Mesa Coding Guidelines

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October 1983

Abstract: The Mesa language is very large and complex and provides numerous opportunities for programmers who are inexperienced with the language to fall into undesirable coding habits. This document describes a number of guidelines for using the language that have been found to be useful in the development of large Mesa systems. Included are hints that may improve speed or readability, or decrease development and debugging times. The guidelines were derived mainly from the programming experiences of members of ED & T / PDSS / Software Tools Area and do not necessarily represent the collective Xerox knowledge of good Mesa programming practices.

Filed as: [Aztec]<MesaCourse>MesaCodingGuidelines.Interpress

CR Categories:

Key words and phrases:

XEROX
Product Development & Software Systems
ELECTRONICS DIVISION & TECHNOLOGY
1350 Jefferson Road / Rochester / New York 14623

I would like to acknowledge the efforts of Karen Anderson in maintaining the clarity and grammatical integrity of this paper and the Software Tools Area for reviewing it for technical correctness.

Mesa Coding GuideLines

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1) Introduction

The Mesa language has evolved to such a level of complexity that there are countless ways in which its power can be applied, ignored, or abused. A programmer needs to use some workable subset of language features to create readable, reliable, maintainable, and efficient code.

This document presents a collection of conventions for Mesa programming. Each convention is a suggested way of approaching a particular generic programming problem. There has been no attempt to dictate a single approach. Instead, any reasonable suggestions are documented along with their pros and cons. Using this document the programmer is able to make an informed choice from among language features. Unit managers and project leaders are free to establish a firmer set of guidelines by identifying a specific subset of the conventions to be applied to projects under their charge. The list of conventions MAY evolve into stricter standards if experience shows that one approach is clearly superior to all others or if dealing with a proliferation of styles is more troublesome to the programmers than working with limited choices.

It is important to understand that adherence to these guidelines will not guarantee fast code since the algorithms used to implement a program normally determine the speed of the program. The programmer would be wise to spend more time selecting the data structures and algorithms than tweeking the code for efficiency.

The comments in this paper apply to the Mesa 6.0 release and later. Dependencies on specific releases are explicitly noted.

2) Sources of Information

2.1) Sources and references.

Most of the information contained herein is a product of the design and coding experiences of the people in the Software Tools area, PARC CSL, and SDD. Other sources include the distribution lists MesaUsers↑.PA and MesaFolklore↑.PA and the Mesa and Pilot manuals. Readers are encouraged to share any other conventions for inclusion in the document and to provide feedback about those already suggested. Throughout the document an attempt has been made to note the source of various conventions. References are listed in the back of the document, and numbers are used as footnotes to emphasize connections to the list.

Most of the section on signalling was abstracted from [1] and applied to the Mesa world. [1] describes in detail the rationale for the guidelines and how to use them and has been paraphrased here where needed. The signalling mechanism has not changed very much since it was first devised and so remains more powerful than is needed. The guidelines set forth in the section of SIGNALs and ERRORs describe ways to use most of the power without rendering the code unreadable or unmaintainable. Therefore, it is expected that new programmers follow the guidelines very closely.

2.2) Cedar Style Sheet

The Cedar Style Sheet was written to give some early standard for coding in Cedar and was found to work so well that it is now considered the guide on the format of Mesa programs as well. It presents guidelines on the following issues:

case in identifiers

naming of program and definitions modules
standard prelude and postlude for a module
employing user-defined types
use of SIGNALs and ERRORS
use of OPEN and qualified names
use of keywords in constructors, argument lists, and extractors
use of ENDCASE in SELECT statements.

Deviations from the style sheet are explicitly noted in the remainder of the document.

2.3) Sample code.
Sample Mesa programs are available in [Aztec]<MesaCourse>*.mesa.

3) BEGIN-END vs. {}

3.1) Alternate nested scope's delimiters with BEGIN-END and {-}.
The Mesa language lets the programmer use either the keywords BEGIN and END or the characters { and } to delimit scopes. The compiler enforces the use of the keyword END if the scope was opened with BEGIN and the character } if the scope was opened with {. This compiler feature may be used by the programmer to reduce the time to find and correct errors. The compiler will insert the correct delimiter if it is missing, or it will replace a delimiter with the correct one if they are not matched properly and report this action in the error log file. One strategy for capitalizing on this feature calls for alternating delimiters for nested scopes with BEGIN-END and {-}. If the scopes are not nested properly or an end delimiter is missing, the compiler will respond by inserting the correct token, thus making it easier for the programmer to determine which scope was not closed properly. This coding trick could result in more work for the programmer if new scopes are introduced which force a change in the delimiter used for scopes nested in the new scope. This problem can be avoided by keeping the number of nested scopes down through the use of procedures.

3.2) Use BEGIN-END to delimit procedures.
Although the Mesa language allows BEGIN-END and {-} to be interchanged arbitrarily, the programmer is wise to use BEGIN-END to delimit procedures. In addition, it helps to mark the end of a procedure by naming which procedure is ending after the end delimiter. If the BEGIN-END pair is used, the last line of the procedure will read well, for example "END; -- of FumbleProc" (which reads better then "}; -- of FumbleProc").

3.3) Use BEGIN-END on scopes that declare data.
Occasionally it is necessary to write procedures that have a large number of disjoint sections of code that may access some data global to the procedure as well as some data that is logically local to the code section. Creating a new procedure for each of these code sections may reduce the readability and speed of the code; so these constraints may force the programmer to make the procedures INLINEs or open new scopes for the data that is local to each code section. If the latter choice is made, using BEGIN-END surrounded with white space to delimit the outermost scopes will improve the readability of the code. In general this practice will not conflict with a desire to alternate scope delimiters with BEGIN-END and {-}. Scopes opened up in the middle of procedures typically result in a code structure (discussed in paragraph 10.7) that makes it easy to get the scoping correct.

4) SIGNALs and ERRORs

4.1) Adherence to signalling guidelines.
The Mesa signalling mechanism is very powerful and, if used improperly, may actually do more harm than good in terms of code readability and speed. Thus it is strongly recommended that the programmer strictly adhere to these guidelines or understand the consequences of deviation.

4.2) Notes on signalling strategies.
Use of signals is described in terms of client-implementor interaction and implementor-implementor interaction. The first set of guidelines (presented in paragraphs 4.3 to 4.12) were taken from [1] and are useful when the interface is being defined for public use and there is little opportunity for the designer of the interface and the programmers who write clients of it to negotiate on faster ways to handle the exceptional conditions that do arise. These guidelines may not be appropriate if speed is very important since they require more work for the program to report a failure. The second set of guidelines (presented in paragraph 4.13) are documented in [7] and may be used by small programming projects where the programmers are able to agree on coding strategies that avoid handling errors at the place they originate.

4.3) Use signals only to indicate exceptional conditions.
Mesa signals should be used to indicate an exceptional circumstance-- a condition that is unusual in some respect. Signals should never be used to indicate a normal condition because of the high cost associated with searching for catch phrases. Under normal circumstances control should be transferred using straightforward procedure calls and returns. Signals should also not be used to pass data around. This practice is much too confusing as well as being too slow and hard to maintain. This warning does not imply that a signal should not have data associated with it, as data is frequently necessary to patch up whatever went wrong.

4.4) The workings of the Sierra signalling mechanism.
The Mesa signalling mechanism is relatively expensive in terms of time, so we would like to reduce the cost of including catch phrases in code as well as the cost of signalling. Each ENABLE clause is translated into a range of affected code bytes and a pointer to a code body to be executed if the signal was raised from within the range. When a signal is raised, each local frame's enable item's range is checked from the innermost scope to the outermost scope to see if the current program counter lies within that range, implying that the signal was raised from within the scope of the enable clause. If it does, the code body for that range is executed, where the signal is checked to see if this catch phrase is for the raised signal. As a result, there is a time cost associated with enclosing a procedure call within the scope of an enable clause when any signal is raised by that procedure. In the following code fragment, if Foo may raise Ferror but not Mumblerror and Mumblerror may be raised by some implementor that Foo uses, the code segment containing the Ferror catch phrase code must be swapped into memory and executed when Mumblerror is raised even though there is no chance that the signal will be caught at the Ferror Enable clause.

```
BEGIN
ENABLE Mumblerror = > {...};
...code...
BEGIN
ENABLE Ferror = > {...};
...code...
Foo[];
```

```
...code...
END;
END;
```

4.5) Placement of catch phrases and size of scope of ENABLE clauses.

