Description of Apollo ARCSAV tape files as produced by JBI, DBDS and KDM, with Addendum

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This document describes formats of files produced by three subcontractors (vendors), John Bordynuik Inc. (JBI), DataBank Data Services (DBDS) and Katalyst Data Management (KDM), by reading ARCSAV tapes for a three-month period of April through June of 1975 archived at the Washington National Record Center (WNRC) and found in 2010.

ARCSAV tapes are 7-track reel-to-reel digital tapes produced at the NASA Johnson Space Center (JSC) during the Apollo missions, each containing 24-hour time-edited raw binary data received from each of the Apollo Lunar Surface Experiment Packages (ALSEP) deployed at the landing sites of Apollo 12, 14, 15, 16 and 17. Detailed descriptions of these tapes are found in Apollo Lunar surface Experiment Package Archive Tape Description Document, JSC-09652.

The files these subcontractors produced are supposed to be bit-by-bit copies of the data on ARCSAV tapes. However, because of problems in reading these old tapes, they often contain irregularities, such as split byte, combined bytes, missed byte, split record, etc. This extraction and restoration effort began in 2013 and ended in early 2017.

Format common to all three vendors are the following:

(1) The data from each ARCSAV tape are written as a variable-length record sequential file.
(2) Each file normally starts with two header records of 48 bytes in length, followed by data records of each 19200 bytes in length and ends with two records of zero length. However, there are some exceptions to this. The record length may vary if there is any problem in reading the tape. There may be a single header instead of two and there may be a single zero-length record instead of two at the end of the file. Additional null bytes may be inserted. Some other irregularities of unknown reason may also be found.
(3) Each 19200-byte data record contains three 6400-byte ARCSAV records.
(4) Each 7-bit byte on the tape, including or excluding the parity bit depending on the subcontractor, is copied to the least significant 7 or 6 bits of each 8-bit byte on the file.

(5) When the parity bit is provided, the header records are written with even parity and the data records are written with odd parity.
(6) A common file naming convention was used:
arcsav_apAA_YYYYDDD_PNNNNN_XXX where AA is the Apollo mission number (12, 14, 15, 16, or 17), YYYY and DDD are the year and day of year for the 24-hour data acquisition period, NNNNN is the ARCSAV tape number, and XXX identifies the JBI, DBDS, or KDM file format which are described below.

Formats specific to the vendors are the following:
(1) In JBI format (file *_j), each record is preceded by and followed by a 4-byte integer containing the byte count of the record in little-endian byte order. In this format, the most significant bit is set if parity error is detected. When this happens, the most significant bit of the byte counts that precede and follow the record is also set.
(2) In DBDS format (file *_d1 and *_d2), no byte count is given, but the most significant bit of the first byte of each record is set.
(3) In KDM format (file *_k), each record is preceded by a header of three 4-byte integers in little-endian byte order. The first integer has a value of 0 except for the final one or two zero-length records for which the value is 1, the second contains the zero based file offset of the header of the previous record (0 for the first record) and the third contains the offset of the header of the following record (0 for the last record). In this format, the parity bit is cleared in each byte.

Since each vendor used a different format, each file produced by DBDS and KDM is also provided in the JBI format so that users need work with only that format. Some specifics for DBDS and KDM files converted to JBI format:
(1) In DBDS files converted to JBI format (file *_dj), the most significant bit is not set when parity error is encountered.
(2) In KDM files converted to JBI format (file *_kj), since the parity bit, the second most significant bit, is always zero in the original KDM files, it is provided based on the remaining 6 bits and thus may be different from that on the tape.

These vendor-extracted ARCSAV tape files are grouped into five Level 0 (Raw) data collections by Apollo mission and archived at the NASA Space Science Data Coordinated Archive (NSSDCA) under these collection identifiers: PSPG-00912 (Apollo 12), PSPG-00913 (Apollo 14), PSPG-00914 (Apollo 15), PSPG-00915 (Apollo 16), and PSPG-0016 (Apollo 17).

Addendum to "Description of ARCSAV tape files as produced by JBI, DBDS and KDM"

These files often contain split bytes, combined bytes, extra bytes, skipped bytes, and any combination of these, all caused by tape-reading errors. Whenever this happens, the rest of any given record is shifted by a byte or more, and unless this is corrected the data extracted for any given experiment is compromised.

One of the symptoms of these errors is a record length that is shorter than or longer than 19,200 bytes. However, this symptom may disappear if a pair of errors, one extends the record and the other shortens it, exists. Other symptoms include incorrect header, short or long time string, discontinuous time strings, displaced sync bit pattern, parity errors, either or both of the least significant two bits of the second byte of a two-byte ALSEP word, which is supposed to be zero, is set.

In addition to these tape-reading errors, there are errors that exist on the ARCSAV tapes, often caused by poor reception of signals from the Moon or those introduced when the ARCSAV tapes were generated. These errors often appear as incorrect sync bit patterns.

If the user ignores any of these while trying to extract data for a specific experiment, the user will end up extracting something other than the real data for that experiment.

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