

Laser-Scan Ltd.

Software Product Specification

LITES2 Version 4.3

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Science Park, Milton Road, Cambridge, England CB4 4FY tel: (0223) 420414

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1 **DESCRIPTION**

The main component of the LITES2 package is the LITES2 cartographic editor program. LITES2 is an interactive graphic and geographic display and editing program and as such forms a basic component of Laser-Scan's LAMPS mapping and GIS systems. It has been designed to be particularly suitable for work with cartographic (map) type data which normally comprises lines, areas, symbols and text but it can also be used on other types of data made up of similar features. It is possible also to display and edit raster images, either as a backdrop to the vector data, or alone.

Other components of the package are the UILMENUS and UISMENUS programs, which allow the user to create and customise hierarchical screen menu systems on windowed display screens. These are primarily intended for use with the LITES2 program, but may be used for other purposes.

The LITES2 package runs on DEC VAX and Alpha AXP series computers and will drive a variety of graphics peripherals via its internal ISO standard GKS interface.

Input vector map data is taken from Laser-Scan IFF files. These are binary files holding feature, coordinate, and attribute information in a compact form for efficient access. Coordinates are held in 32 bits (64 bits/coordinate pair) with at least 7 significant decimal digits. The magnitude of a coordinate cannot be smaller than 0.29×10^{-38} nor greater than $1.7 \times 10^{+38}$. There are least 40 million addressable values for each coordinate. Each file has an origin offset held as double precision (64-bit) values, and associated projection information, allowing accurate coverage over the whole world.

The basic element of graphical data operated on is the feature. The areal extent of features can be defined by the user; it can comprise the most simple of units - a link between two junctions - or it can extend to more complexity such as a whole building complex. Features can be grouped together into layers which are typically used to separate background from foreground, or data for different colour separations. Edit operations can therefore be carried out on features, parts of features or groups of features.

Each feature is uniquely identified by a feature serial number, and has a feature code as its primary attribute. It may also have an arbitrary number of other numeric (integer, or real), date, time, character, or textual Ancillary Codes (ACs). The coordinate points within the feature, may also have optional attributes.

2 **FEATURE ATTRIBUTES**

Numeric feature codes are in the range 0 to 32767 and are used to identify different kinds of features; examples in a cartographic application include pavement, house, parish boundary, spot height. Each feature code implies a certain graphical representation. The correspondence between feature codes and feature representation is made by looking up the feature code in a Feature Representation Table (FRT) to determine the graphical type, colour, size, symbology etc (see the FRT User's Guide and the FRTLIB Reference Manual for the design of feature coding schemes described above).

Facilities are available for definition of arbitrary groups of feature codes each with a unique name to allow easy selection of subsets of the data for display, editing or output. For example, all types of roads may be classed together in a group called "Roads" so that a given operation can be performed on all roads even though different types such as motorways, A-class roads etc. may be coded differently.

Features may have an arbitrary number of other numeric (integer, or real), date, time, character, or textual Ancillary Codes (ACs). These are commonly used for such items as "date of last edit", or "pipe diameter", or "feature height". The content, format, and description of ACs is defined in the FRT using a flexible "Ancillary Code Definition" (ACD) mechanism.

As well as X and Y coordinates, features may have a number of additional per-point attributes (up to 18 per point at present). These are defined using the ACD mechanism as for the per-feature ACs. These attributes may be of numeric (integer, or real), date, time, or character data types.

3 **FEATURE TYPES**

The validity of certain editing operations is dependent on the graphical type of the feature which is being operated on (line, symbol, text etc).

