

System Design

System Design of SaX2 SuSE advanced X-configuration

Project, Implementation and Maintenance
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Contents

1	The SaX2 Principle, based on X11 R6, Version 4.x	5
1.1	Level 1: Init	6
1.2	Level 2: XC	6
1.3	xw	7
1.4	Startup Script	7
1.5	Diagram of procedures	11
2	Sysp	13
2.1	Sysp Modules	13
2.2	Calling up sysp	14
3	ISaX	15
3.1	ISaX Modules	15
3.2	Calling up isax	16
3.3	Creating configurations with isax	16
4	libsax	17
4.1	Diagram of libsax procedures	17
4.2	SaX Import Classes	18
4.3	SaX Manipulation Classes	19
4.4	SaX Export Classes	19
4.5	libsax classes and inheritance	20
5	libsax - Error Handling	21
5.1	Exception handling	21
5.2	Traditional <i>error</i> functions	23
6	libsax - Examples	25
6.1	New configuration...	25
6.2	Change current configuration...	26
7	libsax - Thread safety	27
8	libsax - Language bindings	29
8.1	SWIG	29
8.2	Interface template file for libsax (SaX.i)	30
8.3	Example: libsax used with perl...	32
9	XFine tuning	33
9.1	The XFine cache	33
9.2	The XFine tune hash	33

A	Examples of Using the SaX2 Batch Mode	35
A.1	Interactive Mode	38
A.2	Profile Mode and Creating Profile Files	38
B	Examples of the Problem of Options	41
C	The Variables API File	43
C.1	API File Keyword Explanations	43
C.2	API File Overview Tables of all Possible Variables	44
C.3	Example of API Variables	48
	Glossary	49
	Index	51

1 The SaX2 Principle, based on X11 R6, Version 4.x

Contents

1.1 Level 1: Init	6
1.2 Level 2: XC	6
1.3 xw	7
1.4 Startup Script	7
1.5 Diagram of procedures	11

SaX2 is based on a three-layered model which was developed for configuring X11. Briefly outlined, a registration of hardware is performed in the first layer, in the second layer the actual configuration takes place, which can either be completely automated or be done manually, using the information gathered up till now. The third layer serves to optimize the position and size of the image, after a successful configuration and start of the X server.

As a result, the first layer will create a cache file which is the so called **registry** stored as `/var/cache/sax/files/config` which is then imported from the second layer to create the initial configuration suggestion. Up to this point a common formatted interface named **ISaX** serves as proxy between the configuration data and the program using the data. ISaX is able to provide a common interface between the cache data gathered up till now and the data contained in an eventually existing configuration file `/etc/X11/xorg.conf`. ISaX is also able to receive data, of the same format as it is able to provide, to create or modify the actual configuration file. The program using the data only needs to create such an interface file and request **isax** to create the X11 configuration. Using the interface more comfortable can be done by using the development library called **libsax**. The registry in combination with the first and second level processes as well as all the perl Modules for the purposes of importing and exporting data is named the **SaX2 engine**

This approach allows the graphical interface to be developed in a completely transparent manner. In this case it also doesn't matter with what means this was created. Whether this was done with ncurses, Tk, Qt or whatever it is based on, you must only ensure that the result of the configuration is either an ISaX interface file matching the corresponding format or use libsax if available in your destination language. The format of the interface is described in appendix C.

The implementation of SaX2 is based on the languages C++ and Perl. Many small tools, for adjusting the mouse, for example, or for parsing various formats, were implemented in C. For reasons of performance, the storage and the re-reading of the hardware registration was also implemented in C. The principle and procedure of the configuration, writing the configuration file and the GUI which SaX2 itself suggests, were implemented in Qt.

1.1 Level 1: Init

Init is represented by **init.pl** and takes on the following tasks:

- Creating the principle file structure and determining default settings.
- Detection of hardware with reference to PCI/PCI-E/AGP graphics cards, pointer devices, keyboard and monitor. The actual hardware scan is started by a *syp* (System-Profiler) call-up. *Syp* is an independent program which is given its functionality through insertable modules, which in turn can take on a specific task. In the case of SaX2, only modules were developed for detecting the above-mentioned components. A description of the individual modules can be found in chapter 2.
- Entry of data into the hardware registry. By means of functions from the perl module *AutoDetect.pm*, the information provided by *syp* is integrated into the file structure. The result from default settings and hardware data corresponds to the hardware registry.
- Saving the registry. The registration data is then saved in its current form as a binary stream in */usr/share/sax/files/config*.

init.pl is usually not called up manually but via a startup script, described at the end of this chapter. There, all available options are listed in detail. It is always necessary to run *init.pl* whenever hardware has been changed, whether by inserting another graphics card, or just changing the mouse. In normal cases the hardware registry is only created once, which considerably speeds up the starting of SaX2.

1.2 Level 2: XC

XC (X-Configuration) is represented by *xc.pl* and takes over the following tasks:

- Reading the hardware registry. Reading in the registry is done very quickly, since the data has already been saved in the form of a hash. Data can thus be read in directly to a perl hash and processed further.
- By means of the functions from *CreateSections.pm*, a first automatic X11 file is created from the hardware registry. If no X server is running this configuration is then used to start the server. In this case the user is prompted with an information about a first configuration suggestion. If the user is satisfied with this configuration he can simply save it and no further configuration tool needs to be started otherwise the user can start the SaX2 GUI or abort the configuration. If there is a server running already, *xc* will start the SaX2 GUI directly and import the actual configuration file. The mode tuning is supported by a perl module with the name *XFineControl.pm*. This module is used in SaX2/*libsax*, since the actual program *xfine* which makes changes to the screen, merely protocols the changes to the modeline in */var/cache/xfine/....* The exact structure of the files in */var/cache/xfine/* and how *xfine* functions is described in chapter 9.

- Starting the graphical interface. The interface itself in turn makes use of the data stored in the hardware registry. Depending on whether an already existing configuration file should be read in or not, either data is used from the registry, or information from the configuration file. Encapsulated into the **ISaX** interface the following tasks can be done. The reading in of an already existing configuration file is done by a perl module called *ParseConfig.pm*. This module represents an extension of the Perl interpreter and is based on the **libxf86config.a**, which is included from version 4.x of X11 R6. The graphical interface itself only has the task of creating a Variables-API file, from which an X11 configuration file is newly created, through a later import, using the *ImportAPI.pm* module in conjunction with the *CreateSections.pm* module. Another possibility of creating the Variables-API file is using the methods from **libsax**. **libsax** hides all the tasks of creating the Variables-API file and calling **isax** within a high level C++ library. More information about **libsax** can be found in chapter 4. In case of testing the newly created X11 configuration the file is used to start a second instance of the X server. On this server the tuning tool **xfine** is started, to be able to make possible changes in position and size.

1.3 xw

In the SaX2 running procedure there are a number of points at which one or more X servers need to be started. Starting a new server is always done by the **xw** program. This program was originally a Perl script, later replaced by a C program. The name **xw** is derived from **xwrapper**. The program fulfills the following tasks:

- Starting the X server in its own process. Here the first option is interpreted as the logfile name, the remaining options are passed on to the X server. The server is started in a process created by **xw** through `fork()`. The output of the X server in the child process, which is written to the `STDERR` channel, is diverted to the logfile by a `freopen()` call. **xw** itself (father) remains in the foreground and waits.
- Only when the `SIGUSR1` signal has been received, which is sent by the X server to the calling process, is the server ready to work. If the signal arrives, then the father process is ended, whilst the child process (X server) continues to function. The process number of the child process is here output to `STDOUT`.
- Set up background picture and surrounding corner marks

1.4 Startup Script

The coordination of the processes **init.pl** and **xc.pl** is controlled by the startup script *sax.sh*, which is located in `/usr/sbin` and is usually called up by the wrapper script `/usr/sbin/SaX2`. The wrapper here takes over the following tasks:

- Creating a secure, temporary directory with **mktemp**.

