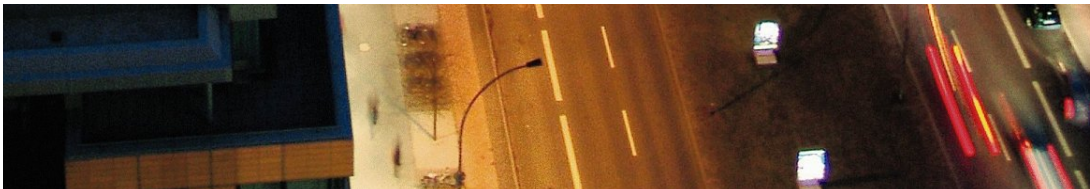
Sitraffic® sLX V 1.0

User's Manual
A001

Intelligent Traffic Systems

SIEMENS



Contents

Abbreviations

Abbreviation	Explanation
SOffP	Switch-off point
SOnP	Switch-on point
GSP	Best point of switching
JAUT (scheduler)	12 month automatic routine
UZP	Cycle time point

Introduction

Sitraffic sLX is latest controller technology for the Sitraffic sX control unit. It is intended for:

- Foreign markets with simple traffic requirements
- State highway departments

The primary Sitraffic sLX requirements include:

- Simple and fast supply of traffic dependency
- Planning and supply of traffic dependency by staff with little traffic technology knowledge is possible

Sitraffic sLX is a stage controller with easy-to-use traffic dependency and which can only run on the Sitraffic sX control unit.
The control unit works primarily with data from the basic supply and only requires very little Sitraffic sLX specific parameters. Data is edited and supplied into the control unit via Sitraffic sCore.

1. Cornerstones of Sitraffic sLX

1.1. What Sitraffic sLX can do

- Operating modes supported: OCIT Control Center, local JAUT, local operation
- Supports the same number of signal groups and detectors as in the Sitraffic sX hardware expansion
- Controlling of an entire intersection
- Traffic effects with mandatory and requested stages, with the calculation capability throughout the minimum and maximum stage duration
- Sitraffic sLX makes uses of stage-oriented signal plans for signaling.
- Flexible number of stages and stage transitions
- Stage transitions are generated automatically in Sitraffic sCore

1.2. Basic conditions for Sitraffic sLX

The following agreements apply with regard to planning

- Sitraffic sLX can only run for stage-oriented signal plans.
- The switching on point, best point of switching, and switch off point are referred to as cycle time point. This is the point at which the cycle time stage begins.
- The cycle time stage exists in all signal plans. The ON, OFF and cycle time (signal plan and operating modes) occurs in the cycle time stage.
- The cycle time stage is a mandatory stage.
- The signal plans may have different stage sequences, however the cycle time stage must be identical.

- Generally, all possible stage transitions are calculated automatically in the Sitraffic sCore supply tool without observing the minimum green and the minimum red times.

  - With the parameter "increased pedestrian protection" set by default it is guaranteed that pedestrians that are walking at the time of flowing vehicle traffic are given the green light at the same time.
    This does not apply if green is delayed due to decreased intergreen times.

  - The planner / user does not have the capability to edit the stage transitions.

1.3. Comparison of Sitraffic sLX Performance Features

The following differences apply for Sitraffic sLX as compared to other stage-oriented traffic-control methods such as PDM or SL:

- No partial intersection (only 1 total intersection)
- No master plans, however coordination operation throughout the distributed time
- Stages not requested are skipped
  the time gained may be distributed to the previous and/or subsequent stage.
- No partial stage transitions
- No parallel stages
- No alternative stages
- No varying transition signals for a signal group
- No option to edit stage transitions, because they are generated automatically in Sitraffic sCore.
- Stage transitions are configured without minimum times
- No additional programming required from the user

- The option to record PT via parallel detector inputs. The PT is treated in the same way as IT, so
  - No PT reporting points are recorded,
  - No PT is logged off,
  - No travel time counters are kept
  - No PT memory is needed.

2. Editing Sitraffic sLX

Editing is done with Sitraffic sCore. The required Sitraffic sLX parameters can be found in the parameter object detectors and signal programs.
This chapter contains a short description of the parameters necessary for Sitraffic sLX. More details are provided in the Chapter "Procedure in Sitraffic sLX ".