The editor supports 12 graphical types which are implied by the feature code. The graphical types catered for and their relationship with the various attributes are:-

Graphical type	symbol/ text Size	Line Weight	Style	Shape	Angle	Colour
Line strings		x	x			x
Clockwise arcs		x	x			x
Anticlockwise arcs		x	x			x
3-point arcs		x	x			x
Full circle		x	x			x
Curves		x	x			x
Unorientated symbols	x	x		x		x
Orientated symbols	x	x		x	x	x
Scaled symbols	x	x		x	x	x
Text strings	x	x		x	x	x
Symbol strings	x	x		x		x
Fill areas	x	x	x	x	x	x

4 **FACILITIES**

The following facilities are included in the LITES2 software. Certain of these are licensed as options, and these are marked below as [OPTION]. Further details of facilities can be found in the LITES2 USERS GUIDE and the LITES2 REFERENCE MANUAL. The facilities described below are subject to continual development and are likely to change at short notice.

4.1 **Data Format**

- * Accept Laser-Scan's internal feature format (IFF) data as input from disk (refer to the IFF User's Guide for details).
- * Output edited IFF data to disk. (Note software is available to transfer other commonly used data formats to and from IFF).
- * Load and display multiple maps from separate IFF files (up to 100 files). LITES2 has support for 'continuous mapping' where the area of interest is divided horizontally into 'tiles', and vertically into 'strata', allowing automatic loading of relevant datasets around a required point.
- * Display and edit data in a different projection from that in which the data is stored in the IFF data. A projection can be chosen for the LITES2 display space and multiple files in perhaps several different projections, or even in geographical (latitude and longitude) coordinates, can all be displayed together on the selected projection.

See the Software Product Specification for the IMP package for details of the supported projections.

- * Load feature representation information from FRT (Feature Representation Table) files. Load symbol and text shape information from SRI (Symbol Representation IFF) and TRI (Text Representation IFF) files. See the Software Product Specification for the MAPPING package for more details.
- * [OPTION] Accept Laser-Scan's raster formats (DTI, LSI or LSR) data as input from disk for display (refer to the SPS for MATRIX or LSRRASTER packages for details). This can be be a scanned raster graphic, a remotely sensed (satellite) image, or a generated model, such as a terrain altitude, slope, aspect, or intervisibility model.
- * [OPTION] Allow LITES2 to operate in a "3 dimensional mode" where it treats Z as a third coordinate rather than as an attribute of a point. In this mode Z values are interpolated and generated in the same way as X and Y values. Principally for use in conjunction with photogrammetric input devices.
- * Allow LITES2 to access attributes of features held in an external relational database. The fundamental facilities to do this are provided by LITES2 when used in combination with Laser-Scan's XGIS toolkit. See the product specifications for the HORIZON and METROPOLIS GIS products for more information.

4.2 *Command Input Options*

- * Read English-like LITES2 commands from one or more keyboards, allowing command abbreviation.
- * Use of a user-defined command menu which may be attached to the digitising table, a separate menu table, or displayed on the screen, for input of commonly used commands (provided menu hardware available).
- * Use of choice devices such as mouse buttons or function buttons, for input of commonly used commands, where appropriate supported hardware available.
- * Read commands from command files, with facilities for interaction between command file sequences.
- * Accept commands from multiple auxiliary input streams, which may be serial line devices such as terminals, voice recognition systems, or may be from other processes via virtual mailbox devices. A common use of the mailbox facility is to accept commands from a menu-driven graphic user interface such as the UISMENUS or UILMENUS programs provided with the LITES2 package.
- * Define and execute "Macro" commands. Macros are created as a series of commonly used basic commands which can be grouped together under an arbitrary name. The sequence of commands can then be performed by simply calling the macro name; very complex editing tasks can be achieved easily in this way.
- * Allow conditional execution of macros, depending on the results of tests.
- * Allow passing of parameters or 'arguments' to macros.
- * Provide statement labels and jump commands to allow iterative execution.
- * Provide lexical functions to carry out string operations, such as padding, trimming, substring extraction.
- * Allow definition and manipulation of integer, real, and character variables, complete with operators and functions, to make the macro language into a complete, easy to use programming language.
- * Allow examination of many "system variables" containing information about the LITES2 command environment and about attributes of found features.
- * Use of a Feature Code menu to select primary attributes of features to be constructed or modified (provided menu hardware available).
- * Provide reading and writing of ASCII files using LITES2 commands.
- * A locking mechanism that prevents simultaneous editing of the same IFF file by more than one operator.

