KNX
Product documentation

GIRA

Last edited:
15.02.2019

KNX IP router

Order No. 2167 00

Table of contents

1 Productdefinition

1.1 Product catalogue

Product name: KNX IP router
Application: gateway, data logger/IP interface
Design: DRA (series installation)
Order No.: 2167 00

1.2 Accessories:

Power supply DC 24 V 300 mA
Order No.: 1296 00
KNX power supply
Order No.: 2120 00, 2122 00, 2130 00, 2138 00

1.3 Application

The KNX IP router connects KNX lines via data networks (Ethernet) using the Internet Protocol (IP). It uses the KNXnet/IP standard so that KNX telegrams can not only be forwarded between lines via an IP network, but bus access is also possible from a PC or other data processing devices.

The KNX IP router is suitable for use as an IP data interface.

The device supports up to 4 KNXnet/IP tunnelling connections and thus enables parallel bus access, e.g. via the ETS and other PC software.

It has an integrated switch with two RJ45 connections. This enables several KNX IP routers or other IP devices in the distribution to be connected without the aid of other active components.

The KNX IP router can be used as an area or line coupler. In this function, it interconnects two KNX lines to a logistical functional area and guarantees electrical isolation between these lines. As a result, each bus line of a KNX installation can be operated electrically independently of the other lines. The exact function of the device is determined by its physical address.

The KNX IP router can be used as a data logger. It incorporates a card reader for micro SDHC cards up to 32 GB. The KNX telegrams in an ETS4-compliant format can be recorded to the card for analysis purposes. The card memory can be used as a ring memory or as a ROM.

As a clock, the KNX IP router can send the time and date to the bus at configurable intervals. Synchronisation with an NTP server is possible. It is possible to trigger the sending of the current time and the current date via a trigger.

The KNX IP router requires a separate power supply 24...30 V DC ±10% to operate. The KNX IP router is supplied with power by this operating power connection. It is thus possible for bus voltage failures to be reported via the data network.

1.4 KNX Secure

The KNX IP router is prepared for KNX Secure from index status I14 in combination with Firmware 3.3 (additional firmware update required). The necessary FDSK (Factory Default Setup Key) is located as a label on the side of the KNX IP router and is also included as a Secure Card.

Important information

- → Store the Secure Card carefully.
- → We recommend that you remove the label on the device for maximum security.
- → Restoration is not possible if the FDSK is lost.

2 Mounting, electrical connection and operation

2.1 Safety notes

Electrical devices may only be installed and connected by a qualified electrician.

Failure to observe the installation instructions can result in damage to the device, fire or other dangers.

Please refer to the operating instructions enclosed with the device for more information.

2.2 Device components

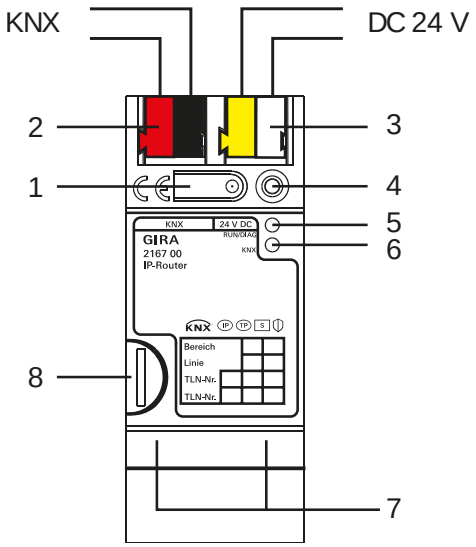

Figure 1: KNX IP router

Dimensions:
Width (W):
36 mm (2 MW)
Height (H):
90 mm
Depth (D):
74 mm

1 Programming button

2 KNX connection

3 External power supply connection* 24 to 30 VDC ±10%.

4 Programming LED (red/yellow/orange)
red = router
yellow = data logger / clock

5 LED operation display (green)
on: Ready for operation
flashing: Diagnosis code

6 LED KNX (yellow)
on: KNX is connected
off: KNX is not connected
flashing: Router is receiving data on KNX/TP line or on KNX IP line

7 Ethernet connection
- 10/100 speed (green)
  on: 100 Mbit/s
  off: 10 Mbit/s
- Link/ACT (orange)
  on: link to IP network
  off: no connection
  flashing: data reception on IP

8 Micro SD card holder

2.3 Mounting and electrical connection

DANGER!
Electric shock if live parts are touched. Electric shock may lead to death.
Isolate all appropriate circuit breakers before working on the device or load. Cover up live parts in the vicinity!

Mounting the device

- Snap on the top-hat rail according to DIN EN 60715. Network connection must be located on the bottom.

ℹ A KNX data rail is not necessary.

ℹ Observe temperature range (0°C to +45°C) and ensure sufficient cooling if necessary.