- Testing for root permissions. If a normal user calls up the program, then authentication is required. This is done by the xauth mechanism, via the *sux* command, or via the xhost mechanism, if *sux* does not exist. In both cases the root password has to be given.
- Calling up the actual SaX2 startup script, **/usr/sbin/sax.sh**

The ability to pass on options to the startup script is provided by the sum of options from *init.pl* and *xc.pl*. The following options are available:

- **-b | --batchmode <interactive|profile>**
With this option the so-called batch mode is activated. In this case SaX2 will not start immediately, but depending on the parameters, will open an interactive shell or allow the input of data from STDIN. Starting a shell is done via the optional parameter *interactive*, with *profile* SaX2 awaits data from STDIN. The batch mode allows it to access the configuration procedure directly. Changes in the batch mode are also stored in the registry. The batch mode requires data to be in a special format. This format is briefly described if you enter *help*. It is very important, however, to understand what changes were made, and where. Examples of using the interactive shell and the STDIN mode can be found in Appendix A.
- **-a | --auto**
With this option the automatic configuration is started. This means that SaX2 works in the background and creates an automatic configuration from the current registry data. In this case, no X server or configuration interface is started.
- **-l | --lowres**
With this option the DDC detection is switched off. This means that possible information provided by the monitor on its resolution options will not be used. SaX2 will then start in 800x600 VGA mode.
- **-m | --modules**
With this option, a server module can be assigned for each graphics chip. An example should illustrate its use:

```
sax2 -m 0=vga,2=mga
```

Chip 0 is assigned to the vga module and chip 2 to the mga module. Which chip number matches which card can be seen with the option *-p*.

- **-c | --chip**
With this option you can determine which chipsets should be used for configuration. For graphics cards with just one graphics processor, this option is the same as the number of graphics cards to be used:

```
sax2 -c 0,2
```

Use the cards with the chips 0 and 2. It should be especially noted that the option *-c* changes the order of module allocations. If, for example, cards 0 and 2 out of 3 graphics cards are to be used, and here the modules for these cards are also to be set by options, then this will be given as follows:


```
sax2 -c 0,2 -m 0=vga,1=mga
```

The sequence of module allocation always increases by a step of one.

- `-p | --pci`
With this information, SaX2 outputs the result of the PCI/PCI-E/AGP detection. The output is important in determining which chip number was assigned to which graphics card.
- `-d | --display < Display-Number >`
With this option the number of the display to be used can be defined. It should be noted here that this does not denote the format of an X display, but just a number. If SaX2 is to be started on display 5, then the command will be as follows:

```
sax2 -d 5
```

- `-x | --xmode`
This option instructs SaX2 not to calculate any modelines. In this case the modelines installed in the X server will be used to start SaX2.
- `-u | --automode`
This option instructs the server to search for the best mode itself. This means that SaX2 does not write any resolution to the start configuration, but leaves this to the server to choose the mode.
- `-n | --node`
With this option the device node for the main mouse cursor can be set.
- `-t | --type`
With this option the protocol to be used for the main mouse cursor is given.
- `-g | --gpm`
This option activates the gpm as a repeater. Then SaX2 uses *MouseSystems* as the mouse protocol and as the device node, the fifo `/dev/gpmdata` provided by GPM.
NOTE: Currently this option does not work for X1 R6 v4.0-based X servers.
- `-s | --sysconfig`
this option tell SaX2 to import the system wide config file even if SaX2 was started from a textconsole which normally will import the SaX2 HW detection data
- `--vesa`
This option will set a given resolution and vertical sync value (in Hz) as VESA standard resolution for a specific card. The format is the following:
Card: XxY@VSync Example: 0:1024x768@85
- `--fullscreen`
start in fullscreen mode

- `-i | --ignoreprofile`
This option will disable the use of profiles which are normally applied automatically if defined for a specific card or chipset
- `-r | --reinit`
Remove detection database and re-init the hardware database
- `-v | --version`
print version information and exit.

1.5 Diagram of procedures

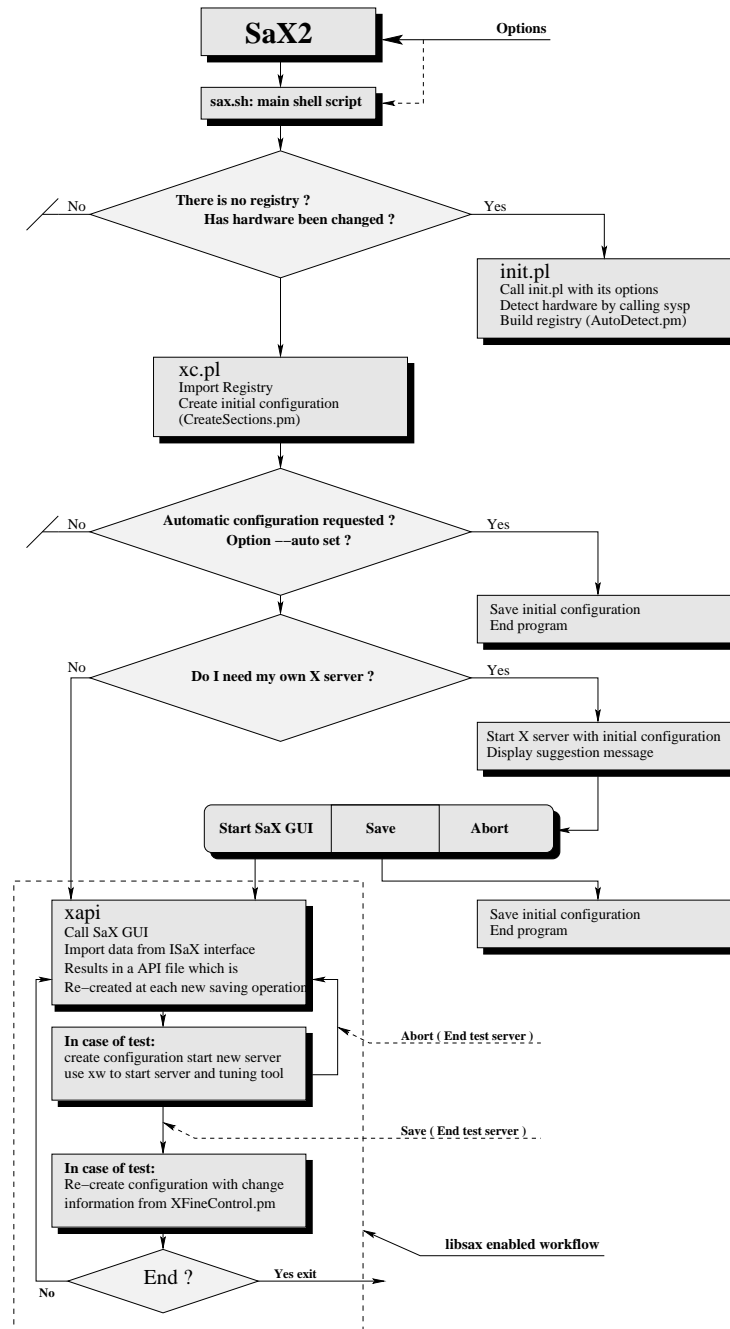


Figure 1.1: SaX2: Diagram of procedures

2 Sysp

Contents

2.1 Sysp Modules	13
2.2 Calling up sysp	14
2.2.1 Sysp Query	14
2.2.2 Sysp Scan	14

Sysp stands for **system profiler** and is an independent program for detecting hardware data based on libhd. Sysp is constructed modularly and saves once detected data in so-called perl DBM hash files. The data in these files can be read out and processed again through a sysp call. Detecting and saving information is a central part of *init.pl*. This action is carried out once by SaX2 during the initialization. Use is made of the sysp data, which as a whole makes up the SaX2 registry, at various points in the configuration process:

- In *xc.pl* to create the initial configuration.
- In *xapi* to make data visible in configuration dialogs.