4.3 *Display And Plotting*

- * Display features with graphical attributes obtained by looking up the feature code in a user-specified Feature Representation Table. The graphical attributes can be defined easily by the user to meet any map specification, including multiple prioritised representations, which allows full cartographic representation, and support for features passing 'under' or 'over' others.
- * Magnify sections of the map onto the screen for clarity or accuracy reasons. Editing can continue on the magnified section and further magnifications may be made upon this section itself, up to the natural limits of the display. Panning and zooming can be achieved easily in this way.
- * Draw refresh pictures on the screen to clarify the current editing operation.
- * Allow labelling of whole features or the individual data points of features with their attributes. On suitable hardware, the background for these labels can be "blanked out" in a user specified colour. This can be used to increase readability by deleting the background or to highlight the text.
- * On suitable hardware, allow the bit planes of the display to be divided into independent overlays.
- * On suitable hardware, allow additional windows on the screen into which graphics and text can be drawn with LITES2 commands.
- * [OPTION] Allow the display of "Raster Image" backdrop pictures (assuming suitable graphics hardware available), in Laser-Scan's DTI, LSI, or LSR formats. This can be a scanned raster graphic, a remotely sensed (satellite) image, or a generated model, such as a terrain altitude, slope, aspect, or intervisibility model. The vector foreground picture can be distorted to fit if necessary.

Legends to explain the meaning of the colours used in these raster images can be generated automatically.

- * [OPTION] Allow the display of stored "Raster Image" pictures as associated images in ancillary display windows (assuming suitable graphics hardware available). Links can be made to such picture files from attributes of features in the main map display, allowing a user to point to a feature and cause a picture to be shown of the geographic object.
- * [OPTION] Allow the generation of perspective views from raster images, with map data overlaid, and their display in ancillary display windows (assuming suitable graphics hardware available).
- * [OPTION] Allow the production of hardcopy plots on a variety of supported plotting devices (assuming suitable hardware available). This option is only available with the version of LITES2 for the DECwindows/Motif windowing system. For full functionality in plotting of combined raster and vector data, a colour electrostatic plotter is

needed. See the PLOTTING package for more information on hardcopy options. Further support for hardcopy plotting using the LITES2 facilities is provided by Laser-Scan's XGIS toolkit. See the product specifications for the HORIZON and METROPOLIS GIS products for more information.

- * [OPTION] If plotting to PostScript hardcopy is available, then the output can be processed to produce files suitable for import into DeskTop Publishing (DTP) systems such as Adobe Illustrator. See the SPS for PLOTTING for more details.

4.4 Operations On Features

- * Position cursor accurately on existing features, or at the intersection of existing features.
- * Create new features.
- * Allow map graphics to be set up on the digitising table, to allow accurate digitising of new features (provided digitising table available).
- * Allow stream digitising from digitising table and other selected input devices.
- * [OPTION] Allow digitising of 3 dimensional data from a photogrammetric plotter (at present KERN DSR)
- * Find and identify existing features within the map data for editing. Find operations are fast because sectoring information is built up as the map file is read in, and then kept in memory.
- * Delete features.
- * Recover features deleted in error.
- * Copy existing features.
- * Shift (reposition or drag) existing features.
- * Remove/insert/replace sections of line features.
- * Split a line feature into two or three parts.
- * Extend the ends of line features.
- * Form closed loops.
- * Join two line features of the same feature code, optionally merging the features.
- * Join multiple line features of the same feature code together into one feature.

