I) Preliminary Info

A) The subprocess structure at the command level of a process contains 4 subprocesses. 1) The Bead ghost, which is a vestage of the old bead, intercepts all of the old bead calls, user errors and interrupts. 2) BEAD Services, which does the simulation of the old bead calls, as well as other services. 3) The line collector, which talks to the teletypes. 4) The command processor, which handles primary control of the process, in conversation with the users teletype, and which this document describes.

B) The command processor actually contains 3 separate programs.

i) The command processor proper, which is used for calling subprocesses.

ii) Services, which is used for a number of utility functions.

iii) and the Bead ghost, which is called by the Bead ghost subprocess to handle errors and interrupts.

C) With one exception, each of these programs uses the same form of command line; a verb followed by 0 or more parameters. The verb and parameters are separated by 1 or more blanks, and the command line is terminated by 0 or more blanks followed by a carriage return. The line may have initial blanks which are ignored.

D) With few exceptions, the parameters have a common structure, described below, which designate either a datum, an object or the location of a datum or object.
II) Command Processor

The command processor accepts 2 types of command lines. The first type is the standard command line of a verb with 0 or more parameters. These cause special actions. First I list those which will appear in the final version.

Note: In describing standard commands, I state the verb as typed, followed by what is expected of its parameters, if any.

i) Services

Causes control to go to Services

Next I list those used in the test version only.

i) USERBUD

Calls Bruce's debugger

ii) IPROC

Causes simulated IPROC, should be done exactly once per call of XIPROC.

iii) KEITH

Makes debug call on Keith's LOAD/DUMP/RECOVER simulator, attempts to simulate rest of IPROC.

iv) BILL

Identifier Identifier

Makes debug call on Bill Bridges Bead simulator. (Actually a Bead B6=0 call on Bead ghost)

v) Crunch

Causes a Bead B6=4 call on Fake Bead ghost. Used for debugging parts of command processor subprocess. Dangerous to use.

The second type of command accepted by the command processor is a subprocess call. This command starts with a standard parameter, naming a file containing a subprocess descriptor for the desired subprocess. This is followed by 0, 1 or 2 bead type parameters, separated by blanks. The line is terminated by 0 or more blanks followed by a carriage return. A bead type parameter is either an identifier or an integer. (See standard parameters.)
III) Services and Bead Ghost

All command lines here are of the same form, a verb followed by 0 or more parameters. What follows is a list of the verbs, and what they expect to be provided by their parameters. Most parameters are standard. Most verbs are common to services and Bead ghost; some are used by one program only and are so indicated. All verbs are to be typed as written.

1.1) **FIN**  
(Services only)  
Returns control to the command processor

1.2) **RETRY**  
(Bead ghost only)  
If the Bead ghost was called by an error or interrupt, and the calling subprocess is in the middle of an XJ then that XJ will be repeated; otherwise same as return.

1.3) **RETURN**  
(Bead ghost only)  
The subprocess calling the Bead ghost continues at its next instruction.

1.4) **PURGE**  
Reduces subprocess call stack to initial value. Deletes all user subprocesses.

2.1) **P.ASCII**  
Changes mode of PDATA to 4 bits, 7 bits, ..., 7 bits

2.2) **P.FULL**  
Changes mode of PDATA to 60 bits

2.3) **P.INST**  
Changes mode of PDATA to 15 bits, 15 bits, 15 bits, 15 bits

3.1) **IN.OCT**  
Causes all integers without trailing 'D' to be read in octal.

3.2) **IN.DEC**  
Causes all integers without trailing 'B' to be read in decimal
4.1) PDATA Datum

Prints the datum in current print mode

4.2) PDATA Datum.Loc Count

Prints several datum words in current print mode.
An interrupt will stop the printing with no damage.
(Except in current test mode, while printing from a disk file.)

4.3) PCAP Object

Prints in octal the contents of the 2 words of the capability.

5.1) MDATA Datum Datum.Loc

Moves datum to given datum.loc, 1 word only

5.2) MCAP Object Object.loc

Moves object to given object.loc, 1 object only
If the object is a disk system object, and the object.loc is a directory.loc, it forms a mail link.

6.1) NEWV Identifier

Creates a variable of given name. Maximum of 8 characters in the identifier. (Current maximum number of variables is 10.) A variable can hold either objects or data.

6.2) NNEWV Identifier

Destroys named variable

7.1) VIEW Datum

Prints out the contents of the 3 words of a subprocess call stack entry. The call stack entry named depends upon whether in Bead ghost or services.