2.1. Parameter object detectors

This is where detectors are assigned and the corresponding signal groups and traffic-related request and / or calculating function occurs.

- Up to two signal groups can be assigned to one detector.
- One signal group can use a random number of detectors for requesting / calculating.

2.2. Parameter object signal programs

As with the definition of the stage fixed-time signal plan, in a first step the requested stage sequence and cycle time stage are defined.

- Stages that should only switch upon request are marked.
- Using arrows in the line Request, the user can define how the time gained by skipping stages can be distributed (distributed time).
  It can be added to the minimum and to the maximum stage time of the ongoing and/or the next stage to be switched.
  If no parameter is set, the time is forwarded to the cycle time stage on synchronous systems.
- The "Calculation" and "Minimum stage duration" parameters are used for the calculation stages. The minimum stage duration is always maintained. The calculation between the minimum and the maximum stage duration depends on the traffic situation.
  Cancelling calculation prematurely will lead to an earlier occurrence of the cycle time stage.

3. Controlling with Sitraffic sLX

3.1. Processing the stages

Principal processing:

- The cycle time stage runs after the system is switched on or after a signal plan change.
- The next stage sequence in the signal plan specifies in which order the stages can be controlled.
- Mandatory stages (stages without a request ID) are switched in each cycle, whereas request stages are only switched if prompted.
  If parameters are set accordingly, a calculation can be performed in both stage types.
- The next stage request is issued at the very latest at the end of the ongoing stage.

Details about the Sitraffic sLX sequence are provided in the following chapters.

3.1.1. Cycle time stage

The cycle time stage has special functions.

- The cycle time is at the beginning (first second) of this stage. The signal plan change and synchronization take place in this stage at this time. This is why this stage is also referred to as the synchronizing stage.
- The cycle time stage is a mandatory stage and is the same for all signal plans.
- The cycle time stage can be calculated (up to the maximum stage duration).

3.1.2. Determining the next stage

The next stage in the sequence is read based on the current stage. This means:

- If the next stage is a mandatory stage, it is switched next.
- If the next stage is a request stage, then:
  - if the stage is requested (more details in Chapter "Requests") and the deadline for the request has not been exceeded, then the next stage is found; this is switched next.
  - The stage was not requested. The stage is skipped and the next stage in the stage sequence is read. Further verification occurs as described above.
- There are AP values "currentStageNo" and "nextStageNo" for the current and requested stage. For more information, see Chapter "Diagnostics".

3.1.3. Calculating the time to start the stage transition

- The stage transition into the next calculated stage starts at the end of the ongoing stage (cancelling calculation (see Chapter "Calculation") or maximum stage duration reached).

3.1.3.1. Basic conditions for starting / ending stage transitions

- A check is performed at the start of stage transitions whether the protection times such as minimum and intergreen times were observed. The following stage transitions or stages are included in the verification. The start of the stage transition into the next stage will be delayed for as long as the protection times are not observed.
- Sitraffic sLX will not issue any more stage requests for the time of a stage transition.

3.2. Requests

3.2.1. Generating detector request flags

In order to generate detector request flags, a parameter must be configured in the "Detectors" supply object.

- At the time of parameter configuration:
  - Request detectors are marked (column Request)
  - Signal groups are assigned to the detector.
    - Two signal groups (for request and for calculation) can be assigned to one detector.
    - One signal group may have several request detectors.
  - The times for "Delete after end of green time" are assigned by Sitraffic sCore automatically. "Amber time" is transferred to the signal group implicitly.
- A defective request detector (hardware or software monitoring) triggers a request.
- A request flag is generated in the current stage in order to decide in which stage the system should change to.
  If the next stage is a mandatory stage, the request flag is not generated.
- The "tailback" function is not supported.
- The detector request flag is available for 96 detectors as an AP value with the designation "detDemTrg". For more information, see Chapter "Diagnostics".