It is a good practice to keep the scope of the catch phrase as small as reasonably possible. If only one procedure call in a block can raise some signal, that call should have a catch phrase attached directly to it. If some signal can be raised by more than one procedure call in a block but the cleanup for each failed call is different, each procedure must have its own catch phrase. If the cleanup for a number of calls is the same but size of the scope is large (in terms of calls to other procedures), it is best to attach procedural catch phrases to all the calls in question and then call some common cleanup procedure from within each of the catch phrases. The reason for this approach was discussed earlier and has to do with the catch phrase being swapped into memory and examined, even if it is not the right one. The previous example corresponds to the last case described above and may be fixed as follows.

```
catchProc: PROCEDURE RETURNS [status: {resume, reject, continue}] = BEGIN...END;
BEGIN
ENABLE Mumblerror = >
 SELECT catchProc[] FROM
  resume = > RESUME;
  reject = > REJECT;
  continue = > CONTINUE;
  ENDCASE;
...code...
BEGIN
ENABLE Ferror = > {...};
...code...
Foo[ ! Mumblerror = >
 SELECT catchProc[] FROM
  resume = > RESUME;
  reject = > REJECT;
  continue = > CONTINUE;
  ENDCASE];
...code...
END;
END;
```

If signals are reserved for truly exceptional conditions it may be better to code for readability. The equivalent code fragment in 4.4 is more readable than this code fragment.

4.6) Reducing the time needed to signal.

An easy way to reduce the time needed to identify whether or not a catch phrase applies to the raised signal is to reduce the number of signals that may be raised. The problem then reduces to deciding where to declare new signals and how to use one signal to describe a number of conditions. To this end the following conventions were abstracted for Mesa from [1].

4.7) Declaration of signals in interfaces.

Each abstraction definition should declare at most one SIGNAL and one ERROR. Each parameter record has at least one field which is an enumerated type naming each of the different failure modes. If there is both an ERROR and a SIGNAL, then each of these should have its own enumerated type. It is common to include other fields in the parameter record which contain data that may be used to correct or understand the failure. The name of the ERROR is "Error" and the name of the SIGNAL is either "Problem" or "Malfunction". The consistent use of the same name in interfaces reduces the amount of time spent looking up these details, so it is strongly recommended that such a convention be strictly followed.

4.8) The signal Error[programmingError].
The signal Error[programmingError] should be raised when the detected condition is "impossible", resulting from an error in the implementation of the abstraction. This condition can be detected through validation of the state of the abstraction instance upon entry to one of the abstraction's public procedures or by raising the ERROR on ENDCASE of SELECT's or the FINISHED exit of loops which should terminate via an EXIT or a GOTO.

4.9) The signal Error[callingError].
The signal Error[callingError] should be raised when the input assertions of the interface have been violated. These assertions should be validated as soon as possible after some exported operation is invoked, preferably before the state of the abstraction is altered. It is not necessary to describe the condition further since the condition is not the result of a programming error in the failed abstraction but is a programming error in the client. The client failed to use the abstraction according to it's interface specification. If the client knew enough about the failure to correct it then the client would have known enough to avoid violating the input assertions. Situations such as this are usually the result of confusion on the part of the client or it's programmer.

4.10) Example of a declaration of signals in an interface.
An example of an interface following these conventions follows.

```
Sample: DEFINITIONS =

 BEGIN

 ErrorCode: TYPE = {programmingError, callingError, invalidHandle};

 ProblemCode: TYPE = {overflow, underflow, outOfRange};

 Error: ERROR [code: ErrorCode];

 Problem: SIGNAL [code: ProblemCode];

 ...

 END.
```

4.11) Unwind signals before they reach the client.
All failures should be unwound and cleaned up before the signal is handed over to the client. This housekeeping will ensure that the state of the failed abstraction is always consistent when the client sees a failure. Restoring the abstraction instance to a consistent state is especially useful in situations where the client will need to perform it's own recovery in the catch phrase. If a signal is raised within a monitor, it should be done so with RETURN WITH SIGNAL|ERROR since this will unlock the monitor before the signal is raised. If one of the objects used by the abstraction fails, it should be caught at the PUBLIC procedure level and fixed, if possible; otherwise the signal should be unwound and a public ERROR raised. A code skeleton for this approach follows.

```
DIRECTORY
 Interface USING [];

InterfaceImpl: PROGRAM EXPORTS Interface = BEGIN
```

```
x: PUBLIC PROCEDURE [h: Handle] = {
 failure: Interface.ErrorCode;
 xInternal: ENTRY PROCEDURE [lock: LONG POINTER TO MONITORLOCK] = {
  ...code...
  IF <cond> THEN RETURN WITH ERROR Error[<some error code>];
  ...more code...};
 xInternal[@h.LOCK !
   <Runtime error> => {
    SELECT code FROM
     <something> => failure ← <something>;
     <something else> => failure ← <something else>;
    ENDCASE => REJECT;
   GOTO Failed}];
 EXITS Failed => ERROR Error[failure]};

...

END.
```

4.12) Signalling within an abstraction's implementation.
Usually it is not necessary to signal within an abstraction's implementation. Unusual conditions in implementations can normally be dealt with via fields in RETURNS records to indicate the success or failure of an operation. When it is necessary to signal in implementations and the size of the scope of the catch phrases for these signals can be limited, feel free to declare as many signals as needed to keep the number of parameters down to one or none. Parameter records in signals with more than one field take more time to process. If the scope of the enable clause must be large, it is better to declare one signal passing an argument describing the nature of the problem since the generated code for discriminating an enumerated item is faster than the code to discriminate signals. It may not be possible to use just one signal because the condition may require other data in order to be repaired. One possible approach is to declare a variant record which contains fields for the necessary data for each of the conditions. If this technique is used, one of the tag fields can be used to describe which of the possible failure conditions occurred. For example, in the Private interface you may declare

```
Problem: TYPE = {someCond, anotherCond, yetAnother, andAFourth};

Error: ERROR [description: FailureHandle];

FailureHandle: TYPE = LONG POINTER TO FailureObject;

FailureObject: TYPE = RECORD [
 SELECT problem: Problem FROM
  someCond => [aField: CARDINAL, anotherField: LONG POINTER],
  anotherCond => [aField: CARDINAL, me: Handle],
  yetAnother => [aField: INTEGER, you: Handle],
  andAFourth => [thatField: LONG POINTER TO someThing],
  ENDCASE];
```

The enable clause for this would look like

```
BEGIN
ENABLE Error =>
 WITH dd: description SELECT FROM
  someCond => {...};
```

```
    anotherCond = > {...};
    yetAnother = > {...};
    andAFourth = > {...};
    ENDCASE;
```

4.13) Allowing signals to cross abstraction boundaries.

A second strategy calls for ignoring the run time system errors at the lower levels and catching them at the higher levels, where they are unwound. In this case, the low-level code would catch only those errors for which there is a known recovery. Problems with the applications code detected by the code itself raise a signal known by the driver, and some string is passed to the driver to describe the nature of the condition.

This strategy is faster because the run time system does not spend as much time switching between searching for catch phrases and executing the program's code and also because the actual amount of code in catch phrases is smaller. The biggest problem with the technique is that programmers must know how code that is more than one level away expects to deal with error conditions, resulting in greater opportunity for program bugs because of the interdependency.

5) PROCEDURES

5.1) INLINE procedures.

Procedures may be made INLINE to improve the speed of the code. It is usually a good idea to make small procedures INLINE, if they are not called in very many places in a module, since the storage overhead of a call is usually greater than the overhead of duplicating the code. If a procedure is called only once in a module (in an attempt at modularization), it is reasonable to make that procedure INLINE. The danger of indiscriminate use of INLINEs is that they tend to increase the size of the compiled code. This increased size may increase swapping and therefore degrade performance to the point where INLINEs cost rather than save.

INLINE procedures should not be used until the program is very near completion because the debugger has problems dealing with them.

5.2) Parameter passing.

During procedure calls arguments are passed by storing them on the Mesa processor's evaluation stack. This stack is of limited depth determined by the implementation of the Mesa processor. Since the language does not specify a limit on the number of fields in a parameter record, the Mesa processor implementation must compensate for it's limitations by using a different scheme for passing arguments when the size of the parameter record (in words, not fields) exceeds the size of the evaluation stack. The trick it uses is to allocate temporary storage of sufficient size (it actually uses the frame allocator), store the arguments in the temporary storage, and pass the address of the temporary storage on the evaluation stack. The cost of such a procedure call is about twice that of a call that does not overflow the evaluation stack. The calls force the processor to go to the frame allocator twice rather than once. The arguments must be loaded onto the stack and then stored in the temporary frame before the call, then loaded onto the stack from the temporary frame and finally stored from the stack into the callee's local frame. This scenario is much worse than the best case, where the arguments are pushed by the caller onto the stack and then stored from the stack into the local frame of the callee. The maximum size of a parameter record in Sierra is 12 words before the temporary frame is used. For Alto Mesa 6.0 the limit is 5. Analogous comments apply to the returns record. See [3] for more information on this topic.

5.3) Nesting procedures.