A) Services

0 Services itself (printer and XJ address)
1 Beads, which called services
2 Builder
   etc.
B) Bead ghost

- 1 Bead ghost itself (printer and XJ address table)
   (Portion lives in command processor)
- 0 The Bead ghost subprocess
- 1 Calling subprocess
   etc.

8.1) NEWOF Directory.Loc

Creates a disk file, of current shape, in the given directory of the
given name. The access key part of the directory.loc is ignored. Makes a non scratch entry.

8.2) NEWDR Directory.Loc Datum Datum

Creates a new directory, of size given in first
datum, with given name. The access key part of the
directory.loc is ignored. Makes a non scratch entry.

In the final version they will either disappear entirely
or appear in heavily modified form.

1.1) USER Identifier (services only)

Sets the running user name and creates a temporary
directory. Should be called once only per call of
XROOT.

1.2) DEATH

Destroys this user process

Calls Bead with ..STOP. (The real Bead, ancestor
of XROOT.)

T.4) CRUNCH

Causes a Bead to STOP call (B6=4) to be made on
fake Bead ghost. Used for debugging parts of the
command processor. Even more dangerous here than
under the command processor.
Additional test commands for SERVICE and guest

**BEANSENSE**

causes 4 words of error information from BEANS
to print out. makes a call on BEANS to get the information. see document on errors in BEANS

**BEANSDBL**

causes BEANs to make a STOP call on
same BEANsense. (causing 'BUH, system has crashed' message.) Dangerous to use.

**GETBD FILE param1 param2**

(get a file or other object) from old BEAN places in variable \verb+BEAD1+.

**NEWBD file1**

creates a data block in the given file at the given address. disc or es file.

**KILLBD file1**

creates a data block from the given file at the given address. disc or es file.
COPY OF FILE  parum parum2 dir.123

on 505 obtains a file from the old disk with name parum parum2.
Creates a disk file with same blockside in given dir.2. This dir with given name, copies the es5 file to the new disk file.
IV) Standard Parameters

These are used to define one of the following:

- **Datum** - 60-word Datum
- **Object** - Capability
- **Datum.Loc** - Location of a 60-word Datum, examples are a file and file address, or a subprocess memory address.
- **Object.Loc** - Location of a capability, examples are a list and index; or a directory name and access key.

**Identifier** - String of characters

A) A standard parameter is written as a sequence of **identifiers**, integers or punctuation marks. **Identifiers** are composed of letters, digits, periods and quoted characters (see below.). An identifier starts with either a letter or a quoted character.

**Integers** are composed of digits, with possibly a trailing 'B' or 'D'. With a trailing 'B' it is read in octal, with a trailing 'D' it is read in decimal. Otherwise it is read in the current input mode. Maximum value is 60 Bits.

A single quote mark quotes the following single character. It makes that character part of an identifier. Any character except carriage return can be quoted. In particular, a single quote mark itself can be quoted.

All other single characters not part of identifiers or integers are **punctuation marks**.

B) Standard parameters are either atomic expressions or compound expressions. Every expression has an immediate value and a value determined by content. A content specifies a type of value desired. Examples are Datum, Object, Datum.loc or Identifier. Some contents can be very specific, for example, Directory.loc.
A content value is computed by first computing the immediate value, compare this with the content and do any further evaluation necessary. For example, if a datum is desired, and the immediate value is a datum.loc, obtain the value from the location. This evaluation procedure is defined more completely in C.

The atomic expressions are identifiers or integers. The immediate value of an identifier is the string of characters composing the identifier. The immediate value of an integer is a 60 bit datum read in octal or decimal depending on the current input mode and whether the integer has a trailing 'B' or 'D'. A trailing 'B' causes the integer to be read in octal. A trailing 'D' causes the integer to be read in decimal. With no trailing 'B' or 'D' it is read in the current input mode.

We now list the compound expressions. For each one we specify the content of each subexpression, and the immediate value of the whole expression. We also say how this immediate value is computed. For some compound expressions with exactly one subexpression, the immediate value is that of the subexpression; we indicate that with the word 'identity'.

Each compound expression is given as a production in a content free grammar. The terminal symbols are:

\, #, $, +, -, *, /, (, ),,: and, which stand for themselves; and a number of key words which stand for themselves.