3.2.2. Request stages

- Parameters must be configured in the supply object "Signal programs" for request stages.
  - The ID for each stage is set in the line "Request".
  - In addition, the parameters (arrows on the left and right of the request box) are used to decide how the time gained by skipping a

request stage should be distributed.
For more information, see Chapter "Passing the time gained due to skipped stages"

- Request stages are only switched if a request for the stage exists
- Request stages must include at least one signal group with at least one request detector and the stage "green".
- Request stages can also calculate

3.2.2.1. Passing the time gained due to skipped stages

- When request stages are skipped, the time gained (distribution time) can be added to the minimum and to the maximum stage time of the ongoing and / or the next stage to be switched into (defined with parameters).
- Definition of time gained:
  Duration of the stage transition in the request stage + maximum stage duration of the skipped stage + duration of the stage transition of the skipped stage in the next stage - duration of the stage transition of the current stage in the next stage to be switched into
- If the time gained should be added to the stage times of the ongoing or the next stage to be switched into, this stage will receive 100% of the time.
- If the gained time should be added to the stage times of the current and the next stage to be switched into, each stage will receive 50% of the time. The rest of a Modulo 2 Division is assigned to the subsequent stage.
- If the time gained is added to the current stage (irrespective of whether 100% or 50%), then the deadline for showing the request stage in the current cycle is reached as soon as the stage duration of the current stage is greater than its configured maximum stage time parameter (without gained time).
  The maximum stage time is either a parameter (if the stage is requested after the current stage) or a calculated value (if between the current stage and the requested stage a stage has been skipped)

- The stage that is assigned the time does not need to be a calculation stage.

- Several request stages may occur one after the next.

- The generated distribution time may be shown as AP values. In so doing, not all of the distribution times are shown, but instead only the distribution time used in the current stage.
  The values for the minimum and for the maximum stage times, incl. the distribution time and the current distribution time for the ongoing stage, are available.
  For more information, see Chapter "Diagnostics".

3.2.3. Creating stage request flags

The stage request flag is updated by the second in the current stage. It contains the stage number for the next stage. The following variations are possible:

- If the next stage is a mandatory stage, its stage number is entered.

- If the next stage is a request stage, a check is performed based on the detector request flag to determine which detectors or signal groups are currently requesting.

  - If one of these requested signal groups is set to the "green time" state in the next stage, the stage request flag is set to this stage number.

  - If there is no request for this stage, the next stage is checked in the sequence until a next stage is determined into which the change can take place. The stage number of that stage is then entered in the stage request flag.

- For signal plans with a constant stage (device remains in the cycle time stage without request), the current stage number is entered for as long as no request is issued.

- The stage request flag is available as an AP value with the designation "stgDemNext". For more information, see Chapter "Diagnostics".

3.3. Calculations

3.3.1. Generating the detector calculation flag

In order to generate detector calculation flags, a parameter must be configured in the "Detectors" supply object.

- At the time of parameter configuration:
  - Calculation detectors are flagged (checkmark in the column Calculation)
  - Signal groups are assigned to the calculation detectors.
    - Two signal groups (for request and for calculation) can be assigned to one detector.
    - One signal group may have several calculation detectors.
- The calculation is performed dynamically using the detector values LS and LU. The time gap values are assigned in Sitraffic sCore automatically with 2.5 seconds.
- A defective calculation detector (hardware or software monitoring) triggers a calculation.
- The generation takes place after a minimum stage time until the calculation is cancelled or until the maximum stage time is reached.
  - Signal groups that are switched to "green" in the last second of the stage transition cannot be calculated in the first second of the stage.
    Important for stages with a minimum stage duration of 0 seconds.
- The detector calculation flag is available for 96 detectors as an AP value with the designation "detExtTrg". For more information, see Chapter "Diagnostics".

3.3.2. Calculation stages

- The calculation range of the stage is the difference between the minimum stage time and the maximum stage time. Parameters must be configured in the supply object "Signal programs" for calculation stages.

- Calculation stages are marked in the optional parameters "Calculation" and "Minimum stage duration".
- Parameters exist for each stage and signal plan.
- If the configuration is not supplied, then the stage is not a calculation stage and the parameter maximum stage time defines the fixed stage duration of the stage.
- The maximum stage time parameter is a mandatory parameter.

- The calculation begins after the minimum stage duration has been reached
- The maximum length of the calculation is up to the time that the maximum stage duration has been reached. The "maximum stage time" parameter exists in each signal plan. The maximum calculation does not extend the cycle duration.
- If the calculation is cancelled prematurely, the cycle time stage is reached earlier. In a coordinated system, the system waits in the cycle time point stage until the "gained" time has expired. The stage times of the cycle time stage are started at the cycle time point after the gained time has expired.
- The times of any unused calculation areas cannot be assigned to a subsequent stage. This can shift the green wave band.
- If the stage is not a calculation stage, the stage is maintained up until the maximum stage duration.