Connecting the device

- Connecting the KNX bus to the KNX connection of the router (2) with a KNX connection terminal.
- Connecting the external power supply* to the power supply connection (3) of the router using a KNX connection terminal (preferably yellow/white).
- Connecting one or two network lines to the network connection of the router (7).

  Note: Only one KNX IP router per KNX power supply should be connected to the additional 30 V DC supply. Otherwise, the KNX power supply may become overloaded following a power failure and subsequent return.

*: The non-choked output of a KNX power supply unit can also be used as an external power supply. Ensure that the maximum quantity of KNX devices which can be operated with the KNX power supply unit is reduced accordingly.

Mounting / removing the cover cap

A cover cap can be mounted for secure isolation to protect the bus connection / power supply connection from dangerous voltage, particularly in the connection area.

The cap is mounted with an attached bus and power supply terminal and a connected bus and power supply cable to the rear.

- Mounting the cover cap: The cover cap is pushed over the bus terminal (compare with Figure 2.A) until it engages noticeably.
- Removing the cover cap: The cover cap is removed by pressing it in slightly on the side and pulling it off to the front (compare with Figure 2.B).

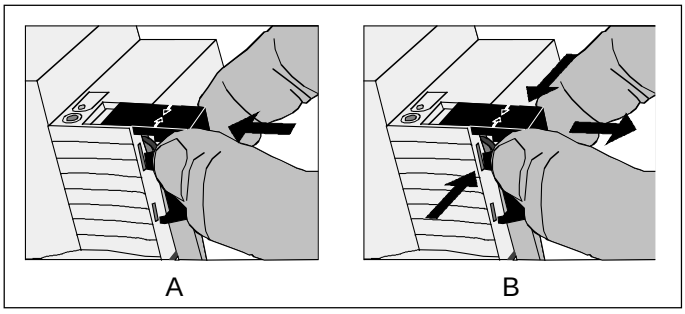

Figure 2: Mounting / removing the cover cap

2.4 Commissioning

After installing the device and connecting the bus line, power supply and Ethernet, the device can be started up.

The following physical addresses are factory preset:

Router	15.15.0
Router (additional functions)	15.15.255

These addresses have to be reprogrammed in order to be able to use the device. Without the imported application, the router works with default settings. The router and the router (additional functions) are secured against importing an incorrect application. The ETS will cancel the download in a case like this. However, as the physical address has already been programmed, the operation indication LED (5) of the device will show a projected status during the next start.

Programming the physical address of the router
Perform programming in the ETS's programming environment. An additional KNX data interface is not required for programming. A connection to the device can be established via IP or KNX.

- Ensure that the device and bus voltage are switched on.
- Ensure that the programming LED (4) is not illuminated. If it lights up yellow, press the programming button (1) until it goes out (>4 s).
- Briefly (<4 s) press the programming button (1).
  Programming LED (4) lights up red.
- Program the physical address using the ETS.
  Programming LED (4) goes out after a successful programming process.
- Make note of the physical address on the device.
- If the device was programmed without an additional KNX data interface, the tunnelling connection must be set up again after the programming process.

Programming the physical address of the router (additional functions)
Perform programming in the ETS's programming environment. An additional KNX data interface is not required for programming. A connection to the device can be established via IP or KNX.

- Ensure that the device and bus voltage are switched on.
- Ensure that the programming LED (4) is not illuminated. If it lights up red, press the programming button (1) as briefly as necessary to deactivate it (<4 s).
- Press the programming button (1) for a long time (>4 s).
  Programming LED (4) lights up yellow.
- Program the physical address using the ETS.
  Programming LED (4) goes out after a successful programming process.
- Make note of the physical address on the device.
- If the device was programmed without an additional KNX data interface, the tunnelling connection must be set up again after the programming process.

Programming application programmes and configuration data
After programming the physical address, the application programmes for the router and the router (additional functions) must be imported into the device. A connection to the device can be established via IP or KNX.

- Ensure that the device and bus voltage are switched on.
- Parametrise the respective device accordingly in the ETS.
- Import the software to the device.
- Wait approximately 10 seconds after the download, during which the device transfers the data.
- Start-up is complete.
- If the device was programmed without an additional KNX data interface, the tunnelling connection must be set up again after the programming process.

2.4.1 Factory reset

The device can be reset to factory settings with the Gira Project Assistant.

- Ensure the device is switched on and has an Ethernet connection to the computer.
- Start the Gira Project Assistant (GPA) on the computer.
- In the GPA, open the main menu and open the Action Center.
- Click on the gear symbol in the KNX IP router column to select the functions.
- Select the "Factory reset" function.
- The device is restarted and the factory reset is carried out.

Alternatively, a factory reset can be carried out directly on the device via a sequence during start-up if, for example, no Ethernet connection is possible.