- * Examine and change certain basic attributes of features, for example feature code, feature serial number or layer.
- * Add, examine, change or delete further attributes of features held as Ancillary Codes (ACs). Ancillary Codes provide facilities for multiple coding of single features with numeric (integer, or real), date, time, character, or textual attributes.
- * Use of constraining facilities when constructing lines. Lines may be forced to be horizontal, vertical, parallel, perpendicular, radial (to circle arcs) or be constrained to lie on existing line features. It is also possible to provide explicit coordinates or lengths.
- * Generate new line features offset from existing ones.
- * Force open and closed line string features to be square.
- * Call a user written routine, optionally passing it a single feature. The routine may interrogate and/or modify the feature and pass it back to LITES2. The routine may also return a LITES2 command to be obeyed.
- * Create invisible lines. e.g. for gaps in contours, or doorways in buildings.
- * Generate line features as circles, arcs or regular polygons automatically.
- * Interpolate curved sections during construction. This facility allows the interpolated points to be inserted in the feature rather than just being generated for display. Curves may use either Akima's or McConalogue's interpolation method.
- * Filter existing features to remove extra points, or to add more points by curve interpolation.
- * Apply a two-point transform to features to relocate, orient, magnify, reduce, or stretch them.
- * Add, examine, change or delete additional per-point attributes containing numeric (integer, or real), date, time, or character data.
- * Allow coordinates to be specified in latitude and longitude, when the map data itself is in a well defined projection.
- * [OPTION] Automated edge-match across a nominated line using either the JOIN or TIE commands, creating a guidance command file to allow interactive completion in cases where automatic matching failed due to e.g. missing element or mismatched feature codes. Features in a read-only map are treated as correct - any editable features are matched on to them.

4.5 *Text Operations*

- * Edit words in text features, by substituting a new string for part of the existing one, adding text or replacing the text entirely.
- * Text can be positioned with its supplied locating point in any of nine positions around the text string.
- * Rotate text and symbol features.
- * Align text and symbol features with another feature. The size of scaled symbols can also be determined by this operation.
- * On suitable hardware, the background for texts can be "blanked out" in a user specified colour. This can be used to increase readability by deleting the background or to highlight the text.
- * [OPTION] Allow the definition and manipulation of "composite texts", which contain multiple text entities with possibly different size, colour, font, position and angle attributes. This allows handling of paragraphed text and curved text.
- * Allow use of standard fonts held in PostScript font files (only on version of LITES2 for DECwindows/Motif displays, and only if workstation provides Display PostScript (DPS) support). Support includes reading of AFM (Adobe Font Metrics) files for pair kerning information, to give cartographic quality texts. Composite characters are also supported through definitions in the AFM file.

4.6 Selection, Layers And Regions

- * Select maps for editing or display.
- * Select layers for editing or display.
- * Select feature code sets or groups for editing or display.
- * Select features by feature serial number, feature code, group, or attributes, for editing or display.
- * Create, delete and merge layers.
- * [OPTION] Allow the definition of polygonal regions, and select features based on whether they are inside, outside, or cut the boundary of the regions. Clip features at the boundary of polygonal regions, retaining only the parts of the features which lie inside, or outside, or both.
- * [OPTION] Allow the definition and manipulation of complex geometries, and select features based on their relationship to the geometry (eg inside a complex area geometry, or intersecting a complex line network geometry). Convert geometries into features and vice versa.

4.7 *Help Facilities*

- * Use of an inbuilt on-line help facility.
- * All the commands performed during an editing session are recorded in a journal file. The journal can then be retrieved at a later date for safety should mistakes have occurred and for audit purposes. Moreover, complete editing sessions can be re-run automatically in the event that a power or hardware failure halts editing abnormally.
- * Predetermined command files requiring the minimum of operator response can be performed on desired data sets for the purposes of training, demonstrations, or semi-automatic edit.

4.8 *Raster Editing [OPTION]*

- * Allow single-bit raster image data files in LSR format to be opened for update. Multiple such binary separates can be displayed simultaneously (up to 8), but only one can be edited at a time.
- * Paintbrush editing of such raster data, including choice of brush size and shape, and of write or erase modes.
- * Editing operations on 'raster objects' (sets of contiguous pixels of the same colour), including 'find' raster object, move, copy, fill, delete.
- * 'Burn-in' of new or existing vector map detail into a raster layer, allowing easy construction into the raster of lines, texts, symbols, etc.