Information which was detected by individual sysp modules is stored in the directory

- /usr/share/sax/sysp/rdbms

and re-read from there as well.

2.1 Sysp Modules

In the course of development for SaX2 the following sysp modules were written:

- **Keyboard**
This module determines, using the KEYTABLE variable in /etc/sysconfig/keyboard, which type of protocol can be used under X11. With systems such as Sparc, for example, a direct hardware scan is started to detect this data.
- **Mouse**
This module determines the connection and protocol of all pointer devices connected to the system. A condition of this is that these are PnP-capable pointer devices, which also provide a checkback signal.
- **Server**
This module determines all PCI/AGP graphics cards which are inserted in the PCI or AGP bus. Furthermore, it attempts to set an X11 R6 v4.x module allocation by means of the unique vendor and device ID's of these cards, as well

as finding special options and extensions. If a single ISA card is used, then it attempts to find out, by registry dump, which X11 R6 v4.x module can be responsible for this. If there is a mixture of AGP, PCI and ISA cards, the ISA cards will definitely not be automatically detected.

- **Xstuff**

This module collects card-specific data, such as video memory, RamDAC speed, possible resolutions per DDC and the synchronization range of the monitor in accordance with the resolutions detected. If there is more than one physical graphics card a minimal X11 configuration is created from the result of the preceding sysp module, and the X server is started for a brief test run. The output of the server is then processed and provides the above-mentioned information.

2.2 Calling up sysp

Calling up sysp does not have to be regulated in a script, but can also be run by hand. For this case, two modes should be differentiated:

- Starting a query
- Starting a hardware detection (scan)

2.2.1 Sysp Query

The following command can be used to query data:

```
sysp -q <ModuleName>
```

2.2.2 Sysp Scan

The following command can be used to start a hardware scan:

```
sysp -s <ModuleName> [ -o options ]
```

When scanning, it is also possible, using the option `-o`, to pass on options for the scan. The option list always contains a colon as a separator. An example of such a command could look like this:

```
sysp -s server -o all:0=mga,1=ati
```

3 ISaX

Contents

3.1 ISaX Modules	15
3.2 Calling up isax	16
3.3 Creating configurations with isax	16

ISaX stands for **interfacing sax** and is a program to transport information from or to the engine. It is possible to query information from isax as well as give information to isax which is then able to create or modify the X11 configuration. If asking isax for data there are two possible data sources:

- The auto probed values from the sax registry
- The current configuration represented by the file */etc/X11/xorg.conf*

3.1 ISaX Modules

The option **-b** is used to obtain data from the sax registry. If no option is set the current configuration is used. The engine of SaX is based on seven sections which can be queried and manipulated:

- **Keyboard**
defines all information about the core keyboard
- **Mouse**
defines all information about mice
- **Card**
defines all information about the graphics hardware
- **Desktop**
defines all information about the desktop which includes settings like resolution and colordepth
- **Path**
defines all information about search paths for fonts and special flags for the X-Server
- **Layout**
defines all information about the server layout which includes information about multihead arrangements as well as priority lists for keyboard and pointers
- **Extensions**
defines all information about new X-Server extensions

3.2 Calling up isax

Calling up isax does not have to be regulated in a script, but can also be run by hand. The following command can be used to query data about the graphics hardware from the current configuration:

```
/usr/sbin/isax -l Card
```

When obtaining data from the SaX registry the call for graphics hardware will look like this:

```
/usr/sbin/isax -l Card -b
```

3.3 Creating configurations with isax

As mentioned in the first section of this chapter isax can be used to create or modify X11 configurations as well. To do this it is necessary to specify a so called **apidata** file. Detailed information and an example of such a file can be found in appendix C (The Variables API File). The important point here is to mention that the information for reading and/or writing data with isax provides a common interface for all operations which can be done with SaX2. The following command can be used to create a new configuration from the information specified in the sample file */var/lib/sax/apidata*:

```
/usr/sbin/isax -f /var/lib/sax/apidata -c /tmp/myconfig
```

When only modifying based on the currently installed configuration the command will look like the following. The apidata file in this case contains only information about the changes which should be migrated with the current configuration data.

```
/usr/sbin/isax -f /var/lib/sax/apidata -c /tmp/myconfig -m
```

Both examples will create an output file specified with the option **-c**. In this case this results in a file named **/tmp/myconfig**.

4 libsax

Contents

4.1	Diagram of libsax procedures	17
4.2	SaX Import Classes	18
4.3	SaX Manipulation Classes	19
4.4	SaX Export Classes	19
4.5	libsax classes and inheritance	20

Between the SaX2 GUI and the SaX2 engine an interface exists to transport the information from the GUI into the engine which is then able to create or modify the X11 configuration. This interface is called **ISaX**. The ISaX interface is the basis for the C++ library explained here. The library is divided into the following major areas:

1. **Init:**
Provide session cache
2. **Import:**
Provide classes to obtain all necessary information
3. **Manipulate:**
Provide classes to manipulate imported data
4. **Export:**
Provide classes to create or modify the X11-Configuration

The programmer starts with an `init()` sequence to be able to access the automatically generated configuration suggestion which is based on the hardware detection. After this it is possible to import, manipulate and export information. The task of initializing is done by **init.pl** explained in chapter 1.1 and shown as black box in the SaX2: Diagram of procedures.

4.1 Diagram of libsax procedures

The following diagram provides a more detailed description of what `init.pl` does and how **isax** interferes between the autoprobe data and the actual configuration file `/etc/X11/xorg.conf`.