- Make sure that the device is switched off.
- Press and hold the programming button (1) and switch on the device.
- Press and hold the programming button until the programming LED (4), the operation indication LED (5) and the KNX LED (6) slowly flash simultaneously. This happens after approx. 30 seconds.
- Briefly release the programming button (1), then press and hold it again until the programming LED (4), the operation indication LED (5) and the KNX LED (6) flash quickly simultaneously.
- The factory reset is carried out.
- Release the programming button.
- The device does not need to be restarted following a factory reset.

The factory reset can be cancelled at any time by interrupting the sequence.

Following the factory reset, the device behaves as in the state of delivery. The device is not configured. This can be seen after the device starts up by the slowly flashing green operation indication LED (5). For the settings of the parameters, please refer to the sections "4.2.5 State of delivery (KNX IP router)" and "4.3.5 State of delivery (KNX IP router – additional applications)".

2.4.2 Information on start-up

For the router, programming the physical address as well as programming the application programme via KNX/IP routing is already possible when no KNX bus line is connected to the KNX connection (2). When programming via KNX/IP routing is started for the router (additional functions), it will continue to run if the KNX bus connection is interrupted, ensuring that it is concluded successfully.

2.5 Operation

The KNX IP router features 3 status LEDs on the top of the housing and 4 status LEDs on the network connection. In addition, there is a programming button with which the router and / or the router (additional functions) can be put into programming mode.

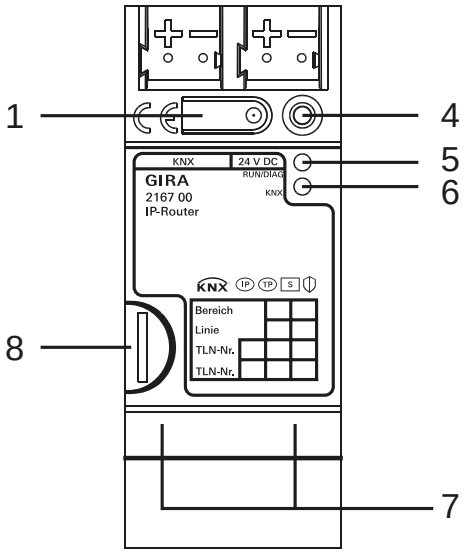

Figure 3: KNX IP router

1 Programming button

4 Programming LED (red/yellow/orange)
red = router
yellow = data logger / clock

5 LED operation display (green)
on: Ready for operation
flashing: Diagnosis code

6 LED KNX (yellow)
on: KNX is connected
off: KNX is not connected
flashing: Router is receiving data on KNX/TP line or on KNX IP line

7 Ethernet connection
- 10/100 speed (green)
  on: 100 Mbit/s
  off: 10 Mbit/s
- Link/ACT (orange)
  on: link to IP network
  off: no connection
  flashing: data reception on IP

8 Micro SD card holder

Diagnosis codes
The current device status can be concluded using the operation indication (5):

- LED off: Device is not switched on or not yet fully powered up.
- LED on: Device is ready for operation.
- LED flashing slowly (~1Hz): Device is not configured or was configured with impermissible parameters. The LED stops flashing when the application of the router and/or the router (additional functions) have been imported via the ETS. Refer to "2.4 Start-up".
- LED flashing quickly (~4Hz): Internal device error. Please contact support.

LED status when starting up the device
When the device starts up correctly, the yellow LED (6) flashes when the operating voltage is supplied, thereby signalling the start-up process. Shortly afterwards the green LED (5) starts flashing. As soon as the device has completely started up, the green LED (5) lights up continuously if the device is already parametrised, or it flashes according to the diagnosis codes. From this point on the yellow LED (6) indicates the KNX bus status and KNX telegrams.
A self-test is carried out when the device is started up. If an error occurs here, the yellow LED (6) and the green LED (5) flash alternately directly after the operating voltage is applied. In this case, please contact support.

Micro SD card holder (8)
A Micro SD card must be inserted for the data logger to be able to record telegrams. In addition, if a Micro SD card is inserted, a log file with system events is automatically created on the card.
Cards up to a maximum of 32 GB are supported. The cards must be formatted with FAT32.

3 Technical data

KNX medium	TP
Start-up mode	S mode (ETS)
KNX supply	DC 21 to 30 V SELV
KNX connection	Bus connection terminal
External supply voltage	DC 24 to 30 V ±10%
Connection	Connection terminal
Power consumption	typically 2 W (for 24 VDC, 2 Ethernet lines connected)
IP communication	Ethernet 10 /100 BaseT (10/100 MBit)
IP connection	2 x RJ45
Supported protocols	ARP, ICMP, IGMP, UDP/IP, DHCP, AutoIP KNXnet/IP according to KNX system specification: Core, Routing, Tunnelling, Device Management
Micro SD card	max. 32 GB
RTC buffering	≥24 h
Ambient temperature	0°C to +45°C
Storage temperature	-25°C to +70°C
Installation width	36 mm (2 MW)
Installation height	90 mm
Installation depth	74 mm
Protection class	IP20 (in accordance with EN60529)
Protection class	III (in accordance with IEC 61140)
Test marks	KNX, CE