The Mesa language supports lexical nesting of procedures within procedures. Normal scoping rules apply so that a nested procedure may access variables within the scope of the containing procedure. Control transfer to a nested procedure is implemented by giving to *xfer* (the control transfer primitive) the address of the procedure descriptor of the callee, which is computed and stored in the caller's local frame. The callee then uses this pointer to compute the address of the local frame of the caller. These actions are performed whether or not there are any cross-scope references to variables. Each time a lexically nested procedure is called, the address of the lexically containing procedure's local frame is stored in the callee's local frame. Any one call need compute only one address of a local frame even if the procedure accesses variables several levels up the stack, although the callee may need to traverse the stack through several levels to find all of the local frame addresses it needs. Such traversals are performed once per variable reference; thus, many such references can get very expensive. It is not a good idea to nest procedures arbitrarily. Nesting is justified at times when you are making many references, you wish to use the same procedure name for another procedure in the same module (not a good idea anyway), you wish to clearly restrict the availability of the procedure, or the procedure is INLINE. An alternative to nesting procedures because of a need to share data is to declare the procedures at the module level, allocate nodes (from a zone) to hold the shared data, and then pass the address of the nodes. It may be useful to move all these procedures to another module since they must be related otherwise they would not be nested. [3] contains more on this subject.

5.4) Naming procedures.

All procedures have the first character of their name capitalized to clearly identify them as procedures. This is also true for procedure variables since the syntax for calling a procedure variable is the same as calling a procedure with a constant declaration. It is common to leave the name of the object off of the procedure name since clients will need to qualify the procedure with the interface name (e.g. use Foo.Initialize rather than Foo.InitializeFoo). Normally, an operation on a public object is performed by an exported procedure. When the operation must be performed within an object monitor, however, an internal procedure would actually be executed to perform it. Such an internal procedure is typically named the same as the exported procedure with Internal appended to the name. For example:

```
prog: MONITOR LOCKS lock USING lock: Lock = BEGIN

 Lock: TYPE = LONG POINTER TO MONITORLOCK;

 heapLock: MONITORLOCK;

 X: PUBLIC PROCEDURE [h: Handle] = BEGIN
  XInternal: ENTRY PROCEDURE [lock: Lock] = INLINE BEGIN...END;
  XInternal[@h.LOCK];
  END; -- of X

 IncrementClientCount: ENTRY PROCEDURE [lock: Lock ← @heapLock] = BEGIN...END;

 ReduceClientCount: ENTRY PROCEDURE [lock: Lock ← @heapLock] = BEGIN...END;

 END. of prog
```

5.5) Cross module references vs. intra-module references.

In the above example, the module is actually using multiple monitors to improve the performance of the code. The ClientCount procedures could have been moved to another module, but that would have slowed things down because cross-module references are slightly more expensive than intra-module references. If the module was not using multiple monitors, then the LOCKS clause could read "LOCKS h USING h: Handle" which would have eliminated the need for the Internal procedure. [2] has more on naming conventions for procedures.

5.6) Default values of fields in parameters and returns records.

Default values of fields in parameters and returns records in interfaces and program modules are usually coded ad hoc. The rule of thumb is to give a parameter field a default value if the client need not assume complete control over that value. If there are many fields in the parameter record, it is nice to default most of them so that a programmer who is only making light use of the interface will get some reasonable performance without having to dive into it to understand what each of the fields means. It is wrong to give a default value to a field if the operation does not make sense with that value. For example, it is usually incorrect to default the Handle field of an operation to NIL as there is usually no default instance of the abstraction. If a field does not have any reasonable default, you should disallow NULL values by following the type specification with a left arrow. For example, use "p: PROCEDURE [a: CARDINAL ← 0, b: CARDINAL ←]".

Default values for parameter record fields in interfaces should almost always be identical to the defaults for the same fields in the matching procedure in the implementation. If they are different, then the semantics of a call to such a procedure through the interface will be different from a call to the procedure from within the exporting module. Such an anomaly is only rarely justified, as in the case of an implementation that needs to use itself in a way that is different from a typical client.

Default values for RETURNS record fields are normally not given in the interface as those values are usually dependent on the implementation and therefore need not be known at the interface level.

5.7) Positional notation vs. keyword notation.

The Mesa language does not require parameter or RETURNS records to have named fields. This can be convenient when a procedure type must be declared that will be provided by a client. By not naming the fields in the type specification, the interface is more accommodating to programmers of clients because it allows the programmer the freedom of naming the fields according to their own desires. This can be a problem if the interface does not clearly indicate the meaning of each field. Parameter fields in interface procedure declarations (not interface procedure types) should be named if there is more than one field. If there are multiple unnamed fields in a record, clients are forced to order the fields in their calls in the order of the declaration (using positional notation). This is also true for RETURNS record fields. Positional notation is inconvenient and can be error-prone, since even strong type checking does not detect parameters out of order if two or more consecutive ones are of the same type. Therefore, it is expected that records with more than one field in procedure declarations have named fields.

6) Naming Variables

6.1) "Handle" "Object" relationship.

Pointers usually have the suffix "Handle". Referents of pointers usually have the suffix "Object" or "Body". It is normal to use just "Handle" or just "Object" if the types are the only pointer-object pair in an interface or if the Handle is used to discriminate between instances of an abstraction. [2]

6.2) Use of Generic Names.

Some programmers tend to use the same variable name to mean the same thing in many programs and also keep the size of these names as small as possible. Keeping their size down reduces the amount of typing, and using the same identifier in similar situations reduces the number of decisions the programmer needs to make in choosing names. A summary of these naming conventions follows..

The names "i", "j", or "k" are used to index arrays or sequences and are used in that order if the previous one is already being used.

The identifier "s" is some string that was either passed in or allocated locally.

The name "ns" is read as New String and is returned by procedures that allocate, copy, or manipulate and return strings in some way.

A pointer to some object is called "p" and is usually constant, although the name can be used for the control variable in some loops.

The identifier "h" names a Handle and is the argument that discriminates between a number of abstraction instances.

A Character is referred to as "c" and is usually an argument to some procedure.

The identifier "name" is a string that refers to some file.

The name for the variant part of a record in the WITH statement is constructed by taking the first letter of each major word in the name of the variant object and prefixing the acronym with a d (for discriminated). For example, the name "objectDescriptor" would be named "dod". If the expression part of the OpenItem is the variant record type being accessed then the alternate name may be the same as the record being accessed.

The size field in a sequence is named "maxlength". Records containing a sequence contain another field, "length", that indicates the current number of objects in the sequence, if there is any question.

Variables or fields in records in implementors are named by concatenating the first character of each word in the type of the object. Examples: sso: Swapper.SpaceObject, dfh: DarwinFile.Handle, si: SpaceInfo. This convention may sacrifice readability or maintainability to speed the development of code, since the programmer spends less time trying to come up with reasonable names. Once programmers become informed of and accustomed to this convention , however, they may be more comfortable reading or maintaining the code because they will be better able to infer the type and meaning of an object from it's name.

The programmer should make an effort to avoid variables that differ only in case.

7) Modules

7.1) Module names.
Public interfaces (those defining abstractions) are named according to the abstraction being defined: e.g., Stack, DarwinFile, Cursor, Window, Token, etc. An old custom suffixed interface names with "Defs" indicating that it is a DEFinitions module. This practice was dropped when it was noticed that this decreased the readability of the code because the reader had to scan "Defs". For example, Stack.Push[] makes more sense than StackDefs.Push[]; the Defs suffix adds no useful information. Interfaces defining types used by multi-module abstraction

implementations are named xPrivate where x is the name of the interface. Implementors are named xImpl for single module implementations, or xImplA, xImplB, xImplC, etcetera for multi-module implementations. Common operations used by an implementation are hidden behind interfaces named xOps. Implementors of xOps are named xOpsImpl, or xOpsImplA, xOpsImplB, etc.. Configurations exporting abstractions should have "Pack" in the configuration name (e.g. MdsStringPack). Interfaces defining Cedar objects should be prefixed with "Class", for example: ClassABSEFile. [2]

Another convention for naming implementors is to select a name which describes the fragment of the implementation contained in the module. For example, instead of naming a SymbolTable implementor SymbolTableImplA you may name it SymbolTableInsertImpl if that module does the insertions. The problem with this naming scheme is that you need to remember the exact name for the module to work on it. For example, the module in question could be named SymbolTableInsertImpl, SymbolTableInsertionImpl, SymbolTableUpdateImpl or something else. The real benefit from using this scheme is the ability to identify what the module does from its name. This could also be described via a comment in the configuration file, which has the added benefits of allowing the programmer more text for description, and also keeps this information all in one place. [2], [7]

All modules should have the same name as the containing file minus extension, unless the programmer is doing tricks with multiple implementations of an abstraction or is using the generic coding feature described in [6].

7.2) Change log.

Each module should have a log describing it's history in terms of who changed it when. At a minimum it should name the person and give the time and date it was last edited. This information precedes the DIRECTORY statement. There is a hack named SourceTime.bcd which facilitates this chore by automatically updating this log with time, day and name of person when the file is saved after an edit. It is also common to maintain a log at the end of the file describing all significant changes. [2]

7.3) Interface module size.

The only real limitation to the size of an interface is the ability of a programmer to grasp the concept of how to use it. If the programmer can understand the interface despite its size and the interface logically belongs in one place, then there is no reason to break it up. Remember that the possibility of multi-module implementations removes any fixed relation between the size of the interface and the size of the implementor(s).