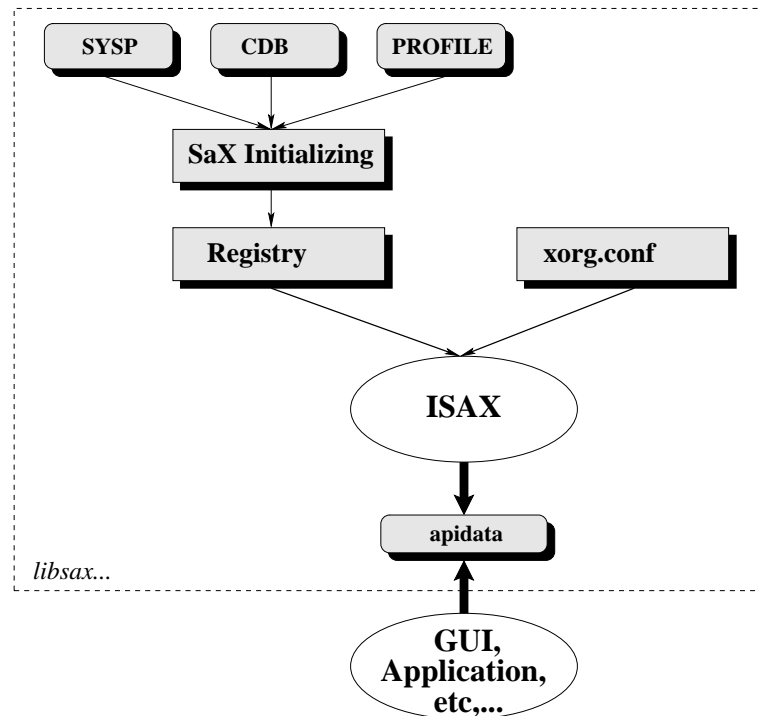


Figure 4.1: libsax diagram of procedures

4.2 SaX Import Classes

- **ISAX**
The data of the currently used X11 configuration or the automatically generated configuration suggestion can be obtained by using the ISaX interface respectively by using the **isax** command. The information is stored into **SaX-Import** objects.
- **SYSP**
Information near to the hardware like PCI IDs, BusID, etc... can be obtained by using the Sysp interface respectively by using the **sysp** command. The information is stored into **SaXImportSysp** objects
- **CDB**
Manually maintained data referring stuff like Mice, Tablets, Graphics Cards, Monitors, etc... can be obtained from the exported files of the CDB (Component Data-Base). The information is stored into **SaXImportCDB** objects
- **PROFILE**
Profile information for a specific card can be obtained using a special ISaX interface script called *createPRO.pl*. The information given here is stored into a **SaXImportProfile** object.

4.3 SaX Manipulation Classes

Once the needed data has been imported the programmer can start to manipulate it. The information from the SYSP, CDB and PROFILE methods are helpful but only the data concerning the ISAX import are used for the later export respectively the later configuration file. If the programmer is familiar with the ISaX interface there would be no need to provide further manipulation classes but to make it comfortable the library should provide SaXManipulation... classes to be able to do the common configuration tasks easily. At this point we need to define what the common configuration tasks are. Currently the following manipulation classes are specified:

- Baseclass: **SaXManipulateCard**
Handle hardware related configuration settings including stuff like graphics drivers options etc...
- Baseclass: **SaXManipulateDesktop**
Handle desktop related configuration settings including stuff like resolution colordepth etc...
- Baseclass: **SaXManipulateDevices**
Handle device creation including stuff like creating or deleting a desktop adding input devices etc...
- Baseclass: **SaXManipulateExtensions**
Subclass: *SaXManipulateVNC*
Handle X-Server extensions for example VNC
- Baseclass: **SaXManipulateKeyboard**
Handle keyboard configuration settings
- Baseclass: **SaXManipulateLayout**
Handle layout configuration settings of multihead environments
- Baseclass: **SaXManipulatePath**
Handle fontpath serverflags and server modules configuration settings
- Baseclass: **SaXManipulatePointers**
Subclass: *SaXManipulateMice, SaXManipulateTablets, SaXManipulateTouchscreens*
Handle pointer devices including stuff like mice tablets or touchscreen configuration settings

After all manipulations to the **SaXImport** objects have been done the programmer needs to add the affected SaXImport objects to a **SaXConfig** object which handles the export.

4.4 SaX Export Classes

the library provides a **SaXExport** and a **SaXConfig** class whereas the SaXConfig class is able to include multiple SaXImport objects. The SaXConfig object will create a corresponding SaXExport object for each SaXImport object bound to the SaXConfig object. With this list of SaXExport objects it is possible to create a new - or modify an existing X11 configuration.

4.5 libsax classes and inheritance

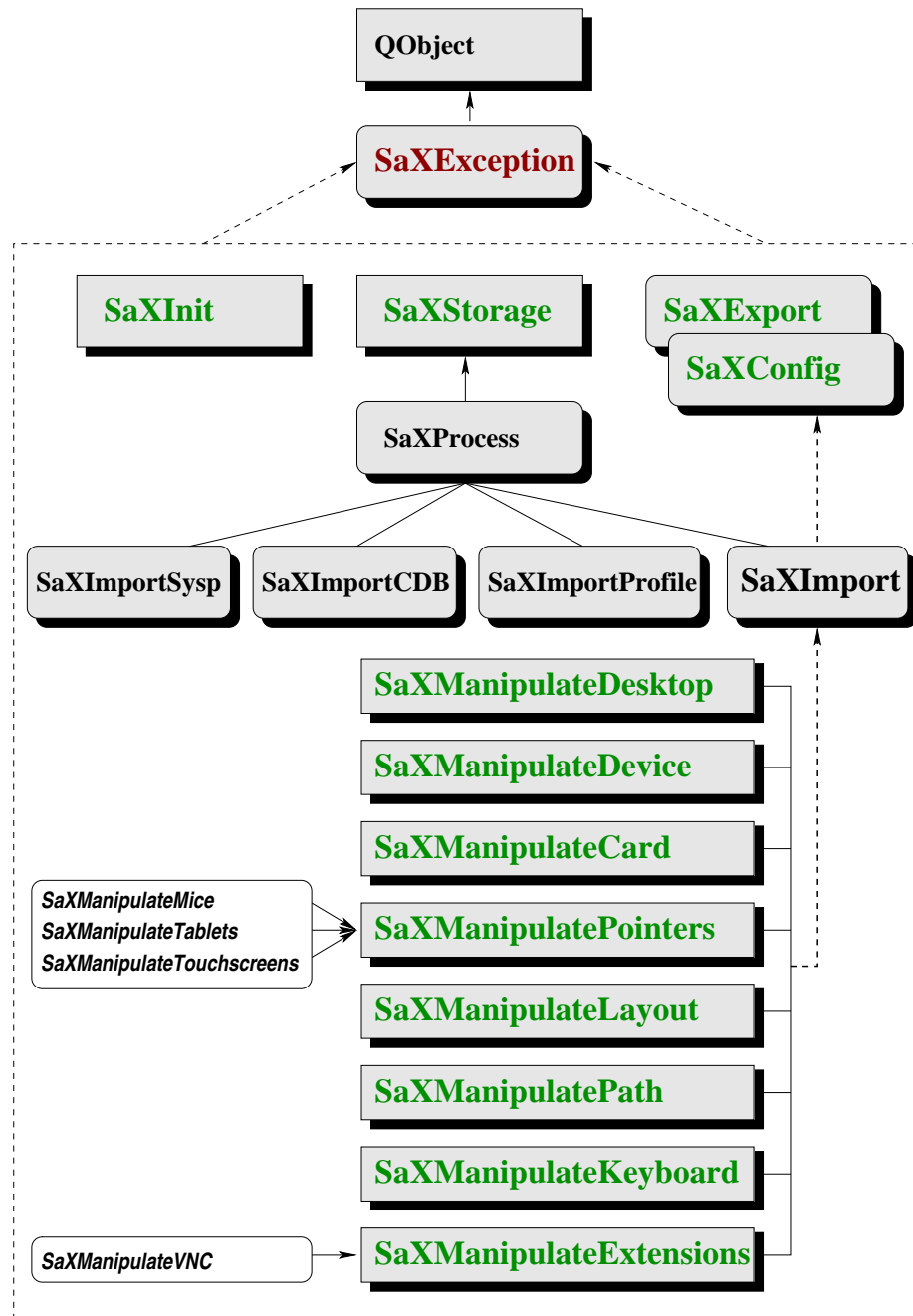


Figure 4.2: libsax: object reference

5 libsax - Error Handling

Contents

5.1 Exception handling	21
5.2 Traditional error functions	23

There are two possible methods to handle errors from the library:

- **Exception handling**
asynchronous method using callback functions to handle the errors. The programmer needs to inherit from `SaxException` and bind an instance of this class to an instance of a `Sax*` class which itself inherits from `SaxException` as well.
- **Traditional error functions**
synchronous method calling error methods after each call to check if the return code is ok or not.