3.3.2.1. Minimum and maximum stage duration

- Minimum stage duration:
  - The minimum stage duration is reached once the stage duration is >= the minimum stage duration.
  - The minimum stage time is the sum total of the parameters "Minimum stage time" + any time assigned from an omitted request stage.
  - If the "Minimum stage time" parameter is not supplied, then the minimum stage time is the sum total of all "maximum stage time" parameters + any time assigned from an omitted request stage

- Maximum stage duration
  - The maximum stage duration is reached once the stage duration is >= the maximum stage duration.
  - The maximum stage time is the sum total of the parameters "Maximum stage time" + any time assigned from an omitted request stage.

3.3.3. Generating the stage calculation flag

During the current stage, the stage calculation flag is updated by the second as of the minimum stage time. It indicates if one of signal groups in the "green" state in this stage and in "block" stage in the subsequent stage is still calculating or not.

- No separate parameter configuration is required to generate the stage calculation flag. It is generated dynamically along with the run time of Sitraffic sLX based on the detector calculation flag and the current stage.
- The stage calculation flag is not set during the minimum stage duration.
- If the current stage does not contain a calculation signal group, then the stage calculation flag is not set.
- The stage calculation flag is available as an AP value with the designation "stgExtTrg". For more information, see Chapter "Diagnostics".

4. Sitraffic sLX Diagnostics

There are several traffic variables (AP values) available to diagnose the behavior of Sitraffic sLX. These make it possible to understand the decisions made by Sitraffic sLX.

The AP values can be selected in the online GUI in the index tab "Monitor / Visu Szp" by clicking on the "Edit configuration" icon and assigning the required AP values.

4.1. AP value "TA state"

The TA state shows the values for the "TA", "IT" and "PT" modifications. In order for sLX to be able to control, the TA and IT or PT modification must be set to "ON".

TA State	Sitraffic sLX control	ID of the modification
0	Off	all modifications off
1	Off	Modification TA on, IT off and PT off
2	Off	Modification TA off, IT on and PT off
3	On	Modification TA on, IT on and PT off
4	Off	Modification TA on, IT off and PT on
5	On	Modification TA on, IT off and PT on
6	Off	Modification TA off, IT on and PT on
7	On	Modification TA on, IT on and PT on

4.2. AP values for requests

4.2.1. Detector request flag "detDemTrg"

A request flag is generated in the current stage in order to decide in which stage the system should change to. If the next stage is a mandatory stage, the request reminder is not generated.

The detector request flag is available for 96 detectors. The number of the AP value instance equals the detector number.
There are three possible values for the AP value:

- = 9 Req flag is not generated
- = 0 Req flag is generated and the Req condition is not met
- = 1 => Req flag is generated and the Req condition is met

4.2.2. Stage request flag "stgDemNext"

This value indicates the next requested stage (requested stage with the currently highest priority). This is either a request stage with a detected request or a mandatory stage. The priority is derived from the stage sequence.

The flag is regenerated every second as long as a stage is running (no stage transition active). This may change in this time due to requests (if a stage with a higher priority issues a request because of the stage sequence).

- = 0 => Req flag is not generated
- > 0 => Number of the next stage to be switched to

4.3. AP values for calculations

4.3.1. Detector calculation flag "detExtTrg"

The detector calculation flag is available for 96 detectors. The number of the AP value instance equals the detector number.
There are three possible values for the AP value "detExtTrg":

- = 9 => Calc flag is not generated
- = 0 => Calc flag is generated and the Calc condition is not met
- = 1 => Calc flag is generated and the Calc condition is met

4.3.2. AP value stage calculation flag "stgExtTrg"

Entered in the stage calculation flag is whether in the current stage one of the signal groups in "green" state" is still calculating or not.
The data is updated by the second after the minimum stage time.
There are three possible values for the AP value:

- = 9 => Calc flag is not generated
- = 0 => Calc flag is generated and the Calc condition is not met
- = 1 => Calc flag is generated and the Calc condition is met

4.4. AP values for stages

4.4.1. AP value for current stage "curStgNo"

The stage currently running is managed as an AP value "curStgNo". Once the stage transition has ended, the requested stage is entered as the current stage.