7.4) Global frame size.

The size of a global frame is determined from the sum of the sizes of the non-constant global data declarations in a program module plus some overhead bytes. It is always a good idea to keep the size of the global frames as small as reasonably possible since they are not freed unless the module is unloaded. On the Alto, this is especially important because the machine does not have virtual memory and so the global frames will permanently occupy real memory. An easy way to reduce the global frame size is to move string constants to the code segment (which gets copied to the local frame upon procedure invocation) by placing an 'L immediately after the string constant. (The programmer is actually trading permanent use of global frame space for longer procedure call times since string constants stored in the code segment must be copied to the local frame for each procedure call.) Another way is to include New and Destroy procedures in the interface. The New operation makes a copy of the instance dependent data from dynamic storage, which will be recovered when the instance is Destroyed. [3]

7.5) Interface object declarations.

Interface object declarations allowing for multiple instances are normally declared as follows.

```
x: DEFINITIONS =

 BEGIN

 Handle: TYPE = LONG POINTER TO Object;

 Object: TYPE;

 ErrorCode: TYPE = {...};

 Error: ERROR [code: ErrorCode, h: Handle];
 -- Error passes the Handle that was used when the failure occurred so that the catch phrase can
use it to clean up whatever went wrong.

 New: PROCEDURE [...] RETURNS [Handle];

 Destroy: PROCEDURE [LONG POINTER TO Handle];
 -- Destroy should check to see if its dereferenced argument is NIL and, if so, return without an
error. This reduces the amount of code needed since nobody else need check to see if the object
to be freed actually exists. Destroy should set its argument's referent to NIL when the object is
destroyed to prevent the client from trying to use it again.

 Initialize: PROCEDURE;
 -- Make the implementation of this interface available for use. This procedure should be called
first and only once.

 operation1: PROCEDURE [Handle] RETURNS [...];

 operation2: PROCEDURE [h: Handle, arg1: ArgType] RETURNS [...];

 END.
```

If it is necessary to provide clients of an interface with instance dependent data, allowing the client to access parts of the concrete data structure is faster and more readable than providing many access routines in the interface. The danger with this is that implementation dependent data is declared in the interface, possibly subjecting clients to many recompilations if the interface changes due to implementation changes.

For abstractions of which only one instance is needed, the declaration is normally as follows.

```
x: DEFINITIONS =

 BEGIN

 Handle: TYPE = LONG POINTER TO Object;

 Object: TYPE;

 ErrorCode: TYPE = {...};

 Error: ERROR [code: ErrorCode, h: Handle];
 -- Error passes the Handle that was used when the failure occurred so that the catch phrase can
use it to clean up whatever went wrong.
```

```
  Reset: PROCEDURE;
    -- Reset destroys the old data structures used by the abstraction's implementation and sets
them up as though this were the first use.

  Initialize: PROCEDURE;
  -- Make the implementation of this interface available for use. This procedure should be called
first and only once.

  operation1: PROCEDURE RETURNS [...];

  operation2: PROCEDURE [ArgType] RETURNS [...];

  END.
```

7.6) Names for related procedures.

For a program such as a compiler, which processes a number of source files, the Reset operation may be named with something more meaningful such as "PerSourceFileInit". Object declarations may provide separate procedures to do the initializations and clean up between uses of the abstraction. In the multiple instance abstraction declaration these operations are performed by the New and Destroy procedures. In the single instance abstraction separate procedures must be provided if this functionality is desired. It is recommended that both of these operations be taken care of in the Reset operation since splitting them up requires a client to remember things about the state of the abstraction that it would otherwise not have to remember.

8) Formatting

8.1) Order of statements.

It usually makes sense to order the classes of statements in a module as follows: types, constants, variables, public procedures, private procedures. Within each class, ordering the statements alphabetically is useful when working on large systems so as to reduce the human lookup time in a module. Readers have quicker access to some alphabetically arranged items than to items that are ordered to reflect what the programmer thinks makes sense.

8.2) Mesa Formatter.

The Mesa Formatter will reformat Mesa source code in such a way that it shows nesting of scopes and also breaks up long lines in a consistent way. The formatter also serves as a debugging aid since it nests code to reflect the actual Mesa input rather than the intent of the programmer. Hand-nested code may deceive a programmer who relies on the nesting to determine whether or not code will be executed. It is strongly recommended that programmers use the formatter on all their source code.

8.3) White space.

White space in code may be used to speed up human search times by clearly identifying the separation between declarations and also may be used to separate nested blocks. It is generally not useful to insert white space in the directory statement since it is usually alphabetically ordered (thanks to Lister Using [...]). In addition, programmers typically do not spend much time looking at this statement.

9) Statements

9.1) OPEN statement

The OPEN statement should be used only in very small scopes where it is very clear which fields from the opened record are being used. For example, if you are setting most of the fields of a SEQUENCE containing record (so that a constructor cannot be used), it is appropriate to open that record. On the other hand, it is not a good idea to have several open interfaces at the same time. This practice can lead to confusion about where something is coming from. Never open interfaces at the outermost scope of a module unless the interface is being exported. The module will be hopelessly confusing for somebody just picking up and starting to read it. [2]

9.2) SELECT statement

There is a form of the SELECT statement that will compile into a jump table. This is very fast but also larger than other equivalent forms. In order for the compiler to use a jump table there can be no expressions on the left side of any of the cases (this includes the IN operator). The programmer generally wants to force the compiler to use a jump table in code which will be executed frequently, such as a scanner. An example of such code follows. (Note that mixing jump tables with testing for range inclusion is generally not a good idea because the generated code is less than optimal.) The Sierra compiler translates this code into 14 instructions in 110 bytes and consistently executes in 7 to 9 code bytes.

```
c: CHARACTER ← ...;
charClass: {alphabetic, numeric, doubleQuote, other} ←
 SELECT c FROM
  'a, 'b, 'c, 'd, 'e, 'f, 'g, 'h, 'i, 'j, 'k, 'l, 'm, 'n, 'o, 'p, 'q, 'r,
   's, 't, 'u, 'v, 'w, 'x, 'y, 'z, 'A, 'B, 'C, 'D, 'E, 'F, 'G, 'H, 'I,
   'J, 'K, 'L, 'M, 'N, 'O, 'P, 'Q, 'R, 'S, 'T, 'U, 'V, 'W, 'X, 'Y, 'Z = >
    alphabetic,
  '0, '1, '2, '3, '4, '5, '6, '7, '8, '9 = > numeric,
  '" = > doubleQuote,
  ENDCASE = > other;
```

An alternative to the above follows. Because this code will not translate into a jump table, it is slower but more compact. This form should be used in initial implementations and converted to the jump table form if there are performance problems. The Sierra compiler translates it into 29 instructions in 44 bytes, with the number of bytes executed for any one character ranging from 14 on up.

```
c: CHARACTER ← ...;
charClass: {alphabetic, numeric, doubleQuote, other} ←
 SELECT c FROM
  IN ['a..'z], IN ['A..'Z] = > alphabetic,
  IN ['0..'9] = > numeric,
  '" = > doubleQuote,
  ENDCASE = > other;
```

9.3) SELECT TRUE vs. IF-THEN-ELSE IF-THEN-ELSE IF...

Rather than have a series of IF-THEN-ELSE IF-THEN-ELSE IF... use the SELECT TRUE FROM form of SELECT. This statement is much easier to read, has exactly the same semantics as the IF-THEN-ELSE IF... construct, and translates into exactly the same byte codes. For example use

```
SELECT TRUE FROM
 String.EqualString[a, b] = > {...};
 String.EqualString[b, c] = > {...};
 String.EqualString[c, d] = > {...};
 ENDCASE = > {...};
```

rather than

```
IF String.EqualString[a, b] THEN {...}
ELSE IF String.EqualString[b, c] THEN {...}
ELSE IF String.EqualString[c, d] THEN {...}
ELSE {...}; .
```

9.4) FOR statement

The FOR statement using the declared control variable option is typically used to enumerate lists or examine successive elements of an array. This is especially pleasing when the list is a product of a stateless enumerator because of the clarity of the code. This code looks like:

```
FOR t: Int.SomeType ← Int.GetNext[NIL], Int.GetNext[t] UNTIL t = NIL DO
 ...
 ENDLOOP;
```

Note the improvements of code readability and code compactness over the following equivalent code fragment. The FOR loop translates into more code bytes but each call requires a little less time since the up-level addressing needed for the forEquivalentProc is not performed.

```
forEquivalentProc: PROCEDURE = { -- code contained in above FOR loop--};
Interface.EnumerateOperation[forEquivalentProc];
```

Since the initial value expression and the next value expression in the Assignation form can be arbitrary expressions of the correct type, they may also be calls to (INLINE) procedures that can free up nodes as the list is traversed. See the following code fragment for an example.

```
getNextAndFree: PROCEDURE [
 currentLink: Handle] RETURNS [nextLink: Handle] = INLINE {
 nextLink ← currentLink.next; zone.FREE[@currentLink]};

FOR h: Handle ← root, getNextAndFree[h] UNTIL h = NIL DO
 ...code... ENDLOOP;
```

Another use is to enumerate a linearly linked list with no backward pointers in such a way that when the interesting node is found it can be deleted or something can be inserted in front of it. An illustration follows.

```
FOR p: LONG POINTER TO Handle ← @rootNode, @p.next UNTIL p↑ = NIL DO
 IF <condition> THEN { -- delete node from list
  t: Handle ← p↑;
  p↑ ← p.next;
  Free[t]};
 ENDLOOP;
```

Note that in the body of the loop p↑ addresses the node ; thus the loop must terminate when p↑ = NIL, not when p = NIL.

