

## Minutes of the 26-28 September 1994 DPCE Meeting

These are the minutes for the Data Parallel C Extensions meetings held September 26–28, 1994. The meetings were held at the Hotel Boulderado, Boulder, Colorado.

### Attendees:

1. David Keaton, Keaton Consulting, dmk@dmk.com
2. Dave McNamara, Pacific-Sierra Research, dave@psrv.com
3. Linda Stanberry, Lawrence Livermore National Laboratory, lstanberry@llnl.gov
4. Phil Hatcher, University of New Hampshire, pjh@cs.unh.edu

### 1. Opening Activities

The meeting was convened at 9:00am on Monday, September 26, 1994 by Keaton. Hatcher was chosen to serve as meeting secretary. Keaton's proposed agenda for the meeting was approved as earlier distributed.

### 2. Liaison Activities

The goal for this meeting is to finish the DPCE document in order to include it in the October 28 X3J11 mailing. A vote will then be requested at the December X3J11/WG14 meeting to include the DPCE document in the X3J11 technical report.

### 3. Status of DPCE Document

Draft version 1.5c will be the basis of the discussion at this meeting. The primary change from version 1.5b is the addition of "slicing" functionality.

### 4. Completion of Uncontested Issues

A complete pass was made over version 1.5c with numerous noncontroversial modifications, additions and deletions approved. These edits will appear in final version 1.5 to be distributed in the October X3J11 mailing.

**Action Item:** Hatcher will provide examples for return of non-void types from nodal and elemental functions.

**Action Item:** Hatcher will provide an example illustrating the "undefined behavior" case discussed on lines 3–4 of page 51 of version 1.5c.

### 5. Examination of Additional Issues

#### 5.1 Parallel arrays and arrays of parallel

It was agreed that in

```
shape [100]S;
int:S x[10];
```

`x` declared an array of parallel ints. Moreover, it was agreed that in an elemental execution context that the elements of `x` in one position of `S` must be accessible via pointer arithmetic from the elemental pointer derived from `x`.

Action Item: Hatcher will consider the use of the elemental qualifier in struct/union member declarations to allow parallel struct/union objects containing pointers.

Action Item: Hatcher will consider an elemental storage allocator.

Action Item: Hatcher will provide examples of elemental functions.

Action Item: Hatcher will review the specification of nodal and elemental functions to ensure that they are consistent with the specification of parallel pointers.

## 5.2 Shape equivalence testing

Straw Vote: Shall we use the "intermediate" test over the "lax" test? Yes 1; No 3.

Primarily people were concerned with the fact that the intermediate test may issue a "false positive" error message. A compile-time message might be issued that two shapes are not the same when at run time the shapes would be the same.

The lax model was then adopted by the group with the agreement that shape compatibility compile-time testing would be mandated at all points in the program where shape equivalence would be required at run time.

## 5.3 C++-compatible parallel indexing

Straw Vote: Shall we change parallel index syntax to better support C++ compatibility? Yes 1; No 3.

The group, of course, was not opposed to C++ compatibility. However, the DPCE document proposes numerous syntax changes, of which parallel indexing is only one. The decision to add syntax was not capricious, but rather the additions were viewed as being important to best aid programmers in the writing of DPCE programs.

In the case of parallel indexing, the group felt that macro expansion could be used to translate to DPCE syntax C++ programs written using classes supporting DPCE concepts.

Action Item: Hatcher will respond to Tom Plum's e-mail that raised the issue of DPCE-C++ compatibility.

Action Item: Hatcher will provide text for appendix A.11 on C++ compatibility.

## 5.4 Grammar issues

1. It was agreed that shape dimensions should be part of the declarator syntax with the constraint that they may only be used with the shape type specifier.
2. It was agreed that the shape specifier must be provided in conjunction with a type specifier (and not a storage class specifier or a type qualifier).
3. It was agreed that the shape specifier may not be provided at the "right end" of a declarator. The shape specifier for a pointer declarator must be placed between the '\*' and the rest of the declarator.
4. It was agreed to disallow shape dimension declarations in abstract declarators. This removes ambiguity with array declarators, and shape dimensions can be provided in abstract declarators indirectly by using a typedef:
 

```
typedef shape [10][20]TenByTwentyShape;
void f(TenByTwentyShape);
```
5. It was agreed to move the parallel index operand '.' to the primary expression subgrammar.