5.1 Exception handling

Every `Sax` class which is able to throw exceptions inherits from the `SaxException` class and therefore provides an interface to make use of the signal/slot concept provided by Qt. If an error occurs the library will emit a signal which can be caught. The following example will illustrate that:

exception.h

```
#include <sax/sax.h>
class myException : public SaxException {
    Q_OBJECT

    public:
        myException ( SaxException* );

    private slots:
        void permissionDenied (void);
};
```

exception.cpp

```
#include <sax/sax.h>
#include "exception.h"
myException::myException (SaXException* mException) {
    QObject::connect (
        mException , SIGNAL ( saxPermissionDenied (void) ),
        this      , SLOT  ( permissionDenied (void) )
    );
}
void myException::permissionDenied (void) {
    printf ("_____Permission denied\n");
}
```

main.cpp

```
#include <sax/sax.h>
#include "exception.h"
int main (void) {
    SaXException().setDebug (true);

    SaXInit* init = new SaXInit;
    new myException (init);

    init->doInit();
}
```

main.pro

```
TEMPLATE = app
SOURCES += exception.cpp
SOURCES += main.cpp
HEADERS += exception.h
CONFIG += qt warn_on release
TARGET = testlib
unix:LIBS += -lsax
unix:INCLUDEPATH += -I /usr/X11/include
```

build with qmake

```
export QMAKESPEC=$QTDIR/mkspecs/linux-g++
export PATH=$PATH:$QTDIR/bin/qmake
qmake -makefile -unix -o Makefile main.pro
make
```

5.2 Traditional *error* functions

If using signals is not appropriate for the current language environment the programmer can call one of the following public error methods:

- `code = errorCode()`
- `info = errorString()`
- `value = errorValue()`
- `errorReset()`

Every SaX class which can throw an exception will provide these error functions. The following example show how to make use of the error functions instead of the exception handling:

main.cpp

```
#include <sax.h>

int main (void) {
    SaXInit* init = new SaXInit;
    ...
    printf ("%d : %s\n",
            init->errorCode(),
            init->errorString().ascii()
    );
}
```


6 libsax - Examples

6.1 New configuration...

The following example will create a new configuration based on the suggestion made by SaX. We will add a new resolution 1600x1200 and want a modeline for the mode to be created.

```
#include <sax.h>

int main (void) {
    SaXInit init;
    if (init.needInit()) {
        init.doInit();
    }
    SaXException().setDebug (true);
    QDict<SaXImport> section;
    int importID[7] = {
        SAX_CARD, SAX_DESKTOP, SAX_POINTERS,
        SAX_KEYBOARD, SAX_LAYOUT, SAX_PATH, SAX_EXTENSIONS
    };
    SaXConfig* config = new SaXConfig;
    for (int id=0; id<7; id++) {
        SaXImport* import = new SaXImport ( importID[id] );
        import -> setSource ( SAX_AUTO_PROBE );
        import -> doImport();
        config -> addImport (import);
        section.insert (
            import->getSectionName(),import
        );
    }
    SaXManipulateDesktop mDesktop (
        section["Desktop"],section["Card"],section["Path"]
    );
    if (mDesktop.selectDesktop (0)) {
        mDesktop.addResolution (24,1600,1200);
        mDesktop.calculateModelines (true);
    }
    config -> setMode (SAX_NEW);
    config -> createConfiguration();
}
```

6.2 Change current configuration...

The next example will change the current configuration to use 24 bit as default color depth.

```
#include <sax.h>

int main (void) {
    SAXException().setDebug (true);
    QDict<SaXImport> section;
    int importID[3] = {
        SAX_CARD,
        SAX_DESKTOP,
        SAX_PATH,
    };
    SaXConfig* config = new SaXConfig;
    for (int id=0; id<3; id++) {
        SaXImport* import = new SaXImport ( importID[id] );
        import -> setSource ( SAX_SYSTEM_CONFIG );
        import -> doImport();
        config -> addImport (import);
        section.insert (
            import->getSectionName(),import
        );
    }
    SaXManipulateDesktop mDesktop (
        section["Desktop"],section["Card"],section["Path"]
    );
    if (mDesktop.selectDesktop (0)) {
        mDesktop.setColorDepth (24);
    }
    config -> setMode (SAX_MERGE);
    config -> createConfiguration();
}
```

7 libsax - Thread safety

To be thread safe there are a view code points which needs a locking. The following list describes the serialized lock parts of the library:

- library included debug messages to STDERR are embedded into flockfile() / funlockfile() calls
- library initializing calls will lock each other using flock()
- library exporting code which creates the apidata files will apply an flock() during file creation

Referring to this the library can be used in a simultaneously way without crashing and without leaving the configuration in an inconsistent state. Of course it does not make much sense to simultaneously configure two different issues in such a case the last one will win. The following example will demonstrate a thread example including a simultaneously initialization.

```
#include <pthread.h>
#include <sax.h>

void* myFunction (void*);

int main (void) {
    pthread_t outThreadID1,outThreadID2;
    pthread_create (&outThreadID1, 0, myFunction, 0);
    pthread_create (&outThreadID2, 0, myFunction, 0);
    pthread_join (outThreadID1,NULL);
    pthread_join (outThreadID2,NULL);
    return 0;
}

void* myFunction (void*) {
    printf ("Checking cache...\n");
    SaXInit* init = new SaXInit;
    if (init->needInit()) {
        printf ("Initialize cache...\n");
        init->doInit();
    }
    printf ("%d : %s\n",
        init->errorCode(),init->errorString().ascii()
    );
    pthread_exit (0);
}
```


8 libsax - Language bindings

Contents

8.1 SWIG	29
8.2 Interface template file for libsax (SaX.i)	30
8.2.1 Interface explanations	32
8.3 Example: libsax used with perl...	32

libsax has been developed as a C++ written library which means including this library into languages providing an object model is a possible task whereas bindings to non object oriented languages requires a self written wrapper for accessing object methods.

8.1 SWIG

SWIG (Simple Wrapper Interface Generator) is a software development tool that simplifies the task of interfacing different languages to C and C++ programs. In a nutshell, SWIG is a compiler that takes C declarations and creates the wrappers needed to access those declarations from other languages including csharp, java, perl5, php4, python or tcl. Creating language bindings for libsax requires the following tasks:

- All libsax C++ header files must be available to create the binding
- C++ operator support is not available in many scripting languages. Because of this reason the binding should disable operator support and the library has to provide methods as well as operators.
- Typemaps for transforming the Qt types used within the library must be provided for each destination language.
- Qts Signal/Slot concept is not supported by the destination languages. libsax is using this mechanism to implement exception handling. As consequence only the traditional error handling is available for the bindings and the SaXException class needs to be wrapped within the bindings interface definition.