9.5) Positional notation or keyword notation.

Record constructors and extractors may use either positional notation or keyword notation. Although it is much easier to type constructors and extractors using positional notation, it is recommended that keyword notation be used wherever there is more than one field. Not only is using keyword notation a convenience for random people reading the code, but it also aids in writing reliable code and debugging new code since the programmer need not remember the exact order of the fields.

9.6) Dereferencing pointers.

The language does not require that pointers be explicitly dereferenced where there is no ambiguity about what is being referenced and the ***RightSide*** (see [5]) is followed by dot qualification, a bracketed array index, or a bracketed argument list. In general you should let the compiler do automatic dereferencing for you because it will tend to reduce the number of errors a newly written source module will generate the first time it is compiled. Not having ↑'s embedded in expressions also helps to improve code readability. See [5], section 3.4.4 for more on this.

10) Storage Management

10.1) Initialization of objects allocated from zones.

Storage is usually allocated from zones. The syntax for this allocation allows initialization of fields within the object being allocated. It is recommended that the programmer make an effort to set as many of these fields as possible. The compiler is able to generate better code than if the same fields are set in the statements following the allocation. If we have the following declarations

```
Handle: TYPE = LONG POINTER TO Object;

Object: TYPE = RECORD [
 a, b, c: CARDINAL,
 d, e: Handle];
```

then the statement

```
h: Handle ← zone.NEW[Object ← [a: 0, b: 1, c: 2, d: NIL, e: oldHandle]];
```

will generate better code than

```
h: Handle ← zone.NEW[Object]
h.a ← 0;
h.b ← 1;
h.c ← 2;
h.d ← NIL;
h.e ← oldHandle; .
```

10.2) Storage management by abstractions.

Each abstraction implementation should manage its own storage via zones. A good strategy is to keep a count of the number of clients so that, when the number increases to one, a zone is allocated and all subsequent clients get their storage from that zone and, when the number drops to zero, the zone is freed. This approach reduces the damage done by storage leaks since any leaks will be in the zone, which gets returned to the free storage pool when the last client disappears. It also helps to reduce the overhead of having the package loaded when it is not being used because the package will automatically reduce it's storage requirements. The procedures to keep track of the number of clients must be in a monitor because there is no way to guarantee that two clients will not try to create or destroy an instance simultaneously. Since most operations on abstractions need to be monitored, the model presented in paragraph 5.4 on Internal procedures demonstrates how to implement a multi-monitor module. The code is reproduced here for convenience.

```
prog: MONITOR LOCKS lock USING lock: Lock = BEGIN

 Lock: TYPE = LONG POINTER TO MONITORLOCK;

 clientCount: CARDINAL ← 0;

 heapLock: MONITORLOCK;

 HeapZone: UNCOUNTED ZONE ← NIL;

 IncrementClientCount: ENTRY PROCEDURE [lock: Lock ← @heapLock] = {
  UNWIND = > NULL;
  clientCount ← clientCount + 1;
  IF clientCount = 1 THEN
    HeapZone ← Heap.Create[initial: 10, checking: debugging]};

 ReduceClientCount: ENTRY PROCEDURE [lock: Lock ← @heapLock] = {
  UNWIND = > NULL;
  IF clientCount = 0 THEN ERROR Error[programmingError];
  clientCount ← clientCount - 1;
  IF clientCount = 0 THEN Heap.Delete[HeapZone]};

 X: PUBLIC PROCEDURE [h: Handle] = {
  XInternal: ENTRY PROCEDURE [lock: Lock] = INLINE {...};
  XInternal[@h.LOCK]};

 END.
```

10.3) Per instance storage management.
Another strategy allows each instance to manage its own storage. This approach is useful if the amount of storage differs depending on how a client is using the abstraction or if each instance needs to allocate a lot of storage but will not be around for very long. The latter case should definitely be handled in this way since the instance's zone can be destroyed with the instance. This is a great improvement over traversing the entire data structure, freeing it up on the way. Not only will the storage that the instance used be returned to the free storage pool quickly, it will also reduce the probability of storage leaks should the data structure change slightly.

10.4) One data structure per zone.
If a data structure is needed for a known time and requires much dynamic storage allocation, a zone can be allocated just for that data structure. If all allocation for the data structure is from that zone and no other nodes are allocated from it, then the zone can be destroyed when the data structure is no longer needed. This method quickly recovers space used by the structure since it requires less work to return pages to the system than nodes to a zone.

10.5) Initial sizes for zones
Initial sizes for zones containing exactly one data structure should be calculated from a projected

expected size for the data structure multiplied by some fudge factor. Initial sizes for other zones should be computed based on the maximum expected storage needs for a single instance of an abstraction and the expected number of simultaneous clients. The increment for the zone should be computed based on the maximum expected storage needs for a single instance of an abstraction.

10.6) The system heap.

The storage heap (Heap.systemZone) should be used for passing objects whose ownership must be transferred. This practice is useful since the implementor who allocated the object need not provide a mechanism for freeing it up. This implies that the implementor also need not be concerned with hanging onto the zone from which the object was allocated until the object has been freed. Allocating objects that must transfer ownership from the system zone thus lowers module coupling and reduces the potential for bugs.

10.7) Clean up after failures.

Storage allocated from a common storage pool must be freed in the event of failures. The most common method for doing this is outlined below. The CleanUpx procedure is provided rather than a simple call to Interface.Destroy since not all objects can be destroyed with a single call. Some require special handling. In such cases, it is better if CleanUpx is not simply an INLINE.

```
BEGIN
x: Interface.Handle ← Interface.New[...];
CleanUpx: PROCEDURE = INLINE {Interface.Destroy[@x]};
BEGIN
ENABLE UNWIND = > CleanUpx[];
...code that uses x...
END;
CleanUpx[];
END;
```

11) Data Structures

11.1) Strings

Strings are a great source of trouble in Mesa. Many string operations require changing the length of a string. Since Mesa does not provide for automatic strings, i. e. strings that grow and shrink at will, the programmer must check for string overflows and under-utilization. When appending a string to another string, it is cheaper to check first for an overflow condition and enlarge the target string if necessary than to attempt the append and raise a signal if there is not enough room. To enlarge a string automatically, a procedure must have a pointer to the LONG STRING and a handle to the zone that it was allocated from. Interface String provides most of the necessary facilities.

Mesa supports the use of string literals by enclosing the character sequence comprising the string inside of double quotes. For example: "This is a string literal", "This is another..."This one ends in a carriage return\n". String literals are stored in the code segment of a bcd until needed. Depending on circumstances, the literal will be copied into either the global frame corresponding to the code segment of the module that used the literal or the local frame of the procedure that used the literal. If the literal is immediately followed by an L, as in "Local frame"L, then the literal will be copied into the local frame of the procedure that declared it each time the procedure is invoked. If the literal is followed by a G (Mesa 10.0) or nothing, as in "Global frame" or "Global frame"G, then the literal will be copied into the global frame of the containing module once when the module is started. There is a time saving associated with putting the literal in the global frame, since it is copied only once and a space saving associated with putting the literal in the local frame, since there is only one copy of it at any time the containing procedure has not been invoked.

There are several dangers associated with using string literals. Since the size of the StringBody containing the literal is a compile time constant, it is not possible to enlarge the string without making a copy of it from some storage pool. Such use of string literals can result in confusion about where a StringBody is allocated when it comes time to free the string. The easiest and safest solution is to use the literal only to make a copy from the storage pool. For example:

```
BEGIN
s: LONG STRING ← String.CopyToNewString[s: "This is the literal."L, z: Heap.systemZone];
-- code that uses s
 Heap.systemZone.FREE[@s];
END;
```

String literals used as arguments to output procedures can almost automatically be made local since there is no question about whether the StringBody will need to be enlarged. If the procedure may be called recursively, all literals should be in the global frame since each literal would be copied once for each recursive call if it were in the local frame.

String literals defined at the module scope can be allocated from a storage pool by following this paradigm.

```
Prog: PROGRAM = BEGIN
 string1, string2: LONG STRING ← NIL;
 zone: UNCOUNTED ZONE ← ...;
...
 Initialize: PROCEDURE = BEGIN
   string1 ← String.CopyToNewString[s: "String one literal"L, z: zone];
   string2 ← String.CopyToNewString[s: "String two literal"L, z: zone]};
   END;
 Initialize[];
 END.
```

When following this paradigm, care must be exercised to free the StringBodies should the module be unloaded.