4 Software description

4.1 Software specification

ETS search paths: - System devices/ IP router/ KNX IP router
- Communication/router applications/KNX IP router V4 (additional functions)

Configuration: S-mode standard

No.	Brief description	Name	Version
1	KNX IP router	KNX IP router V4.0	4.0
2	Additional functions: data logger, time functions	KNX IP router V4.0 (additional functions)	4.0

4.1.1 History

Application name	**Application no.**	**Note**
KNX/IP router 901210	901210	01.2011 as of ETS 3.0f
KNX/IP router V2.0 901610	901610	07.2012 as of ETS 3.0f, devices as of index I02. Older units can use this application after a firmware update.
KNX/IP router V3.0 901B30	901B30	11.2015 as of ETS 3.0f, ETS shows additional tunnelling connections.
KNX/IP router V3.5	901B35	01.2018 as of ETS 4.2, devices as of index I14 in conjunction with firmware 3.3 Secure Ready, 4 separate addresses
KNX/IP router V4.0	901B40	12.2018 as of ETS 5.6

Application name	**Application no.**	**Note**
Data logger/clock 901310	901310	01.2011 as of ETS 3.0f
Data logger/clock V2.0 901510	901510	07.2012 as of ETS 3.0f, devices as of index I02. Older units can use this application after a firmware update.
Router application V3.0 901A10	901A10	11.2015 as of ETS 3.0f, parameter reliable communication, NTP server
Router application V3.5	901A35	01.2018 as of ETS 4.2, devices as of index I14 in conjunction with firmware 3.3 Secure Ready
KNX IP router V4 (additional functions)	901A40	12.2018 as of ETS 5.6

4.2 Software "KNX IP router V4.0"

4.2.1 Range of functions

- IP secure and data secure
- Simple connection to higher-level network systems by using the Internet Protocol (IP)
- Direct access from any point in the IP network to the KNX installation (supports group and bus monitor connections via KNXnet/IP tunnelling)
- Fast communication between KNX lines, areas and systems (KNXnet/IP routing)
- Communication across buildings and properties (networking of properties)
- Filtering and forwarding of telegrams, depending on:
  - physical address
  - group address
- Simple to configure
- Failure message of the KNX system to applications via KNXnet/IP
- Using the ETS, 4 additional individual addresses can be configured. These are used among other things for KNX communication of the visualisation.
  These individual addresses can be configured in the ETS using the properties of the device and are available after the application program has been downloaded.
  When a device is inserted into a line, the addresses are generated automatically. They are given the next available address of the line.
- Simple connection of visualisation systems and facility management systems
- If a Micro SD card is inserted, there is automatic creation of a system log with important events for analysis purposes
- Reliable communication
  - Expansion of the KNXnet/IP protocol for minimising data loss in communication between KNX devices

4.2.2 Information on the software

- The KNX IP router can be parametrised for ETS 5.6 or higher.
- The KNX IP router is protected against importing an invalid application version.
- Router functionality is maintained without parametrised router (additional functions).

4.2.3 Object table

Number of communication objects: 0

4.2.4 Functional description

Monitoring for bus voltage failure
The KNX IP router monitors the KNX bus for power failure. It can be configured so that a message is sent to the IP network if there is a state change to the bus voltage. This can be configured using the "Monitoring for bus voltage failure" parameter on the "General" parameter page. The default is "blocked".

If the parameter is activated, a TP bus voltage failure on the IP side will trigger a broadcast command (GA=0/0/0) of the type "NetworkParameterWrite".
The data content is "00063301" (hex) for bus voltage failure and "00063300" (hex) for bus voltage return. This command can for example be evaluated by the Gira HomeServer or Gira Facility Server with the reception of a simple IP telegram. (Setting: UDP/Multicast with the port 3671 and the corresponding IP addresses. Initially "any desired data" must first be received for the data blocks, and then the binary data "000633". The values "01" and "00" for failure and return respectively can be assigned to a 1-byte communication object.)

IP address assignment
The device's IP address can either be assigned manually or via a DHCP server. This can be configured via the properties tab IP in the ETS for the IP router.
For the "Manual entry" setting, the values which are preset on the "IP address", "IP subnet mask" and "IP standard gateway" parameter pages are valid for the router. In the state of delivery, the router gets its IP address from a DHCP server.
For the "From DHCP service" setting, a DHCP server must assign the KNX IP router a valid IP address. If there is not a DHCP server available for this setting, the router starts up after a certain waiting time with an AutoIP address (address range from 169.254.1.0 to 169.254.254.255). As soon as a DHCP server is available, the device is automatically assigned a new IP address.

