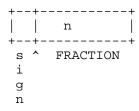
Network Working Group Request for Comment #401

NIC #11923 Category: D.6 Updates: RFC #387 Obsoletes: None Jim Hansen Center for Advanced Computation University of Illinois October 23, 1972

Conversion of NGP-0 coordinates to floating point PDP-10 coordinates was discussed in RFC #387. In general, however, it is undesirable to convert NGP coordinates to floating point coordinates because real devices require integer addressing. To this end, a means is described to convert NGP coordi- nates to integer coordinates in the range zero to M, where M is the maximum address of the device screen on a machine using 2's complement arithmetic. It would not, however, be difficult to modify this algorithm to operate on machines using one's complement or sign-magnitude arithmetic.

First consider the NGP coordinate format:



Where the sign occupies the most significant bit of the coordinate followed by bits of numerical information (initial implementation of NGP requires N=15). Negative numbers are represented by 2's complement. Conversion to device coordinates is accomplished by:

$$D = S * f + S$$

Where D =>integer device coordinate
 S =>scaling factor (typically M/2)
 f =>NGP fractional coordinate

Let us rewrite this as:

$$n n$$

D = S*(2 *f)/2 +S

Now factor S into two terms:

Where Q is an odd integer and I is an integer.

When:

$$D = Q * 2 * (2 *f)/2 +S$$

$$I-n n$$

$$= Q * 2 * (2 *f) +S$$

n

The factor (2 *f) is represented in 2's complement form simply by extending the sign bit of f into the upper portion of the computer word, If Q = 1 (as it would be with many devices), it can be ignored. If Q >< 1, we may console ourselves that an integer multiply is faster on most machines than a floating point multiply. In fact, on a PDP-10, this multiply can usually be performed with no access to memory since Q is usually small.

I-n

We are now left with the 2 factor. This can be accomplished with an arithmetic shift left by (I-n) or an arithmetic shift right by (n-I) as is appropriate. The offset factor, S, may now be added using an integer add.

The procedure for converting NGP coordinates to integer device coordinates is then:

- 1. move coordinate to a register and extend sign
- 2. integer multiply by Q (if necessary)
- 3. arithmetic shift left by (I-n)
- 4. integer add S

This procedure would generally be much faster than:

- 1. move coordinate to register and extend sign
- 2. float fractional coordinate
- 3. floating point multiply
- 4. floating point add
- 5. conversion to fixed point

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