11.2) Ownership of objects.
Owning an object is defined as having responsibility for maintaining that object, including deletion when it is no longer needed. It is customary to document the rules for transferring ownership between client and implementor in the interface defining the procedure that operates on the object. When strings are passed to procedures through an interface, ownership is not normally transferred since each abstraction is responsible for its own storage. Ownership of strings returned from procedures is normally transferred to the caller.

11.3) Sequences vs. dynamic arrays.
Sequences were intended to replace Mesa's notion of dynamic arrays, which were implemented using descriptors for arrays. The difference between sequences and dynamic arrays is mostly in the way the object is allocated and what initialization is done at allocation time. It is recommended that sequences be used instead of descriptors for arrays since the language provides more conveniences for operations on sequences.

11.4) File I/O

File I/O is a potential bottleneck in any system. The Mesa runtime system supports a number of views of a file including stream oriented and segmented. The most common uses for files are to preserve text and to store data structures. Byte streams are the most useful abstraction for accessing text files. For data structures, it is generally faster to treat the file as a series of fixed size pages which may be swapped in at will by the virtual memory manager. The idea is to treat sections of the file (segments) as blocks of virtual memory and to write the data structures to that place in VM as though it were memory and not a file segment. When those addresses are referenced, the corresponding pages will be swapped in; and, when memory is full or the file is closed, those pages will be swapped out with the data that was written there. The only real problem is handling the relocation of the data structures which use pointers when the file is opened up later since there is no way to guarantee that the structures will be swapped into memory at the same place. The best solution is to write at some known place in the segment (usually the first few words are reserved for this) a directory that allows a program to compute the VM address of the rest of the data structure when needed. This tends to be faster than storing and retrieving data structures via streams since the loading of the structure into VM is done only once and then accessing it is the same as with any other data structure that has always existed in memory. Another possibility is to use the relative pointer facilities in the language to compute the address when needed rather than compute the real address just once and store that. The trade off is figured on how much the data structure will be accessed. If it will be used a lot, then it pays to compute the real address; otherwise it may be cheaper to do the relative address computation each time it is needed.

Appendix A: Recommended Sierra Interfaces

This list has been compiled to help maximize the upward compatibility of software written for the Sierra release with the next release of Mesa.

The next release of the Mesa Development Environment (MDE) is a maintenance release that incorporates the new release of Pilot. There are no changes to MDE interfaces; so clients of MDE are guaranteed upward compatibility. There are changes to several Pilot interfaces which should not affect most clients. The public Pilot interfaces that are changed are Environment, DeviceTypes, Inline, NSConstants, System, Process, Runtime, Supervisor, Stream, PhysicalVolume, Volume, FileTypes, Scavenger, ScavengerExtras, Heap, Log, LogFile, Floppy, FormatPilotDisk, OthelloOps, and TemporaryBooting. Mesa 11.0 introduces a new interface, ObjAlloc, to control the allocated/free state of a collection of objects.

Clients of MDE should avoid using interface Storage since the same functionality is provided in other interfaces. This interface may disappear in future releases of MDE. All other public MDE interfaces are acceptable for use.

References

[1] Guidelines for Signalling in Cedar, Roy Levin

[2] Cedar Style Sheet, James Mitchell

[3] Mesa Myths and Methods, Roy Levin

[4] Writing Mesa programs for efficiency, Dick Sweet

[5] Mesa Language Manual, James Mitchell, William Maybury, Richard Sweet

[6] Generic Interfaces, Richard Orgass

[7] Sequel Compiler-Wide Conventions, Irene Allen

Index

This index describes the various uses of potentially interesting words. Each word in this list may not exist in the tense given, thus a user of the index must be wary of spellings that change with tense. Each number following a word indicates which division the word was used in.

Xerox Publishing Illustrator (XPI)
Step By Step (SBS) Supplemental Training

Written & published by Lee Thomas Hedges
Integrated Systems Operations (ISO) Publishing Marketing
17 January 1990 San Diego, California USA

STEP BY STEP

INTRODUCTION OVERVIEW

Overview:

The Step By Step Supplemental Training Series is intended to be a quick access and learning tool for the Xerox Publishing Illustrator user.

Problem Summary:

It is a common critique by XPI users, both internal and external, that there is no classroom training offered, and the training and reference documentation that is available is unacceptable as a training tool for initial as well as advanced learning.

Solutions Analysis:

Concensus is that there needs to be additional training, either in a classroom environment or as detailed, step by step applications documents. The classroom training environment is not an alternative that can easily be addressed by ISO Publishing Marketing. The detailed, step by step documents however, can easily be accomplished with little time and expense.

Solution Proposal:

The Xerox Publishing Illustrator (XPI) Step By Step Supplemental Training Series is the most beneficial and cost effective immediate solution. Each Step By Step (SBS) would be a one-page, easy reference and learning document, with appropriate graphics and applications information. Each document will be of a separate topic relating to the features, functionality, integration, or applications related to the XPI & 7650 Pro Imager software. There would be 50 (fifty) documents in a complete set, issued monthly in subsets of 5-10 documents. This would allow each user to spend an appropriate amont of time with each topic, understanding the information, practicing each step, and applying the knowledge as it might apply to the specific job requirements.

The benefits are extensive, both for internal and external XPI users. Customers could quickly learn the individual topics and become advanced users in a very short period of time. Training would be in-house, and would also be self-paced to allow for different levels of sophistication and application. Customers would be more comfortable with the learning process, as the training materials would be fresh, detailed, application specific, and written by an expert user of the software.

Internal users would benefit from the quick learning time required of each topic, for the 'realistic' Xerox analyst, sales representative, and customer support center personnel has little time to 'come up to speed' as well as continue to learn and apply the knowledge with deadlines, interruptions, and the daily business of customer support. Internal users would also benefit from the on-line Network access of these documents (in IP format), as obtaining product documentation in-house is a common problem.

Final Summary:

Xerox Publishing Illustrator (XPI) Step By Step Supplemental Training Series would be a series of 50 single-page, detailed applications training documents, intended to enhance any XPI users knowledge and application of the functionality available.

Xerox Publishing Illustrator (XPI)
Step By Step (SBS) Supplemental Training

Written & Compiled By Lee Thomas Hedges
Integrated Systems Operations (ISO) Publishing Marketing

STEP BY STEP

Table of Contents

Notice: If there is no page listing for a specific Topic, the information page has not yet been developed. Development and distribution of XPI Step-By-Step Supplemental Training Topics will be continuous, on the average of 10 per month, to give the user time to develop the necessary skills in each particular topic. If there is a request for a specific Topic not yet written or if there is an additional topic not listed, feel free to call or write the author with the request. Requests will be completed on a first-come first-served basis. Users with specific applications involving XPI are encouraged to share the applications with the author to better serve all users of the software.

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Xerox Publishing Illustrator (XPI)
Step By Step (SBS) Supplemental Training

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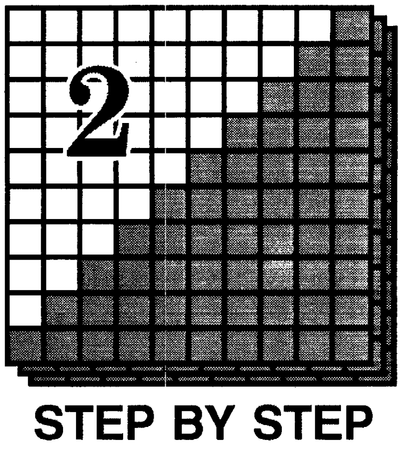
Integrated Systems Operations (ISO) Publishing Marketing



Basic Scanning

Overview:

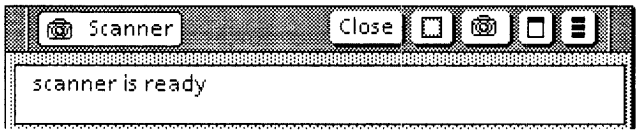
The first encounter with the 7650 Pro Imager and its user interface (XPI Local Scanning software) can be overwhelming. Certainly it is a lot of information to comprehend and a wealth of details to memorize, but learning the basics of the scanner operations can be as simple as five steps. This document will provide the necessary information to get the beginner started and on the way to understanding the intricasies of the scanner capabilities. Remember, practice makes perfect and mastering the scanner operations only comes about through useage.

The five basic scanning steps are Preview, Crop, Resolution, Output, and Scan.

User Interface:

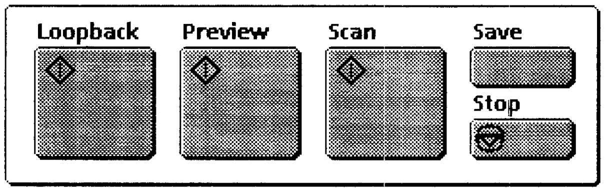
It is best to understand the basic features of the scanner software before attempting to use it. Once the basic operations are understood, the illustrator can then proceed to learn by using, rather than fumble through without a base level of understanding.