IP routing multicast address
The IP routing multicast address determines the target address of the KNX IP router's IP telegrams. The default setting is 224.0.23.12. This is the address determined for KNX IP devices by the KNX Association in conjunction with the IANA. It should only be changed if it becomes necessary due to the existing network. In this connection, it must be ensured that all KNX IP devices which are to communicate with one another via IP must use the same IP routing multicast address. The corresponding setting can be carried out on the "General" parameter page.
If a new IP routing multicast address is loaded to the device via KNX/IP routing, the ETS outputs the error message "Download failed". Re-downloading should then run without issues. This behaviour is due to the system.

Telegram filtering
The KNX IP router can filter telegrams both from KNX to IP as well as in the other direction. For this, there are the parameters "Group telegrams of the main group 0-13" and "Group telegrams of the main group 14-31" on the "Bus> IP" and "IP> Bus" parameter pages. For telegrams of the main groups 0-31, the options "forward", "block" and "filter (normal)" are available. If this parameter is set to "filter (normal)", a filter table is created automatically by the ETS and also loaded to the device during downloading.
In addition, a filter option for individually (physically) addressed telegrams and broadcast telegrams is available for both communication directions. They can either be forwarded, blocked or filtered. The corresponding parameter is located on the "Bus >IP" and "IP >Bus" parameter pages.

Confirming group telegrams
From the KNX side, the KNX IP router can either confirm all group-oriented telegrams or only those telegrams which are forwarded from KNX to IP. In this case, only those telegrams which are entered in the filter table of the device are confirmed. The respective "Confirm group telegrams" parameter is located on the "Bus IP" parameter page. The default is "for forwarding".

Automatic creation of a system log when a Micro SD card is inserted
If a Micro SD card is inserted in the device, a system log is automatically created on the card. This log is saved in the card's root directory in the file System.txt. Important system events are noted in this log. Specifically, these events are:

- Programming the router (additional functions)
- Setting the time via KNX or NTP
- Error during NTP synchronisation
- Change of the IP address
- KNX power failure
- KNX voltage recovery
- Restarting the device
- KNX bus status when starting up the device
- Occupancy level warning when 70%, 80% and 90% of the SD card memory capacity is reached
- SD card full and resulting end of system event logging

The System.txt file can have a maximum size of 1 megabyte. If this size is exceeded, the current System.txt is renamed System.bak and a new System.txt file is created. If this again exceeds the 1 megabyte limit, the old System.bak is overwritten and a new System.txt file is created.
Micro SDHC cards up to a maximum of 32 GB are supported. The cards must be formatted with FAT32.

Reliable communication
Reliable communication can be activated for the device. This is an extension of the KNXnet/IP protocol that serves to minimise data loss in communication over potentially unreliable connections. This is recommended for communication via WiFi, for example.

To use reliable communication, suitable components (e.g. the Gira G1 or other KNX IP router) for which reliable communication has also been activated must be used in the system.

Via the "Use Reliable communication?" parameter in the "Reliable communication" parameter view of the ETS, this function can be activated.

Reliable communication is deactivated in the state of delivery.

4.2.5 State of delivery

Physical address	15.15.0
physical address of the tunnelling connections	15.15.255
Device name	Gira KNX IP router
Monitoring for bus voltage failure	disabled
TTL	16
IP address assignment	from DHCP service
IP address	DHCP
IP routing multicast address	224.0.23.12
IP subnet mask	DHCP
IP standard gateway	DHCP
Bus > IP	
Group telegrams of the main group 0-13	filter
Group telegrams of the main group 14-31	forward without filtering
Physically addressed telegrams	filter
Broadcast telegrams	forward
Confirm group telegrams	upon forwarding
IP > bus	
Group telegrams of the main group 0-13	filter
Group telegrams of the main group 14-31	forward without filtering
Physically addressed telegrams	filter
Broadcast telegrams	forward
Use reliable communication?	deactivated

4.2.6 Parameter

Description:	Values:	Comment:
General		
Monitoring for bus voltage failure	**disabled** approved	Defines if a bus voltage status change is signalled in the IP network.
DNS	**deactivated** Enabled	Activation or deactivation of a manual address assignment of a DNS server.
DNS		
Primary DNS		Defines the IP address of the first DNS server to be used if manual address assignment is activated. The address is composed of 4 individual bytes. Default is 0.0.0.0.
Byte 1 (0 to 255)	0..255, **0**	
Byte 2 (0 to 255)	0..255, **0**	
Byte 3 (0 to 255)	0..255, **0**	
Byte 4 (0 to 255)	0..255, **0**	
Secondary DNS		Defines the IP address of the second DNS server to be used if manual address assignment is activated. It is automatically used if the first DNS server cannot be reached. The address is composed of 4 individual bytes. Default is 0.0.0.0.
Byte 1 (0 to 255)	0..255, **0**	
Byte 2 (0 to 255)	0..255, **0**	
Byte 3 (0 to 255)	0..255, **0**	
Byte 4 (0 to 255)	0..255, **0**	
Bus > IP		
Group telegrams of the main group 0-13		This parameter determines how to proceed with telegrams with group addresses of the main groups 0-13. They can either be forwarded, blocked or filtered.
	forward without filtering	All telegrams with group addresses of the main groups 0 to 13 are forwarded from the KNX bus to IP.
	block	All telegrams with group addresses of the main groups 0 to 13 from the KNX bus to IP are blocked.
	filter	All telegrams with group addresses of the main groups 0 to 13 from the KNX bus to IP are filtered according to the filter table. The filter table is calculated automatically by the ETS.