The nonterminals appear at the left of the productions below, so no more need be said except that Loc.exp is the name of the whole class of expressions.
1.1) LOC.EXP ::= LOC.TERM

(Identity)

1.2) LOC.EXP ::= LOC.EXP # INTEGER.EXP

 Contexts: LOC.EXP Object
            INTEGER.EXP Datum

 Result: Indexed.Obj

 Typical examples are an indexed slot within a clist, or an address
 within a file.

1.3) LOC.EXP ::= $REG # INTEGER.EXP

 Contexts: INTEGER.EXP Datum

 Result: Subprocess index

 Used for reference to core or clist of a subprocess that has called
 the Bead ghost. Not available except in the Bead ghost.

1.4) LOC.EXP ::= LOC.PRIM

 (Identity)

2.1) LOC.TERM ::= LOC.PRIM

 (Identity)

2.2) LOC.TERM ::= LOC.PRIM > IDENTIFIER

 Contexts: LOC.PRIM Object
            IDENTIFIER Identifier

 Result: Scan list loc

 Used for making a scan list reference.

2.3) LOC.TERM ::= IDENTIFIER

 Contexts: IDENTIFIER Identifier

 Result: Scan list loc

 The scan list used is the standard scan list currently associated
 with the process.
2.4) \( \text{LOC.TERM} ::= \text{LOC.PRIM} \cdot \text{IDENTIFIER} \cdot \text{LOC.PRIM} \)

Contexts: \( \text{LOC.PRIM}_1 \) Object
\( \text{IDENTIFIER} \) Identifier
\( \text{LOC.PRIM}_2 \) Object

Result: Directory loc

A directory loc is formed, using 1st object as a directory, the identifier as the name, and 2nd object as an access key.

2.5) \( \text{LOC.TERM} ::= \text{LOC.PRIM} \cdot \text{IDENTIFIER} \cdot \text{LOC.PRIM} \)

Contexts: \( \text{LOC.PRIM} \) Object
\( \text{IDENTIFIER} \) Identifier

Result: Directory loc

A directory loc is formed as in 2.4 using the null access key as access key.

3.1) \( \text{LOC.PRIM} ::= \text{WORD.EXP} \)

(Identity)

4.1) \( \text{WORD.EXP} ::= \text{INTEGER.EXP} \)

(Identity)

4.2) \( \text{WORD.EXP} ::= \text{WORD.PART} \)

Contexts: \( \text{WORD.PART} \) Word.part

Result: Datum

Ignores the bit count field of the word.part, and takes as value the datum part.

4.3) \( \text{WORD.EXP} ::= \text{WORD.EXP}, \text{WORD.PART} \)

Contexts: \( \text{WORD.EXP} \) Datum
\( \text{WORD.PART} \) Word.part

Result: Datum

The 1st datum is shifted left (end off) by the amount of the bit count in the word.part. The result is then or'd with the datum part of the word.part.
5.1) \textsc{word.part} ::= \textsc{integer.exp} \setminus \textsc{integer.exp}

\begin{align*}
\text{Contexts:} & \quad \textsc{integer.exp} & \text{Datum} \\
& \quad \textsc{integer.exp} & \text{Datum} \\
\text{Result:} & \quad \text{A word.part}
\end{align*}

The resulting word.part consists of a bit count and a datum part. The bit count is the first datum. The datum part is the second datum.

(Note: for 6.1 to 8.3 The contexts and result are all datum)

6.1) \textsc{integer.exp} ::= \textsc{integer.term}  

(Identity)

6.2) \textsc{integer.exp} ::= \textsc{integer.exp} + \textsc{integer.term}  

60 Bit integer addition

6.3) \textsc{integer.exp} ::= \textsc{integer.exp} - \textsc{integer.term}  

60 Bit integer subtraction

6.4) \textsc{integer.exp} ::= + \textsc{integer.term}  

(Identity)

6.5) \textsc{integer.exp} ::= - \textsc{integer.term}  

60 Bit 1's complement. Except for 0, same as 0- datum. A -0 will produce all bits on.

7.1) \textsc{integer.term} ::= \textsc{integer.prim}  

(Identity)

7.2) \textsc{integer.term} ::= \textsc{integer.term} * \textsc{integer.prim}  

(not yet implemented, probably 48 bit multiplication)

7.3) \textsc{integer.term} ::= \textsc{integer.term} / \textsc{integer.prim}  

(not yet implemented, probably 48 bit division)

8.1) \textsc{integer.prim} ::= \textsc{identifier}  

\text{The value of the identifier is the result.}

8.2) \textsc{integer.prim} ::= \textsc{integer}  

The value of the integer is the result

8.3) \textsc{integer.prim} ::= (\textsc{loc.exp})  

(Identity)

8.4) \textsc{integer.prim} ::= \textsc{identifier}  

\begin{itemize}
\item If the identifier resolves as a variable, the value of the variable is the result.
\end{itemize}
C) Evaluation Procedures

If the type of value in hand does not match the desired type and the desired type is not object or datum, then the evaluation fails. If the type of value in hand does match the desired type, then no computation is necessary. Otherwise the following procedures are used.

