SECTION 3

ACCESS.bus

Locator Device Protocol Specification

TABLE OF CONTENTS

3.0 Introduction

3.0.1 Design Objectives

The locator device protocol described in this specification defines standard messages for reporting locator movement and key switch activation as needed for mice, tablets, and other basic positioning devices. The protocol is designed to accommodate a range of basic locator devices such as a mouse or tablet. More complex devices can be modeled as a combination of basic devices or can provide their own device driver, thus minimizing the burden on the protocol.

3.0.2 Overview of Generic Locator

A generic locator consists of one or more dimensions described by numeric values and, optionally, a small number of key switches. The standard driver requires the locator device to identify the type of data it will report from a small list of options and adjusts to handle this data type. These options are:

- Number of dimensions, e.g., 2-D, for a mouse or a tablet
- Dimension type: absolute, i.e., referenced to some fixed origin, like a tablet; or relative, i.e., change since last report, like a mouse
- Resolution in divisions per unit, e.g., counts per inch or counts per revolution
- Dynamic range of values that can be reported, i.e., the minimum and maximum values
- Number of key switches, from 0 to 15

The assignment of scalar-value dimensions returned from one or more devices to the user interface functions is left to the application. However, to accommodate most conventions, the scalar dimensions and the key switches can be labeled in the capabilities string.

3.1 Locator Event Reports

Locator reports are generated in response to a poll command, or at each sampling interval in which a change in position or button state has been detected. The sampling interval defaults to twelve milliseconds (12ms) (83Hz update), but is setable from the host.

Locator event reports include the current button state and the current position or movement since the last report. For simplicity, these are coded as a sequence of two byte integers. The first integer contains the state of up to sixteen (16) locator key switches. The remaining integers represent locator dimensions. Locator event reports are transmitted using the device data stream message (see ACCESS.bus Description and Protocol Specification).

Example: A 2D mouse might report:

50h	computer address
54h	device address
06h	data stream, data length 6
000lh	button "Bl" is down
0017h	X movement is 17 units
FFF4h	Y movement is -12 units
xx	message checksum

3.2 Capabilities Information

The keywords defined in this section have standard meanings within the ACCESS.bus Generic Locator Device Protocol.

Keyword	Meaning
buttons()	The "buttons()" entry lists and describes the key switches that are reported to host software. The parenthesis contain a list of tagged labels giving the bit number in the keyswitch word or name.
L	Left mouse button.
R	Right mouse button.
M	Middle mouse button.
Bl B2 B3 B4	Numbered locator buttons.
Tip	Stylus tip button.
Barrel	Stylus barrel button.
P	Sensor in proximity indicator.
dim()	The "dim()" entry gives the number of dimensions reported by a locator device.
d0() . . .dn()	The "d0()", "dl()", . . . , "dn()" entry groups' attributes that apply to a single dimension. Capability attributes within the parenthesis apply only to that dimension. Capability attributes outside a "dn()" entry apply to all dimensions reported by the device.
rel	The "rel" attribute identifies dimensions that report relative coordinates, i.e., change since last report, like a mouse.
abs	The "abs" attribute identifies dimensions that report absolute coordinates, i.e., referenced to some fixed origin, like a tablet.
res()	The "res()" entry describes the resolution of one or more locator dimensions. The parenthesis contain an integer number and unit. The number represents the number of movement increments reported for a change of one unit.
inch	Counts per inch.
cm	Counts per centimeter.
rev	Counts per revolution.

range()	The "range()" entry describes the range of values that can be reported for one or more dimensions. The parenthesis contain two integer numbers corresponding to the minimum and maximum values that can be reported.
dname()	The "dname()" entry specifies a label or name for a dimensions.
X	X dimension
Y	Y dimension
Z	Z dimension
RX	Rotation about X axis
RY	Rotation about Y axis
RZ	Rotation about Z axis

Consider the following example locator device capabilities string:

```
(
  prot(locator)
  type(mouse)
  model(VSXXX)
  buttons(l(L)2(R)3(M)) dim(2) rel res(200 inch) range(-127 127)
  d0(dname(X))
  dl(dname(Y))
)
```

"prot(locator)" tells host software that this device is a generic locator and follows the locator device protocol.

"type(mouse)" provides a user recognizable description of the type of locator device.

"model(VSXXX)" is a user readable identification of the device model.

"buttons(l(L)2(R)3(M))" describes the device as having 3 key switches or buttons labeled "L" (left), "R" (right), and "M" (middle). The corresponding bits in the key switch word are also identified.

