Australia
es	1	33	37	45	Spain
it	5	21	13	33	Italy
de	4	17	18	31	Germany
ca	4	18	19	29	Canada
gov	8	13	20	27	US Government
mil	5	17	13	22	US Military
pl	2	13	9	18	Poland
in	6	10	7	16	India
nl	4	8	9	14	Netherlands
fr	3	10	2	14	France
tw	6	7	7	10	Taiwan
cn	3	4	3	8	China
br	3	4	1	7	Brazil
kr	2	5	5	7	Korea (South)
mx	2	6	5	6	Mexico
pt	2	4	3	5	Portugal
ru	1	3	2	5	Russian Federation
inva	0	0	5	5	(Germany, key invalid)
se	1	2	1	4	Sweden
ar	1	2	2	4	Argentina
fi	0	3	4	4	Finland
ie	0	4	4	4	Ireland
cl	1	1	1	3	Chile
be	1	0	2	3	Belgium
il	0	3	1	3	Israel
za	0	1	3	3	South Africa
ch	1	0	1	2	Switzerland
at	2	0	0	2	Austria
hu	1	2	0	2	Hungary
dk	0	2	2	2	Denmark
co	0	2	0	2	Colombia
th	0	2	0	2	Thailand
cz	0	1	0	1	Czech Republic
yu	0	1	0	1	Yugoslavia
id	0	1	0	1	Indonesia
gr	0	1	1	1	Greece
mu	0	1	0	1	Mauritius
hr	0	1	0	1	Croatia (Hrvatska)
sk	0	1	0	1	Slovak Republic
None	1	7	13	14	
Unknown	59	156	189	270	
Total	246	832	982	1460	



December 31, 2005

AIPSLETTER
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USA

FIRST CLASS

To:

DATED MATERIAL-DO NOT DELAY