If the type of value in hand is:

1) Identifier
   a) And datum is desired
      If a variable with the identifier as name exists and contains a datum, that is the value.
   b) And object is desired
      If a variable with the identifier as name exists, and contains an object, that is the value.

2) Scan list loc
   And an object is desired
   The given name is looked up in the given scan list, the resulting object is returned as value.

3) Directory loc
   And an object is desired
   The given name is looked up in the given directory with the given access key, the resulting object is returned as value.

4) Indexed object
   a) And datum is desired
      The given object is assumed to be a file, ECS or disk, and is read with the given datum as address
   b) And object is desired
      The given object is assumed to be a clist, and an object is fetched with the given datum as index.

5) Indexed subprocess (available only during Bead ghost)
   a) And datum is desired
      A word is read from the full path of the subprocess, word address 0 refers to word 0 of the subprocess calling the Bead ghost. Negative addresses can be used.
b) And object is desired

Or capability is obtained from the full path of the subprocess. Index $0$ refers to index $0$ of the subprocess calling the Bead ghost. Negative addresses can be used.

(See variable FULLC later)

6) Register loc (available only during Bead ghost)

The given datum is used to reference the XJ package of the subprocess calling the Bead ghost. $A_4$ & $B_4$ are in word index $4$; $A_7$ & $B_7$ in word index $7$; $X_4$ in word index $16$ and $X_7$ in word index $17$.

D) Some Present Variables

1) FULLM

Contains a datum. When added to a number appearing in an indexed subprocess, permits that number to address core relative to the first word above the field length of the Bead ghost, i.e. $\#FULLM$ addresses word $0$ of the $1$st subprocess that is a descendant of the Bead ghost.

2) FULLC

Contains a datum. Action is similar to FULLM except that it is used with the clist of the subprocess.

3) BEADF (temporary, for test only)

The command `get-BD-file` followed by $2$ identifiers separated by blanks obtains an object from old Bead upon which the test system is running. That object is placed in this variable.

4) ROOTD (test only)

Contains the root directory of the disk system. Very dangerous.
E) MISC

1) The standard scan list consists of

0) Your temporary directory (ownership capability)
1) Null access key
2) The S directory (not an ownership capability)
3) Public access key

2) Your temporary directory initially contains:

○ Order S: The S directory, non ownership capability
○ Order TEMPDIR: The temporary directory itself

F) Examples (1st set under services or Bead ghost)

1) PDATA A

The name A is looked up in the standard scan list. In the current version that means A is first looked up in your temporary directory, if that fails then in S. (A will not be found in S.) If there is an A in your temporary directory, the capability for A will be printed.

2) PDATA TEMPDIR A

TEMPDIR is looked up in the standard scan list. Initially it would be found in your temporary directory with value of your temporary directory. Then A will be looked up in the result (your temporary directory) using the null access key.

3) PDATA A @ 6 5  A # 6 5

A is looked up in the standard scan list, the result is assumed to be a file. Words 6, 7, 10, 11, 12 are printed.

4) PDATA # 7 5

Words 7, 10, 11, 12, 13 from your subprocess core are printed.

5) PDATA # FULLM 7 5

Words 7, 10, 11, 12, 13 from the core of the subprocess which is the 1st descendant of the Bead ghost in the current full path are printed.

6) MDATA 6 # 7

A 6 is placed in your subprocess core address 7
7) MCAP

A is looked up in the standard scan list. The resulting capability is placed at index 5 in your subprocess C-list.

Examples under command processor:

1) EDITOR INPUT

EDITOR is looked up in the standard scan list. It will probably be found under S. The result is assumed to be a file containing a subprocess descriptor. The subprocess is constructed. It is called with disp Thiên code representation of Input as its 1st parameter.

2) TEMPDIR:EDITOR INPUT

Assuming TEMPDIR still names your temporary directory, EDITOR is looked up in your temporary directory. The result is treated as above.

More complicated examples of parameters:

12D\6, 18D\10

Produces following datum (in octal) (assuming octal input)

6000010