- = 0 => Stage number not known
- > 0 => Number of the currently running stage

4.4.2. AP value for requested stage "nextStgNo"

While a stage transition is in process, the target stage is entered as the requested stage in the AP value "next StgNo".

- = 0 => no stage transition is in process
- > 0 => stage transition is in process in the specified target stage.

4.5. AP values for the distribution times

The AP values for the distribution times (stageMinDurCur, stageMaxDurCur, stageAddDurCur) apply to the next requested stage and so they also change when the requested stage changes.

4.5.1. Minimum stage duration "stgMinDurC"

This values indicates the minimum stage time for the stage in process based on the requested next stage (including the distribution time of request stages that were not switched)

- = 0 => the AP flag is not generated
- > 0 => Minimum time of the stage in process based on the requested next stage (in seconds)

4.5.2. Maximum stage duration "stgMaxDurC"

This values indicates the maximum stage time for the stage in process based on the requested next stage (including the distribution time of request stages that were not switched, but that are in the stage sequence of the current stage)

- = 0 => the AP flag is not generated
- > 0 => Maximum time of the stage in process based on the requested next stage (in seconds)

4.5.3. Offset time "stgAddDurC"

This value indicates the offset time for the stage in process. The time is calculated based on the distribution times of request stages that were not switched, but that are in the stage sequence **prior to** the current stage.

- As opposed to the minimum stage time "stgMinDurCur" and the maximum stage time "stgMaxDurCur", this time does not depend on the target stage. The time must be added to the minimum stage time and to the maximum stage time. So, the resulting times are the sum totals from the minimum stage time plus "stgAddDurC" as well as the maximum stage time plus "stgAddDurC".
- >= 0 => Offset time of the current stage based on request stages that were not switched, but that in the stage sequence are prior to the current stage (in second)

5. Operating Modes

5.1. Activating Sitraffic sLX

- Controlling using Sitraffic sLX requires that:
  - Sitraffic sLX Logic is activated.
    Activation occurs as a result of the modifications "TA" on and "PT" on and / or "IT" on.
    This can occur from the control center, the local JAUT or manually at the BAZ.
  - This operating mode allows controlling via Sitraffic sLX.
  - All of the parameters required for Sitraffic sLX are supplied
- Sitraffic sLX always begins controlling at the cycle time point. This applies, for example:
  - After the control unit is switched on (switch-on program has completed)
  - After a signal plan change by one signal plan without Sitraffic sLX into another signal plan with Sitraffic sLX
  - After a parameter supply (when a supply with Sitraffic sLX parameters is activated for the first time in the current operation)
- For an active Sitraffic sLX the number of the synchronization stage of the signal plan is loaded at the cycle time point as the current stage and the stage duration starts counting.
- The value of the modifications can be displayed via the "TA state" AP value.

5.2. Deactivating Sitraffic sLX

- Deactivating Sitraffic sLX
  - Sitraffic sLX is deactivated using the modification settings "TA off" or "TA on and PT off and IT off".

This can be done by the operator at the control center, the local JAUT or manually at the BAZ.

- □ The operating mode does not allow controlling.
  - When changing into on signal plan without Sitraffic sLX
  - When switching off, e.g. after off flashing
  - In manual operation

- The time of deactivation takes place by the next cycle time point. The icon of the cycle time point stage is active as a signal.

- The Sitraffic sLX switching requests expire at the cycle time point. From there, signaling is performed by the Sitraffic sLX controller.

5.3. Signal program switchover

- The switchover occurs at the cycle time point. The cycle time point stage is signaled at the time of the switchover.

- The cycle time stage is the same for all signal stages.

- When switching from Sitraffic sLX into fixed-time mode, the change occurs in the same manner. Signals are generated via Sitraffic sLX until the cycle time point. As of the cycle time point, the signals originate from the Sitraffic sLX firmware

5.4. Synchronization

5.4.1. Synchronization by the Sitraffic sX control kernel

In synchronized mode, this synchronization occurs automatically if the TX and the reference time index of the current signal plan do not match accounting for the configured offset.