5 *PREREQUISITES*

5.1 *Computer Hardware Prerequisites*

- * Any DEC VAX, MicroVAX, or VAXstation computer supported by the current version of OpenVMS VAX, or any DEC Alpha AXP computer or workstation supported by the current version of OpenVMS AXP.
- * At least 10MB available disk space for software, plus sufficient for data files.
- * At least 8192 pages working set per process for efficient use on a typical vector map. Increasing working set above this will improve performance in many cases, particularly when handling raster datasets, or multiple maps.

- * Any DEC-compatible alphanumeric terminal, preferably VT300 series (optional if graphics device has alphanumeric terminal capabilities).

5.2 *Graphics Peripheral Prerequisites*

LITES2 is usually used with a Laser-Scan supported graphics device, currently one of:

- * DEC VAXstation integral screen, under the DEC VWS (UIS) windowing system.
- * DEC VAXstation or Alpha AXP workstation screen, under the DECwindows/Motif windowing system.
- * DEC X-terminals, such as the VT1200 (monochrome) or the VT1300 (colour), or VXT2000, or Tektronix XP2 series X-terminals such as the XP29. These may be driven from any VAX or AXP computer running the DECwindows/Motif windowing system.
- * Sigmex 6100 series, 6200 series, and 6300 series intelligent GKS workstation.
- * Sigmex ARGS 7000 series colour display.
- * Tektronix 4014 or 4016 DVST with enhanced graphics and Laser-Scan TMU controller.
- * Tektronix 4100/4200 series display (but not the 4105/4205).
- * Laser-Scan HRD1/FASTRAK/LASERTRAK high resolution display/plotter.

5.3 *Graphical Input Device Prerequisites*

The following input device may optionally be used with LITES2 for input of map coordinates, or commands from a menu:

- * Summagraphics BITPAD 1 with 4-button cursor, or other local tracking devices attached to the graphics workstation such as bitpad, mouse, trackerball,
- * ALTEK DATATAB digitising table with 16 button cursor and AC40 controller,
- * Other digitising tablets or controllers to be advised by Laser-Scan,
- * Photogrammetric plotter for input of data, with or without an image injection system for display of data. This can only be used in conjunction with the version of LITES2 for the DECwindows Motif windowing system. Presently supported plotters are:

- * Kern DSR photogrammetric plotters with or without the KRISS image injection system.
- * LEICA SD2000 plotters with or without the COLORISS image superposition system

This list reflects a set of currently available hardware options, but the graphics devices are under constant review in the light of new products and customer requirements.

5.4 *Software Prerequisites*

OpenVMS VAX Version 5.5-2, or OpenVMS AXP Version 1.5 (or higher version, assuming continued upwards compatibility by DEC) concurrently with other interactive and batch processes.

DEC windowing software is required for the VAXstation or DECstation displays, either VAX Workstation Software layered product (VWS) or DECwindows Motif layered product (the latter is required for X-terminals). The "VMS DECwindows Developers Kit for Motif" is not adequate.

The MAPPING package is a LITES2 software prerequisite. As part of this package Laser-Scan provide the necessary interface libraries for data files (IFF files) and data representation information (FRT files).

The MATRIX package is a LITES2 software prerequisite if the Raster Image option is required. This provides interface libraries and utilities to manipulate the image files.

The LSRRASTER package is a LITES2 software prerequisite if the Raster Image option is required and LSR files are to be manipulated. This provides interface libraries to manipulate the image files.

The PLOTTING package is a LITES2 software prerequisite if the hardcopy plotting option is required.

LITES2 would normally be used in conjunction with the IMP map processing package and the FPP plotting program which forms the main component of the PLOTTING package.

Laser-Scan's VTRAK automated digitising package is recommended for volume input of documents.

6 *GROWTH CONSIDERATIONS*

The minimum hardware and software requirements for any future version of this product may be different from the minimum requirements for the current version.

7 ***SUPPORT LEVEL***

LITES2 is a fully supported Laser-Scan standard software product.