"dim(2)" describes the device as a two dimensional locator.

"rel res(200 inch) range(-127 127)" are characteristics of the device that apply to all of its dimensions since they are not enclosed within a single dimension tag. In this case, each dimension reports relative movement with resolution of 200 counts per inch. The reported movements can range from -127 to +127.

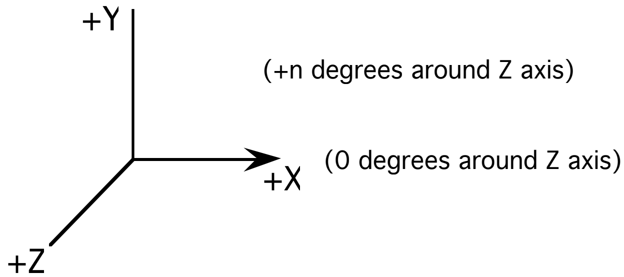
The dimension tag "d0( )" indicates characteristics that apply to a single dimension only. The "dname(X)" tag names dimension "d0" as "X".

3.3 Locator Conventions

The following conventions are recommended for devices used to input 2D or 3D spatial information:

1. Position coordinates are reported in order: X positive from left-to-right; Y positive from down-to-up; Z positive out of the screen (toward the operator viewpoint).

2. Rotations are reported in order around the X, Y, and Z axis using a "right hand" coordinate system.



3. Key switches are reported as bits in a 16 bit key switch word (l=depressed or on) and should be labeled in the Capabilities String. The following default assignments are recommended (Bit 1 = LSB).

Table 3.1: Recommended Default Bit Assignments in Locator Key Switch

bit-numbered (label)	description
1 (L)	left mouse button
2(R)	right mouse button
3(M)	middle mouse button
1 (B1) 2(B2) 3(B3) 4(B4)	button 1-4
1 (Tip)	stylus tip button
2(Barrel)	stylus barrel button
15(P)	sensor in proximity

4. Dials are reported in order from left to right and top to bottom, with increasing values corresponding to clockwise rotation. Obviously, not all devices will fit these conventions. These recommendations are intended to simplify interchanging common locator devices such as mice, tablets, trackballs, joysticks, touch screens, and dial boxes.

3.4 Timing and Exceptions

It is assumed devices attached to the ACCESS.bus will have an opportunity to report during each frame refresh interval. This is necessary to track locator devices smoothly. For 60 Hz video, this interval is 16.6 milliseconds.

If a dimension reporting relative movement overflows within a single reporting interval, the maximum value should be reported.

If a command is received while another transmission is pending, the most recently received command should be performed. Notice that losing a single relative motion report is generally not critical, but that button transitions must be reported.

3.5 Locator Messages and Commands

3.5.1 Locator Report (Device Data Stream)

The Locator Report message reports the current locator position or movement, and key switch state.

Format:

```
dddddddd0
 sssssss0
 000xxxxx                  (P=0, length=4-34)
 locator button state      (16-bit keyswitch word)
 |
 one to 16 scalar          (each value is a 16-bit
 dimension values           signed integer)
 |
 cccccccc
```

3.5.2 Application Set Sampling Interval

The Set Sampling Interval command sets the locator sampling interval from 25 to 8 milliseconds (40-120 reports/second). A parameter value of zero selects polled operation, that is, no unsolicited reports. All other values are ignored. Set Sampling Interval is a device defined control/status message.

Op-code: 01 Data: l-byte number of milliseconds.

3.5.3 Application Poll

The Application Poll command instructs the locator to report its current state as a Locator Event Report. The Locator Event Report includes the current movement or position and status of any locator buttons.

Op-code: 02 Data: none.

3.5.4 Locator Self Test (Attention) Report

At power up, or upon receiving a "Reset" command, the locator will test its electronics and firmware and report the results as an "Attention" report (see ACCESS.bus Description and Protocol Specification). The locator uses the following status values in its Attention report:

0	Success
1	ROM checksum error detected
2	RAM error detected
3	Key down detected

If a ROM checksum error is detected, the second data byte will give the computed non-zero checksum.

The locator will ignore incoming messages during self test. Messages addressed to the device will not be acknowledged. If a ROM, RAM, or key down error is detected, the locator will attempt to start normal operation anyway.

These same parameters are used for AppReply in response to an AppTest command. In this case, the previously stored power-up test results are used.