Group telegrams of the main group 14-31		This parameter determines how to proceed with telegrams with group addresses of the main groups 14-31. They can either be forwarded or blocked. Filtering is not an option here as the ETS does not calculate a filter table for these main groups.
	forward without filtering	All telegrams with group addresses of the main groups 14-31 are forwarded from the KNX bus to IP.
	block	All telegrams with group addresses of the main groups 14-31 from the KNX bus to IP are blocked.
	filter	All telegrams with group addresses of the main groups 14 to 31 from the KNX bus to IP are filtered according to the filter table. The filter table is calculated automatically by the ETS.
Physically addressed telegrams		This parameter determines how to proceed with individually addressed telegrams. They can either be forwarded, blocked or filtered.
	forward without filtering	All individually addressed telegrams are transferred from the KNX bus to IP.
	block	Individually addressed telegrams are blocked by the KNX IP router. With this setting, it is not possible to send individually addressed telegrams from the line in a lower level than the KNX IP router to another line (e.g. during programming).
	filter	Only the individually addressed telegrams which should leave the line of the KNX IP router are transmitted from the KNX bus to IP.
Broadcast telegrams		This parameter determines how to proceed with broadcast telegrams. They can either be forwarded or blocked.
	forward	All broadcast telegrams are transferred from the KNX bus to IP.
	block	Broadcast telegrams are blocked by the KNX IP router. With this setting, it is not possible to send broadcast telegrams from the line in a lower level than the KNX IP router to another line.

Confirm group telegrams		This parameter determines when the KNX IP router should confirm group telegrams with a telegram.
	upon forwarding	Only those group telegrams which are also forwarded to IP are confirmed with a telegram. This means that only telegrams which are also entered in the filter table are confirmed.
	always	All group telegrams on the KNX bus are confirmed by the KNX IP router with a telegram.

IP > bus

Group telegrams of the main group 0-13		This parameter determines how to proceed with telegrams with group addresses of the main groups 0 to 13. They can either be forwarded, blocked or filtered.
	forward without filtering	All telegrams with group addresses of the main groups 0 to 13 are forwarded from the IP to the KNX bus.
	block	All telegrams with group addresses of the main groups 0 to 13 from the IP to the KNX bus are blocked.
	filter	All telegrams with group addresses of the main groups 0 to 13 from IP to the KNX bus are filtered according to the filter table. The filter table is calculated automatically by the ETS.

Group telegrams of the main group 14-31		This parameter determines how to proceed with telegrams with group addresses of the main groups 14-31. They can either be forwarded or blocked. Filtering is not an option here as the ETS does not calculate a filter table for these main groups.
	forward without filtering	All telegrams with group addresses of the main groups 14-31 are forwarded from the IP to the KNX bus.
	block	All telegrams with group addresses of the main groups 14 to 31 from the IP to the KNX bus are blocked.
	filter	All telegrams with group addresses of the main groups 14 to 31 from IP to the KNX bus are filtered according to the filter table. The filter table is calculated automatically by the ETS.
Physically addressed telegrams		This parameter determines how to proceed with individually addressed telegrams. They can either be forwarded, blocked or filtered.
	forward without filtering	All individually addressed telegrams are transferred from the IP to the KNX bus.
	block	Individually addressed telegrams from the IP to the KNX bus are blocked.
	filter	Only the individually addressed telegrams which are addressed in the line of the KNX IP router are transmitted from the IP to the KNX bus.
Broadcast telegrams		This parameter determines how to proceed with broadcast telegrams. They can either be forwarded or blocked.
	forward	All broadcast telegrams are transferred from the IP to the KNX bus.
	block	Broadcast telegrams from the IP to the KNX bus are blocked.

Use reliable communication?		This parameter determines if reliable communication is to be used. Activating this function enables reliable KNX communication within the system (recommended for communication via WiFi). To use this function, the system must contain suitable components (e.g. the Gira G1 or other KNX IP router) with the corresponding settings activated. If this setting is changed, the router will restart directly after the application has been programmed! The router should always be programmed separately.
	deactivated	Reliable communication is not used.
	Enabled	Reliable communication is used.