Message Window: This is where all messages are displayed. Keep an eye on this box during your first few trys at scanning.



scanner is ready

Scanning Control Buttons: These buttons control the operation of the scanner. They are only selected after all properties are set-up first.



Crop Area: This is the area in which the image is cropped for specific image area.

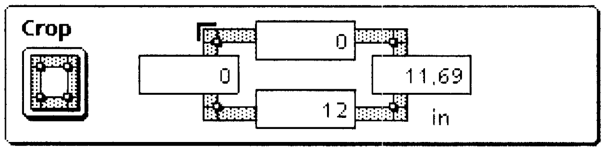
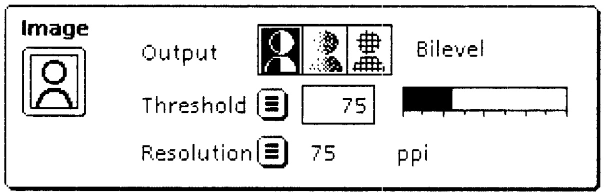


Image Area: This section is where the user specifies the type of image to be scanned and the resolution or quality required of the final image to be printed.



Output: Bilevel
Threshold: 75
Resolution: 75 ppi

Five Easy Steps:

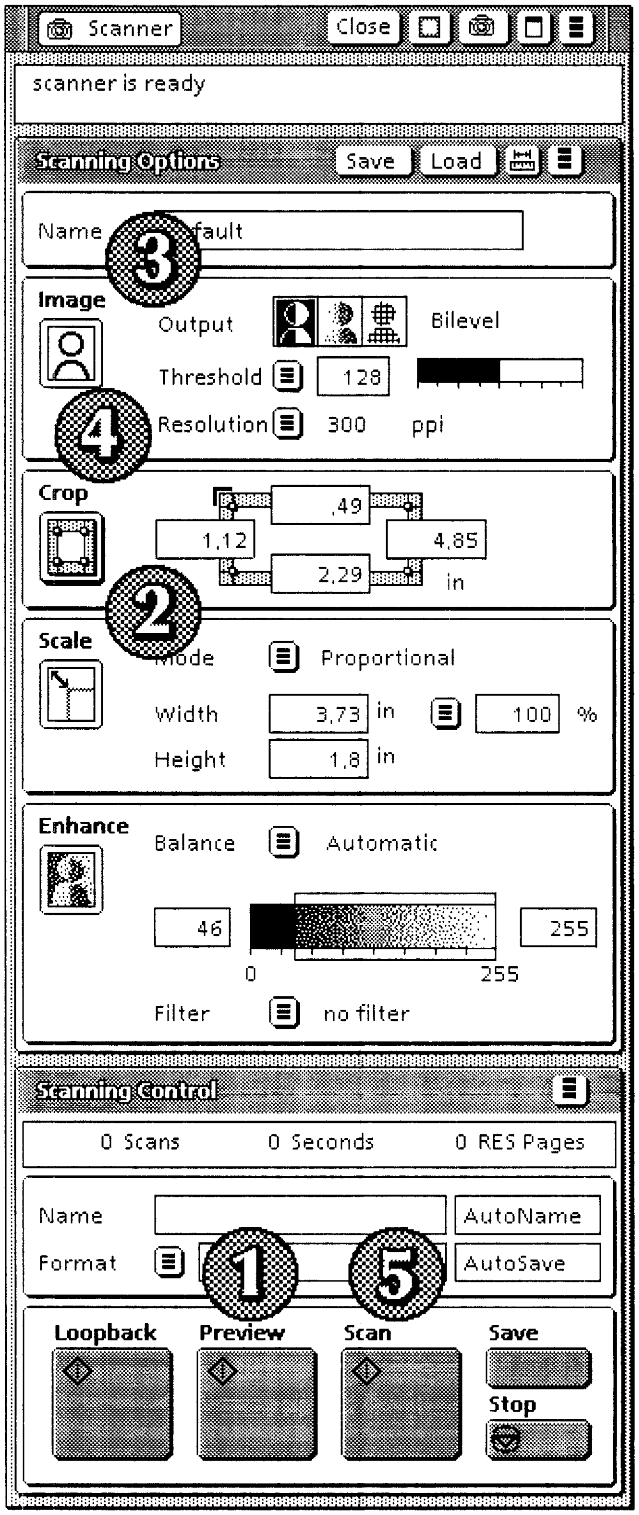
Step One: Select the *Preview* button. This will scan a fast, low resolution image of whatever is on the scanner.

Step Two: Select the *Crop* button (underneath the word *Crop*). Move the cursor into the Platen area (scan display area), point down with the left mouse button (holding it down) at the top left corner of the desired image, drag it across to the lower right of the image area, and let up on the mouse button. If the crop area needs to be adjusted, point on the white adjustment box (with the right mouse button) and realign the crop area.

Step Three: Select either the *Bilevel* or *Halftone* Output (head & shoulders figures) by mousing on the figures, depending on what you are scanning as the original. Bilevel is for line art drawings and Halftone is for photographs. For Bilevel, notice the Threshold area underneath it. Set it to *128* as a start. Adjust it up (for a darker scan) or down (for a lighter scan) after the first scan is completed. For Halftone, notice the Screen area underneath it. Set it for *71 dpi @ 300* as a start.

Step Four: Select the Resolution of the final image by pulling down on the picklist. This will depend on what level of quality is desired for the image. For most applications, 300 ppi is the best. Also make sure that Scale is at 100% or whatever final size is required.

Step Five: Select the *Scan* button. This will take all of the settings and scan just the area cropped. After the scan has completed, look at the scanned image and make adjustments if necessary. If none are required, select the *Save* button after naming the image.



scanner is ready

Name fault

Output Bilevel

Threshold 128

Resolution 300 ppi

.49

1.12 4.85

2.29 in

de Proportional

Width 3.73 in 100 %

Height 1.8 in

Balance Automatic

46 255

0 255

Filter no filter

0 Scans 0 Seconds 0 RES Pages

Name AutoName

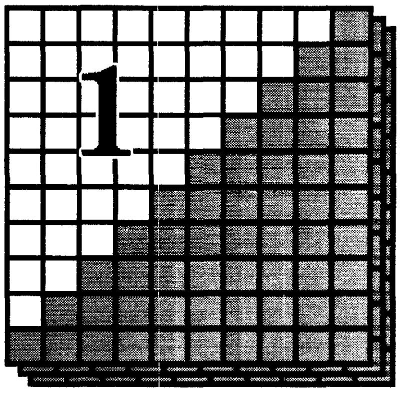
Format AutoSave

Tips & Techniques:

When setting up the Preview program, pull down *Load* (at the top of the menu) and select *Preview Values* to show current programmed values for Preview. Change any settings as desired and then pull down *Save*, select *Preview Values*, and confirm in the herald. This will program the new values to scan every time Preview is selected. The best basic values are: Bilevel, 75 Threshold, 75 ppi, 11.69 x 12 crop setting, 100% Scale, Automatic Balance, and Low Edge Enhance Filter.

Xerox Publishing Illustrator (XPI)
Step By Step (SBS) Supplemental Training

Written & Compiled By Lee Thomas Hedges
Integrated Systems Operations (ISO) Publishing Marketing



STEP BY STEP

Overlay

Overview:

Overlay is one of the Special softkey functions within the XPI Raster Editor. It is best used when a graphic needs to be traced for an outline drawing or template creation, and can be best symbolized as using tracing paper. Two simple examples of Overlay are tracing a scanned-in photograph to produce a line drawing, and using the scanned-in photograph as a template to make an ellipse shape, as in a picture frame mat. Both applications use Overlay as a tracing tool, to get a more accurate drawing reference for a line drawing.

Overlay is best suited for the photograph to line art creation process. For instance, taking a real photograph, of a mechanical part for instance, scanning it in on the 7650 Pro Imager scanner, and saving it to the desktop as an RES file. The scanned image is then edited, selected as a brush and made into an Overlay. The Overlay is then used like tracing paper to draw the required line art from scratch.

There are two different ways to create an Overlay. The first is using Select and the other is using Place. Both methods will be covered in detail in the following section.

User Interface:

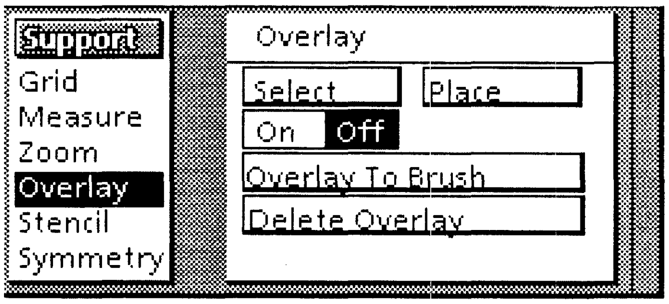
It is best to understand the features and functionality of Overlay before attempting to use it. Once the basic operations are understood, the illustrator can optimize these skills for increased efficiency and performance.