8.2 Interface template file for libsax (SaX.i)

The following template illustrate the steps which needs to be implemented to be able to map all libsax types into the destination language.

```
//=====
// Interface definition for libsax
//-----
#define NO_OPERATOR_SUPPORT 1
%module SaX
%{
#include "../sax.h"
%}
//=====
// SWIG includes
//-----
#include exception.i

//=====
// Typemaps
//-----
//=====
// Allow QString return types
//-----
// [ destination language dependant ]
// ...

//=====
// Allow QString refs as parameters
//-----
// [ destination language dependant ]
// ...

//=====
// Allow QDict<QString> return types
//-----
// [ destination language dependant ]
// ...

//=====
// Allow QList<QString> return types
//-----
// [ destination language dependant ]
// ...
```

```
//=====
// Exception class wrapper...
//-----
class SaXException {
    public:
        int    errorCode          ( void );
        bool   havePrivileges     ( void );
        void   errorReset         ( void );

        public:
        QString errorString      ( void );
        QString errorValue       ( void );

        public:
        void setDebug ( bool = true );
};
//=====
// ANSI C/C++ declarations...
//-----
#include "../storage.h"
#include "../process.h"
#include "../export.h"
#include "../import.h"
#include "../init.h"
#include "../config.h"
#include "../card.h"
#include "../keyboard.h"
#include "../pointers.h"
#include "../desktop.h"
#include "../extensions.h"
#include "../layout.h"
#include "../path.h"
#include "../sax.h"
```

8.2.1 Interface explanations

The interface file is divided into four *sections* which handles the following interfacing problems:

1. Module name and include files to be able to create the wrapper code. The namespace used here is called **SaX**
2. type mappings from C++ into the destination language. Currently perl,python,java and csharp types are supported.
3. Exception class wrapper which doesn't include the Qt signal/slot definitions
4. Declarations used to create an interface for the destination language. Referring to perl this information is used to create the appropriate SaX.pm file

8.3 Example: libsax used with perl...

The following examples will do the same as the last example from the Examples chapter; Changing the default colordepth of the current configuration to 24 bit.

```
use SaX;
sub main {
    my %section;
    my @importID = (
        $SaX::SAX_CARD, $SaX::SAX_DESKTOP, $SaX::SAX_PATH
    );
    my $config = new SaX::SaXConfig;
    foreach my $id (@importID) {
        $import = new SaX::SaXImport ( $id );
        $import -> setSource ( $SaX::SAX_SYSTEM_CONFIG );
        $import -> doImport();
        $config -> addImport ( $import );
        $section{$import->getSectionName()} = $import;
    }
    my $mDesktop = new SaX::SaXManipulateDesktop (
        $section{Desktop},$section{Card},$section{Path}
    );
    if ($mDesktop->selectDesktop (0)) {
        $mDesktop->setColorDepth (24);
    }
    $config -> setMode (SaX::SAX_MERGE);
    $config -> createConfiguration();
}
main();
```


9 XFine tuning

Contents

9.1 The XFine cache	33
9.2 The XFine tune hash	33
9.2.1 The <i>ImportXFineCache</i> flag	34

XFine in SaX2 represents both a module and an independent X11 application. The module **XFineControl.pm** is used within SaX2 to save changes in the image geometry and to write these to the configuration file.

9.1 The XFine cache

The **xfine** application writes this change information to the image geometry as a file in the directory:

- `/var/cache/xfine`

Per resolution a file is created with change information. The files are named according to the *SCREEN:XxY* convention. The format of the files has the following convention:

```
SCREEN:OLDMODE:NEWMODE:DACSPEED
```

When using **xfine** as a standalone application no changes are made to the actual configuration file, only if used within SaX2 the data written to `/var/cache/xfine` is processed.

9.2 The XFine tune hash

When SaX2 is using the cache data written by **xfine** the main task in using **XFineControl.pm** is in the creation of the so-called *tune* hash. This hash serves in SaX2 as a reference for already changed modelines and is checked with each test run. It contains the original modeline, the last changed modeline and the current modeline. By means of the timing values and the number of original modelines, a check is made on whether the tune hash needs to be newly created, or if it can serve as a reference.

9.2.1 The *ImportXFineCache* flag

To activate processing the cache data and creating the tune hash the following flag has to be set in the Desktop section of the ISaX interface file:

```
Desktop {  
    0 ImportXFineCache = yes  
    ...  
}
```

If using libsax the xfine cache is automatically included after a successful test of the X server. When testing the script `/var/lib/sax/createTST.pl` is called which will start the server and the tuning tool.

A Examples of Using the SaX2 Batch Mode

Contents

A.1 Interactive Mode	38
A.2 Profile Mode and Creating Profile Files	38

The batch mode in SaX2 allows you to make special settings directly after the hardware scan. This mode can be switched on in the *init.pl* stage. There are two different modes:

- Interactive mode
A shell is provided to enter commands.
- Profile mode
STDIN is read in and you can specify a profile file which contains shell commands.

Changes at this point directly influence the contents of the %var hash which is used to construct the registry and create the initial configuration. It is absolutely essential to understand the hash structure if you want to use this mode sensibly.

This structure is not a static form. It can be extended at will with the batch mode, but it is not clear that all data of the hash can also be used in the configuration, since simply everything in the hash can be included. The automatically created structure, when SaX2 is started, is built up as follows:

```
#-----#
# Files specification...                               #
#-----#
Files      ->    0  -> FontPath
Files      ->    0  -> RgbPath
Files      ->    0  -> ModulePath
Files      ->    0  -> LogFile

#-----#
# Module specification...                               #
#-----#
Module     ->    0  -> Load

#-----#
# ServerFlags specification...                           #
#-----#
```

```

ServerFlags -> 0 -> Option
ServerFlags -> 0 -> blank time
ServerFlags -> 0 -> standby time
ServerFlags -> 0 -> suspend time
ServerFlags -> 0 -> off time

#-----#
# Keyboard specification... #
#-----#
InputDevice -> 0 -> Identifier
InputDevice -> 0 -> Driver
InputDevice -> 0 -> Option -> Protocol
InputDevice -> 0 -> Option -> XkbRules
InputDevice -> 0 -> Option -> XkbModel
InputDevice -> 0 -> Option -> XkbLayout
InputDevice -> 0 -> Option -> XkbVariant
InputDevice -> 0 -> Option -> AutoRepeat
InputDevice -> 0 -> Option -> Xleds
InputDevice -> 0 -> Option -> XkbOptions

#-----#
# Mouse specification... #
#-----#
InputDevice -> 1 -> Identifier
InputDevice -> 1 -> Driver
InputDevice -> 1 -> Option -> Protocol
InputDevice -> 1 -> Option -> Device
InputDevice -> 1 -> Option -> SampleRate
InputDevice -> 1 -> Option -> BaudRate
InputDevice -> 1 -> Option -> Emulate3Buttons
InputDevice -> 1 -> Option -> Emulate3Timeout
InputDevice -> 1 -> Option -> ChordMiddle
InputDevice -> 1 -> Option -> Buttons
InputDevice -> 1 -> Option -> Resolution
InputDevice -> 1 -> Option -> ClearDTR
InputDevice -> 1 -> Option -> ClearRTS
InputDevice -> 1 -> Option -> ZAxisMapping
InputDevice -> 1 -> Option -> MinX
InputDevice -> 1 -> Option -> MaxX
InputDevice -> 1 -> Option -> MinY
InputDevice -> 1 -> Option -> MaxY
InputDevice -> 1 -> Option -> ScreenNumber
InputDevice -> 1 -> Option -> ReportingMode
InputDevice -> 1 -> Option -> ButtonThreshold
InputDevice -> 1 -> Option -> ButtonNumber
InputDevice -> 1 -> Option -> SendCoreEvents

#-----#
# Monitor specification... #