## 5.5 Slices

It was agreed to treat slicing syntactically as a parallel index expression. (In particular, slice declarations were removed.)

The syntax will use ':' instead of ';':

```
[ start_exp : end_exp : stride_exp ]
```

The ":" stride\_exp" is optional, with the stride defaulting to 1. No other defaulting for these three expressions is supported. All three expressions must be of nonparallel integral type.

A slice is evaluated with "forall" semantics as if on a single processor responsible for executing the nonparallel portions of the program. The explicit forall semantics allows an implementation to evaluate a slice in parallel. However, mandating that a slice be considered part of the nonparallel portion of the program means that it is evaluated without consideration of the context of the shape of the value being indexed.

The rank of a slice is the number of slicing expressions it contains. The dimension of an axis of a slice is the number of positions selected in that axis. For two slices to conform they must have the same rank and the corresponding dimensions must be the same. This conformance requirement provides a position-to-position mapping for operations on slices.

Hatcher proposed that slicing be generalized for use with array indexing. While there was some support for this proposal, the group in general felt that this was beyond the scope of the DPCE project.

## 5.6 Steele's review of draft version 1.5b

The group considered Guy Steele's suggestions from his review of version 1.5b. Most of the suggestions were adopted.

**Action Item:** Keaton will investigate the use of constant 0 and NULL with parallel pointer and pointer to parallel types.

## 6. Other Business

### 6.1 Shape layout

Numerous edits were proposed and adopted for the specification of shape layout. A type, `dpce_layout_t`, was mandated to appear in `dpce.h` to support the run-time specification of shape layout. In addition, a set of functions were adopted for querying the layout of a shape:

1. `int: void nodeof(shape);`
2. `int: physical nodepositionsof(shape);`
3. `dpce_layout_t layoutof(int axis, shape S);`

**Action Item:** Hatcher will examine the need to add constants to `dpce.h` for default values for reduction operators.

### 6.2 The shapeof operator

It was agreed that the `shapeof` operator should return a pointer to the shape of its operand. The operand must be a parallel variable.

### 6.3 The newshape function

The `salloc` function was replaced by the `newshape` function. The goal was to make it clear that storage allocation is separate from the construction of a shape object. The `sfree` function was also deleted.

#### 6.4 The contextof function

For completeness the contextof function

```
int: void contextof(shape);
```

was added to allow the context of a shape to be explicitly retrieved.

#### 7. Future Activities

Stanberry will present the changes to the DPCE document at the December WG14/X3J11 meeting. This meeting will be held in Plano, Texas December 5-9. DPCE will also run open evening meetings at this time to hear concerns from X3J11 members. X3J11 will then be asked to vote on including the DPCE document with the X3J11 technical report.

**Action Item:** Stanberry will e-mail out her plans for the presentation to X3J11.

**Action Item:** Keaton will consult with Rex Jaeschke about X3J11 agenda strategies.

**Action Item:** Stanberry will distribute a new draft of the DPCE document, including changes adopted at this meeting, by October 17.

The following detailed schedule was agreed to:

1. Oct 10: Stanberry will distribute version 1.5d. This will include the changes adopted at the meeting, except for the relatively major modifications for slicing.
2. Oct 17: Stanberry will distribute version 1.5e. This will include the slicing modifications.
3. Oct 24: All final edits must be to Stanberry for inclusion in the X3J11 mailing.
4. Oct 28: X3J11 mailing deadline.

**Action Item:** Stanberry will send her fax number to the DPCE e-mail reflector to allow marked up pages to be transmitted to her.

#### 8. Resolutions

**Vote:** Move to formally accept the straw votes for this meeting. Yes, 4; No, 0.

#### 9. Adjournment

The meeting was adjourned at 4pm on Wednesday September 28.