4.3 Software "KNX IP router V4.0 (additional functions)"

4.3.1 Range of functions

- Time server
  - The current time and current date are sent to the bus periodically.
  - Triggering of the sending of the current time and date by means of a group telegram (trigger).
- Time client
  - Receives the current time and/or the current date from the bus.
- Data logger
  - Records all KNX telegrams of the higher-level and lower-level lines to a Micro SD card.
- NTP
  - Requesting current time and date from NTP server

4.3.2 Information on the software

- Router (additional functions) can be parametrised from ETS 5.6.
- Router (additional functions) are protected against importing an invalid application version.
- If the parameters for the time zone or for using reliable communication are changed, the device automatically restarts after successful programming of the application.

4.3.3 Object table

Number of communication objects: 15
Number of addresses (max.): 60
Number of assignments (max.): 60
Dynamic table management: No
Maximum table length: 255

Function: Time server

Object	Function	Name	Type	DP type	Flag*
1	Send	Time	3 bytes	10.001	C, T

Description: 3 byte object for sending the current time. The interval can be parametrised.

Function: Time server

Object	Function	Name	Type	DP type	Flag*
2	Send	Date	3 bytes	11.001	C, T

Description: 3 byte object for sending the current date. The interval can be parametrised.

Function: Time server

Object	Function	Name	Type	DP type	Flag*
3	Receive	Trigger send date/time	1 bit	1.017	C, W

Description: 1 bit object for triggering the sending of the current time/date if the object has been assigned any desired value.

Function: Time client

Object	Function	Name	Type	DP type	Flag*
4	Receive	Time	3 bytes	10.001	C, W

Description: 3 byte object for receiving the current time.

Function: Time client

Object	Function	Name	Type	DP type	Flag*
5	Receive	Date	3 bytes	11.001	C, W

Description: 3 byte object for receiving the current date.

Function: Data logger

Object	Function	Name	Type	DP type	Flag*
6	Receive	Activate data logger	1 bit	1.001	C, R, W

Description: 1 bit object to activate the data logger. When a "1" is assigned to the object, the data logger is active. If a "0" is assigned to it, it is deactivated.

Function: Data logger

Object	Function	Name	Type	DP type	Flag*
7	Send	Data logger status	1 bit	1.002	C, R, T

Description: 1-bit object which reflects the state of the data logger. If the object has a value of "1", the data logger is active. A "0" means that the data logger is inactive.

Function: Data logger
Parameter: Memory type = ROM
Memory status type = binary

Object	Function	Name	Type	DP type	Flag*
8	Send	SD card memory state	1 bit	1.002	C, R

Description: 1-bit object for display of the occupancy level of the SD card. When a "1" is assigned to the object, the SD card is full. If it is assigned a "0", then there is still space for logging on the SD card.

Function: Data logger
Parameter: Memory type = ROM
Memory status type = value (0-255)

Object	Function	Name	Type	DP type	Flag*
9	Send	SD card memory occupancy	1 byte	5.001	C, R

Description: 1-bit object for displaying the memory occupancy of the SD card. The value range is 0-255 (equivalent to 0-100%).

Function: NTP

Object	Function	Name	Type	DP type	Flag*
10	Send	NTP status	1 bit	1.002	C, R, T

Description: 1-bit object for display of the status of the last NTP query. If the NTP query was successful and the system time has been reset as a result or if there was an error during the previous query, the object is assigned a "1". If the last NTP query was not successful, the object is assigned a "0".

Function: Data logger

Object	Function	Name	Type	DP type	Flag*
11	Send	Bus voltage failure	1 bit	1.002	C, T

Description: 1-bit object which signals the status of the bus voltage. A "1" is sent upon bus voltage failure. A "0" is sent when power is restored.

Function: Always

Object	Function	Name	Type	DP type	Flag*
13	Send	SD card error	1 bit	1.002	C, R, T

Description: 1-bit object for signalling an SD card error. When a "1" is assigned to the object, an SD card error has occurred.

Function: Always

Object	Function	Name	Type	DP type	Flag*
14	Send	SD error code	1 byte		C, R

Description: 1-bit object for signalling an SD card error.
0 = SD card OK
1 = SD card full
2 = SD card not inserted
4 = Fault has occurred in SD card (e.g. incorrectly formatted)

Function: Time server

Object	Function	Name	Type	DP type	Flag*
15	Send	Date/time	8 bytes	19.001	C, T

Description: 8 byte object for sending current time and date. The interval equals the shortest parametrised time for date or time.

Function: Time client

Object	Function	Name	Type	DP type	Flag*
16	Receive	Date/time	8 bytes	19.001	C, W

Description: 8 byte object for receiving current time and date.

*The default values are specified.