```

```

#-----#
Monitor      ->    0  -> Identifier
Monitor      ->    0  -> VendorName
Monitor      ->    0  -> ModelName
Monitor      ->    0  -> HorizSync
Monitor      ->    0  -> VertRefresh
Monitor      ->    0  -> Modeline          -> 0          -> 640x480
Monitor      ->    0  -> Option

#-----#
# Device specification...          #
#-----#
Device       ->    0  -> Identifier
Device       ->    0  -> VendorName
Device       ->    0  -> BoardName
Device       ->    0  -> Videoram
Device       ->    0  -> Driver
Device       ->    0  -> Chipset
Device       ->    0  -> Clocks
Device       ->    0  -> BusID
Device       ->    0  -> Option
Device       ->    0  -> Special          -> hw_cursor

#-----#
# Screen specification...          #
#-----#
Screen       ->    0  -> Identifier
Screen       ->    0  -> Device
Screen       ->    0  -> Monitor
Screen       ->    0  -> DefaultDepth
Screen       ->    0  -> Depth          -> 8          -> Modes
Screen       ->    0  -> Depth          -> 8          -> ViewPort
Screen       ->    0  -> Depth          -> 8          -> Virtual
Screen       ->    0  -> Depth          -> 8          -> Visual
Screen       ->    0  -> Depth          -> 8          -> Weight
Screen       ->    0  -> Depth          -> 8          -> Black
Screen       ->    0  -> Depth          -> 8          -> White
Screen       ->    0  -> Depth          -> 8          -> Option

#-----#
# ServerLayout specification...    #
#-----#
ServerLayout -> all  -> Identifier
ServerLayout -> all  -> InputDevice    -> 0          -> id
ServerLayout -> all  -> InputDevice    -> 0          -> usage
ServerLayout -> all  -> InputDevice    -> 1          -> id
ServerLayout -> all  -> InputDevice    -> 1          -> usage
ServerLayout -> all  -> Screen         -> 0          -> id
ServerLayout -> all  -> Screen         -> 0          -> top

```

```
ServerLayout -> all -> Screen -> 0 -> bottom
ServerLayout -> all -> Screen -> 0 -> left
ServerLayout -> all -> Screen -> 0 -> right
```

A.1 Interactive Mode

The interactive mode provides the user with the following basic grammar:

```
key -> key ->...-> key [ = ( value | ${variable} ) ]
$variable = ( string | <key sequence> )
```

- **!help**
The *!help* command prints a small help text.
- **!remove <sequence>**
The *!remove* command removes the given sequence which is a key path to a specific value or subtree. In case of a subtree the tree will be removed. In case of a value the value is set to an empty string
- **exit**
Ends interactive mode and saves all changes.

A.2 Profile Mode and Creating Profile Files

In some very specific cases it may be necessary for a profile for a card to be created. SaX2 provides a mechanism which allows you to include known profiles in the SaX2 package. These profile files are located under:

- /usr/share/sax/profile/

If there is an entry in /usr/share/sax/sysp/modules/maps/Identity.map which starts with PROFILE=... then the profile for this card is integrated. The profile files essentially consist of variable values, as the following example illustrates:

```
# /.../
# set some fixed values
# ----
Device -> [X] -> Driver = fglrx
Desktop -> [X] -> CalcModelines = no
Monitor -> [X] -> CalcAlgorithm = XServerPool

# /.../
# save the 16bit Modes into a variable
$Modes = Screen -> [X] -> Depth -> 16 -> Modes

# /.../
```

```
# save first 16bit mode as 24bit mode
# ----
Screen  -> [X] -> Depth -> 24 -> Modes = ${Modes[0]}

# /.../
# copy 16bit modes to 8bit modes
# ----
Screen  -> [X] -> Depth -> 8 -> Modes  = ${Modes}

# /.../
# remove all Modelines from the Monitor section
# ----
!remove Monitor -> [X] -> Modeline
```

Since it is never known in advance for which monitor, screen or device the new setting is to be made, it is possible to set a place holder in the form of an **[X]** mark, otherwise a number must be entered at this point.

B Examples of the Problem of Options

1. Four cards are inserted, of which the last 3 should be used. For cards 2 and 4, modules should be set. In this case the command would be:

```
sax2 -c 1,2,3 -m 0=mga,2=nv
```

The numbering of the chips begins with 0, as does the order of modules. The device 0 is connected to chip 1, device 1 to chip 2, device 2 to chip 3.

2. Two cards with a total of 4 chipsets are inserted. Three of the 4 chips are on the first card, the other one on the 2nd card. A multihead setup should be created which in each case uses the first chip on both cards:

```
sax2 -c 0 3
```

If modules need to be allocated for these chipsets, then it should be noted that these are detected as card 0 and card 1 and consequently the module option needs to be set to 0 and 1:

```
sax2 -c 0,3 -m 0=mga,1=glint
```


C The Variables API File

Contents

C.1 API File Keyword Explanations	43
C.2 API File Overview Tables of all Possible Variables	44
C.2.1 Path Variables: Section Files, Modules and Server Flags . . .	44
C.2.2 Card Variables: Device Section	45
C.2.3 Mouse Variables: InputDevice Section	45
C.2.4 Desktop Variables: Section Monitor,Modes and Screen . . .	46
C.2.5 Layout Variables: Section ServerLayout	46
C.2.6 Keyboard Variables: InputDevice Section	47
C.3 Example of API Variables	48

In this chapter all variables which may be found in a variables API file are explained. The variables API is normally created by SaX2's own configuration interface, but this is not absolutely necessary. As soon as a variables API exists, this can be used to create a configuration file. In conjunction with the *ImportAPI* module and the *CreateSections* module, an X11 configuration can be created from the API file.

C.1 API File Keyword Explanations

The individual tables in their format description use various keywords, which are explained in the following list.

- **String:**
Refers to any sequence of characters which are **not** embedded in quotation marks.
- **Subsection:**
Refers to the name of a subsection in the X11 configuration. This word is followed by an entry in the subsection.
- **Flagname:**
Refers to the name of a server flag. This is followed by the value for the server flag.
- **Integer:**
Refers to a whole number. Is usually used in connection with variables for defining size.
- **ButtonX:**
Refers to the number of the mouse button which should be adapted for the wheel movement in the X axis.

- **ButtonY:**
Refers to the number of the mouse button which should be adapted for the wheel movement in the Y axis.
- **Clocks:**
Refers to a list separated by spaces. with clock values. These values can be whole numbers as well as fractions.
- **Mode:**
Refers to a resolution string in the form of [Xpixel]x[Ypixel]
- **Algorithm:**
Refers to the two possible algorithms *CheckDesktopGeometry* or *IteratePrecisely*.
- **Modeline:**
Refers to a modeline string, starting with a name in quotation marks which must match a *resolution string*, followed by the RamDAC speed and 8 further parameters.
- **Sync:**
Refers to a frequency range. This is specified through a number range in the format: [Minimum] - [Maximum]
- **Left,Right,Up,Down**
Refers to a screen position. The value matches an identifier string in accordance with the monitor. If there is no screen at this point then <none> should be entered.