- The cycle time is at the beginning (first second) of the synchronization stage. At this time, synchronization can occur in Synchronous Mode.

- The stage duration is not increased during synchronization (is set to the value 0)

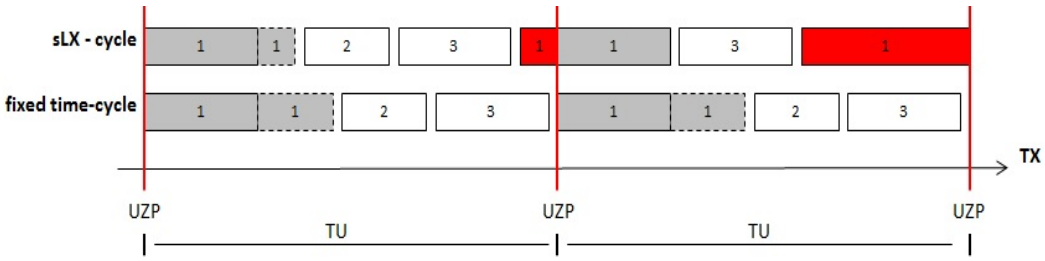
5.4.2. Synchronization or TX effect by Sitraffic sLX

5.4.2.1. Coordinated mode

This synchronization takes place within Sitraffic sLX if, while in synchronous mode at the start of a synchronization stage, the TX does not match the cycle time point value, because the last cycle was reduced.

This is the case if

- one or more of the request stages were skipped and / or one or more calculation stages did not calculate by the maximum stage time
- An extension of the cycle duration in Sitraffic sLX is not possible, because the stage-oriented fixed-time signal plans are structured as follows:
  - All stages are listed one after the next with their maximum stage time in the defined stage sequence and the stage transitions are inserted in-between.
  - As such, the fixed-time signal plan is equivalent to a Sitraffic sLX cycle in which all of the request stages are requested and all of the calculation stages calculate up to the maximum stage time.
- During Sitraffic sLX synchronization, the system waits at the beginning of the synchronization stage until the TX has reached the cycle time point value.
  - The stage duration is not increased during this time (is set to the value 0)
  - As of the cycle time point, the supplied stage sequence is once again processed from the start.

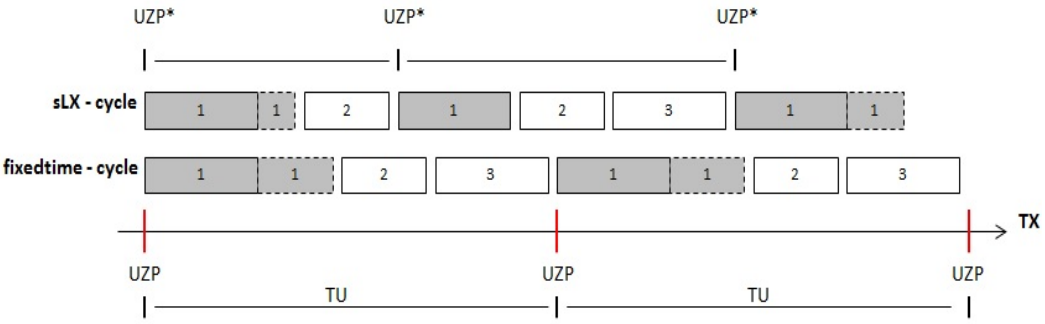


Coordinated mode comparison sLX and fixed-time cycle

5.4.2.2. Uncoordinated mode

Uncoordinated mode occurs in signal plans that are not synchronized. (no Sync flag are set in the signal plan supply)

- In uncoordinated mode, the TX is set to the value of the cycle time point at the start of the synchronization stage. This may result in a shorter cycle.
- The operating mode or signal plan change takes place just as in coordinated mode at the cycle time point.
- The TX is not affected by any changes in the operating state (switching on or off, changes in parameters, etc.).



Uncoordinated mode comparison sLX and fixed-time cycle

More information
is available from:

Siemens AG
Infrastructure and Cities Sector
Mobility and Logistics Division
Road and City Mobility

Otto-Hahn-Ring 6
D-81739 Munich, Germany

The information in this guide contains performance attributes that can change with further development of the products. The desired performance attributes are only binding if they have been explicitly agreed upon at conclusion of the contract.

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