Select: selects an area of the existing illustration to be the Overlay.

Place: places a Brush into the illustration as the Overlay.

Overlay to Brush: copies the Overlay into a Brush.

Delete Overlay: eliminates it



Selecting an Overlay:

Put the art (to be the Overlay) in the illustration. Select the "Overlay" button in the softkeys and then select "On" and "Select". Notice that Overlay goes from ON to OFF (that's normal). Hold down on the left mouse while dragging it towards the bottom-left of the desired Overlay area. Delete the contents of the illustration (Erase in Frame Controls). Notice that moving the cursor in and out of the illustration will make the Overlay disappear and redisplay, so that the drawing underneath can be seen more accurately.

Placing an Overlay:

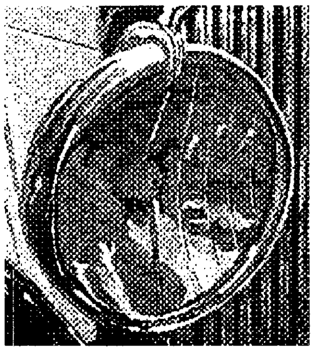
Of the two ways to create an Overlay, the most efficient way is by using the "Place" feature. To do this, select the area required for the Overlay as a Brush. Delete the contents of the illustration (Erase in Frame Controls). Point down on "Overlay" in the softkeys (while the Brush is still on the cursor) and then select "On" and "Place". Move the Brush back into the illustration and make sure to center it inside the illustration frame before pointing down (once). Pointing down will "set the Overlay". The original Brush can be deleted from the cursor.

Using "Overlay to Brush":

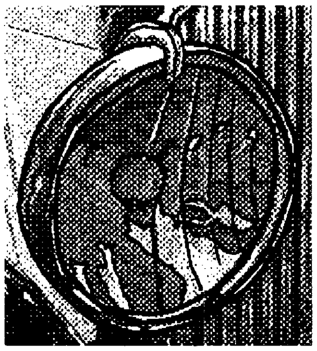
If the illustrator wants a copy of the Overlay already in use, then the only way to get a copy as a Brush is to select "Overlay to Brush". This will create a Brush from the Overlay image, while keeping the original Overlay active and displayed.

Using "Delete Overlay":

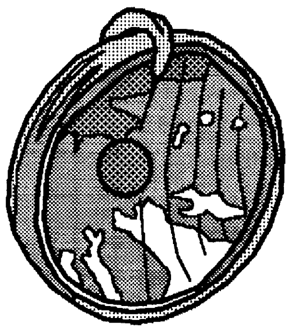
If the illustrator wants to delete the Overlay in use, having completed the drawing operations for that illustration, then the "Delete Overlay" button must be selected. This will delete the original Overlay and allow a new one to be created. Closing the illustration will also cause the Overlay to be deleted, so before selecting the Close button, make sure to save the Overlay as a Desktop Brush.



Overlay



Overlay & Line Tracing



FInal Shaded Line Tracing

Tips & Techniques:

When drawing based on the Overlay, always draw in the Unscaled view. This will facilitate the drawing process, allow the illustrator to connect lines and objects easier and with more confidence, and most importantly, Unscaled view will always display the "real" data of the illustration. Editing in any other view will always display a representative, or distorted and 'best guess' view, based on the screen resolution of 75 dpi.

When using Overlay with Stencil, to create a stenciled area based upon the Overlay image, Place the Overlay first, create the Stencil based on the Overlay, select the Stencil image and Place it in the illustration, and then use the Overlay to Brush feature selection to bring the Overlay image back into the Stenciled area. Using this feature will allow the user to access the components of the illustration much faster than saving as Desktop Brushes or Saved Brushes.

In the current version of XPI software (V-2.3), when Delete Overlay is selected, the image will disappear and Overlay will turn OFF, but if you want it again, simply select ON and it will reappear. This is a software bug in this version but has no real user impact because whenever the user wants to delete the Overlay s/he can either Close the illustration or Place another Overlay image into the illustration.

Postmark:	3-April-90 (Tuesday) 10:05:39 PDT - (WellsFargo:SD:Xerox)		
From:	Hedges:sd:xerox	**To:**	ISA Teams:ISO, ISC Teams:ISO
Sender:	Lee Hedges:SD:XEROX	**Copies:**	7650Users:all areas, ISOMo P:OSBU:RX, Hedges:sd, NFors:DlosNSC, Audie Johnson:DLOSLV, Peggy Rahkola:ISO-ES, Gary Robinson:OSBU:RX, Bob Sampson:STLOUIS, David Schmitz:ES LBC, Greg Stewart:XOS-MAR, Walton Gilpin:Costa Mesa, Dennis Checkley:Indianapolis, Ron Brown:Sacramento, Kevin Heckman:Nashville, ISO-SD:sd, Mayme:sd, PQ:sd
Subject:	Step By Step XPI Training Series		
Reply To:	Hedges:sd:xerox		
Attachments:	MailFolder		
Size:	692 Disk Pages		
Note Format:	XEROX Format		

Note: Take a look at the "Read Me 1st" mailnote. It's about new XPI & 7650 Pro Imager Training documents developed in an easy-to-read, learn, and reference format. It is intended for "users" of XPI & 7650 Pro Imager (6085 version), both internal and external. From all draft reviewers, it is claimed to be the answer to the XPI/7650 Training problem! Give it a try ...

Enclosed you will find five (5) documents. The first is a printing instructions mailnote (& where to find the other files). The second is an overview document (IP) that describes the training. The third is a Table of Contents for the Step By Step (SBS) Training Series. The fourth and fifth are two (2) sample SBS documents that are representative of the style, format, and simplicity of the training serie s. There are currently seven (7) SBS documents completed. You must access the file drawer described in the 1st mailnote to get the current SBS documents #1-7. There will be 10 new ones each month. Now is your chance to learn on your own, at your own pace, without having to call someone for help at every turn. Take your time, do one at a time, Step By Step, until you become a master!

If you have any questions or suggestions, please feel free to call or write ...

Lee Thomas Hedges
ISO Publishing Marketing Product Manager
*843-7712
Hedges:sd

From: XPI Wizard **To:**
Subject: Read Me 1st
Note Format: XEROX Format
Note: For those of you that do not know me, my name is Lee Thomas Hedge s. I am the ISO Publishing Marketing Product Manager, responsible for all the current publishing products, located in San Diego, California.

As most of you know, there is a great need for customer training classes for both the Xerox Publishing Illustrator (XPI) and Xerox 7650 Pro Imager products. Although there still are no classes at this time, I would like to let all of you know that I have done something to alleviate the problem. I have created a series of training documents for XPI & 7650 Pro Imager users, both internal and external. The name of this series is:

Xerox Publishing Illustrator
Step By Step (SBS) Supplemental Training

As many of you know, I have been involved with XPI & the 7650 for a long time and know a little bit about these products, their features, and users requirements. Since many of you have requested that I present a training class to train both customers and internal users, and I cannot possibly train everyone, I have written down (almost) everything that I know about these two wonderful products. The format of the training supplements is simple - a 1 page document on each specific topic relating to a feature or application. There are currently 50 topics to be written, each with precise and detailed information about the topic.

I will create 10 a month, and have them available on-line, via a network file drawer. As of today, there are seven (7) completed SBS topics.

1 Overlay
2 Basic Scanning
3 6085-2 "Helen" Performance Summary
4 Raster Editor User Interface: Softkey Menu
5 Halftone Scanning Application for Previously-Screened Originals
6 Scan Parameter Recommendations
7 7650 Pro Imager User Interface

All that is required of the user is to copy the Interpress Master out to a local printer. The steps in which to get the IP Masters is as follows:

1st Copy the Table of Contents document onto your workstation from the following file server [Pennant:SD:Xerox / ISO Field Info/XPI Demo Directory / Training Documents / Step By Step Supplemental Training Series / SBS IP Masters].
2nd Copy the Table of Contents from your desktop to a networked printer that is capable of printing large bitmapped images (1.5 MB memory or more).
3rd Look at the listing and see what is currently available. Copy the specific IP Master for the specific SBS document to your desktop.
4th Once the document has been printed, take the two pages and put them on the copier to make a single duplex page. Put these pages into a folder for future reference.

NOTICE: Be aware that these documents are large files, due to the bitmap frame artwork in each. It is NOT advised to copy the entire IP Master folder onto your desktop because it may take several hours and kill the network.

Keep checking the file drawer for additional listings. Expect 10 new SBS document topics each month.

Please take a couple of minutes to copy out a few of the SBS topics, read them over, try some of the suggestions and features, and then let me know what you think. Any suggestions, comments, or additional topic subjects will be graciously accepted. I hope that all of you take advantage of this series, both for your own benefit and that of your customers.

If there are any questions or problems, please call or write:
Lee Hedges:SD:Xerox
*843-7712