C.2 API File Overview Tables of all Possible Variables

Below, all variables which may appear in an API file are listed in tabular form. The contents of each table refer to a section in the API file. It should be noted that one API section may cover a number of xorg.conf sections.

C.2.1 Path Variables: Section Files, Modules and Server Flags

Identifier	Variable	Format
Integer	FontPath	String,String,String,...
Integer	RgbPath	String,String,String,...
Integer	ModulePath	String,String,String,...
Integer	ModuleLoad	String,String,String,...
Integer	Extmod	Subsection,String\nSubsectio,String,...
Integer	SpecialFlags	Flagname,String\nFlagname,String,...
Integer	ServerFlags	String,String,String,...

C.2.2 Card Variables: Device Section

Identifier	Variable	Format
Integer	Identifier	String
Integer	Driver	String
Integer	Memory	Integer
Integer	BusID	String
Integer	Vendor	String
Integer	Name	String
Integer	DacChip	String
Integer	GraphicsChip	String
Integer	ClockChip	String
Integer	DacSpeed	String
Integer	Clocks	Clocks,Clocks,...
Integer	Option	String,String,...
Integer	RawData	String,String,...
Integer	MaxDac	Integer

C.2.3 Mouse Variables: InputDevice Section

Identifier	Variable	Format
Integer	Identifier	String
Integer	Driver	String
Integer	Protocol	String
Integer	Device	String
Integer	Baudrate	Integer
Integer	Samplerate	Integer
Integer	Emulate3Buttons	Yes No
Integer	Emulate3Timeout	Integer
Integer	ChordMiddle	Yes No
Integer	MinX	Integer
Integer	MaxX	Integer
Integer	MinY	Integer
Integer	MaxY	Integer
Integer	ScreenNumber	Integer
Integer	ReportingMode	String
Integer	ButtonNumber	Integer
Integer	ButtonThreshold	Integer
Integer	SendCoreEvents	Yes No
Integer	ClearDTR	Yes No
Integer	ClearRTS	Yes No
Integer	ZAxisMapping	Off None ButtonX ButtonY X Y
Integer	ZAxisNegMove	Off ButtonX
Integer	ZAxisPosMove	Off ButtonY
Integer	Vendor	String
Integer	Name	String
Integer	TabletMode	String
Integer	TabletType	String

C.2.4 Desktop Variables: Section Monitor,Modes and Screen

Identifier	Variable	Format
Integer	Identifier	String
Integer	Device	String
Integer	Monitor	String
Integer	VendorName	String
Integer	ModelName	String
Integer	Virtual	Integer Integer
Integer	Visual	String
Integer	HorizSync	Sync
Integer	VertRefresh	Sync
Integer	MonitorOptions	String,String,...
Integer	ScreenOptions	String,String,...
Integer	Modelines	Modeline,Modeline,...
Integer	SpecialModeline	Modeline,Modeline,...
Integer	ColorDepth	Integer
Integer	CalcModelines	Yes No
Integer	CalcAlgorithm	Algorithm
Integer	ViewPort	Integer Integer
Integer	ScreenRawLine	String,String,...
Integer	Modes:4	Mode,Mode,...
Integer	Modes:8	Mode,Mode,...
Integer	Modes:15	Mode,Mode,...
Integer	Modes:16	Mode,Mode,...
Integer	Modes:24	Mode,Mode,...
Integer	Modes:32	Mode,Mode,...
Integer	ImportXFineCache	Yes No

C.2.5 Layout Variables: Section ServerLayout

Identifier	Variable	Format
Integer	Identifier	String
Integer	Keyboard	String
Integer	InputDevice	String,String,..
Integer	Xinerama	On Off
Integer	Screen:<Identifier>	Left Right Up Down

C.2.6 Keyboard Variables: InputDevice Section

Identifier	Variable	Format
Integer	Identifier	String
Integer	Driver	String
Integer	Protocol	String
Integer	XkbRules	String
Integer	XkbModel	String
Integer	XkbLayout	String
Integer	XkbVariant	String
Integer	XkbOptions	String,String,...
Integer	AutoRepeat	String
Integer	Xleds	String
Integer	XkbDisable	Yes None
Integer	VTSysReq	Yes None
Integer	VTInit	String
Integer	ServerNumLock	Yes None
Integer	LeftAlt	String
Integer	RightAlt	String
Integer	ScrollLock	String
Integer	RightCtl	String
Integer	XkbKeyCodes	String

C.3 Example of API Variables

```
Keyboard {
  0 Protocol      = Standard
  0 XkbLayout     = de
  0 Identifier    = Keyboard[0]
  0 XkbModel      = pc105
  0 XkbVariant    = nodeadkeys
  0 Driver        = kbd
}
Mouse {
  1 ZAxisMapping  = 4 5
  1 Driver        = mouse
  1 Device        = /dev/input/mice
  1 ButtonNumber  = 5
  1 Vendor        = Sysp
  1 Identifier    = Mouse[1]
  1 Name          = Autodetection
  1 Protocol      = imps/2
}
Card {
  0 Name          = RivaTNT
  0 Identifier    = Device[0]
  0 BusID         = 1:0:0
  0 Driver        = nv
  0 Vendor        = Nvidia
}
Desktop {
  0 VertRefresh   = 50-160
  0 Device        = Device[0]
  0 ModelName     = Vision Master Pro 450 (A901HT)
  0 CalcModelines = yes
  0 Identifier    = Screen[0]
  0 ColorDepth    = 16
  0 Monitor       = Monitor[0]
  0 Modes:16      = 1800x1350,640x480
  0 HorizSync     = 27-115
  0 VendorName    = Iiyama
}
Path {
  0 ServerFlags   = AllowMouseOpenFail
  0 FontPath      = /usr/lib/X11/fonts/misc:unscaled
  0 ModuleLoad    = dbe,type1,speedo,extmod,freetype
}
Layout {
  0 Screen:Screen[0] = <none> <none> <none> <none>
  0 InputDevice     = Mouse[1]
  0 Keyboard        = Keyboard[0]
  0 Identifier      = Layout[all]
}
Extensions {
}
```


Glossary

SaX2

Is an abbreviation for SuSE advanced X-configuration SaX2 is available for X11 R6 from version 3.3.3 onwards.

Device File

The interface between the functions of a driver and the access to these functions is formed by a device file. By means of the major and minor number of this file (also called node), allocation is made to a specific driver.

Device Node

Another term for *device file*.

/etc/sysconfig/...

Contains configuration and start options for all services of the installed system.

batchmode

The batch mode stands for the concept of batch processing, and symbolizes a series of actions which are processed in the form of a stack. In SaX2 the batch mode is a kind of command interface into which you can enter commands or define variables for later use. The batch mode in SaX2 can be controlled automatically, or via a file.

Index

A

API file examples 48

appendix

API file 43

batch-mode examples 35

start examples 41

D

diagram of procedures 11

I

init.pl 6

ISaX 15

call up 16

L

libsax 17

O

options 7

S

Section

Device 44

files 44

InputDevice 45

Modes 45

module 44

Monitor 45

Screen 45

serverflags 44

ServerLayout 46

Sysp 13

call up 14

Module 13

X

xc.pl 6

xw 7