4.3.4 Functional description

Time server
As a clock, the device can send the current time to the bus at configurable intervals. For this, first the "Time function" parameter must be set to "Time server" in the "General" parameter view so that the further configuration parameters become visible. The respective desired interval can be configured with the "Send time" and "Send date" parameters. The time sent is obtained from the system time. This can be synchronised with a configurable NTP server. For this, the "Use NTP server" parameter must be set to "Yes" in the "General" parameter view. The NTP server can then be configured in the newly available "NTP configuration" parameter view.
The device can be configured for various UTC time zones. The "Time zone" parameter used for this is located in the "General" parameter view.
Time changeover is taken into account either automatically depending on the time zone set or not at all. A "Generic Time Zone w/o DST" must be parametrised so that no automatic time changeovers are carried out.

If an NTP server is used, the clock will only send the date and time if at least one successful NTP synchronisation has been executed after device start-up. This is to prevent the sending of a wrong system time even if the the NTP function is activated.

With the clock function, a communication object is provided with which the sending of the time/date can be triggered (trigger). For more details, see "4.3.3 Object table".

The time function is deactivated at delivery.

Time client
As a timekeeper, the device synchronises the system time with time information from KNX time telegrams which for example can be sent from clocks or the ETS. For this, the "Time function" parameter must be set to "Time client" in the "General" parameter view.
The time function is deactivated at delivery.

Bus voltage monitoring
The device monitors the bus voltage and provides a communication object for this purpose. If the group address of the communication object is entered in the filter table of the router, the notification of the bus voltage state will not only be sent via TP, but also via IP.
For more details, see "4.3.3 Object table".

Data logger
The device can be used as a data logger. The data logger functionality is controlled via the "Data logger" parameter in the "General" parameter view. If it is set to "Yes", the data logger functionality is always activated. If a Micro SD card is inserted into the device or if there is already a card in the device, logging begins automatically if it is not deactivated via the "Activate data logger" communication object.

The data logger state is sent via the "Data logger status" communication object, however it can also be queried directly. The communication object has the value 1 for as long as the data logger is active. If the SD card is removed, then no memory capacity is available, or if the data logger is deactivated via the "Activate data logger" communication object, the "Data logger status" communication object assumes the value "0" and sends it.

The data logger supports two types of memory management. The SD card memory can be used as ROM or as a ring memory. When used as a ring memory, the remaining memory is monitored. When the remaining memory capacity drops below 2.5 MB, the oldest log file is deleted to create space for new data.

When used as ROM, logging is automatically ended as soon as the Micro SD card is full until a new card with sufficient capacity is inserted.

The data logger can be activated or deactivated via the "Activate data logger" communication object. Naming and saving the log files on the Micro SD card is in accordance with the following scheme:

Year
-----Month
----------Day
----------2010_01_06_LAN.trx
----------2010_01_06_TP1.trx

If there is a loss of voltage and a resulting loss of time/date, a file name can be repeated. In this case, a tilde (~) is attached to the end of the file name, for further repetitions, consecutive numbers (~1) are added to the tilde.

Before the Micro SD card is removed, logging should be deactivated to prevent damage to the card.

The KNX IP router supports SDHC cards up to a maximum of 32 GB. The cards must be formatted with FAT32.

Various communication objects are available for monitoring the memory status. The current card status and the occupancy level are queried via these communication objects. For more details, see "4.3.3 Object table".

4.3.5 State of delivery

Physical address	15.15.255
Time function	None
Data logger	No
Time zone	(UTC+01:00) Europe/Berlin
Use NTP server	No

4.3.6 Parameter

Description:	Values:	Comment:
General		
Time function		This parameter determines which time function the device executes.
	None	No time function is executed.
	Time server	The device works as a Time server and sends the current time and date to the bus at configurable intervals. If an NTP server us used in addition, the date/time will only be sent if the system time was synchronised at least once since the device started up.
	Time client	The device works as a time client and receives the time telegrams sent from a clock and evaluates them.
Send time	**Each minute** Each hour Each day	Only visible when the device works as a clock. The interval for sending the time to the bus is configured with this parameter.
Send date	**Each minute** Each hour Each day	Only visible when the device works as a clock. The interval for sending the date to the bus is configured with this parameter.
Data logger		This parameter determines whether the data logger function is activated. The corresponding communication objects are only available when it is activated.
	No	The data logger function is deactivated.
	Yes	The data logger function is activated.
Data logger memory type		Only visible when "Data logger" is set to "Yes". This parameter specifies how the SD card memory is to be used.
	Ring memory	The SD card memory is used as a ring memory.
	ROM	The SD card memory is used as ROM.

Data logger memory status type		Only visible when "Data logger" is set to "Yes" and the "Data logger memory type" is set to "ROM". This parameter specifies what type the status object of the card occupancy level should be.
	Binary	A 1-bit object is used. The value "1" means that the card is full, "0" means that there is still space on the card for logging.
	Value (0-255)	A 1-byte object is used. The value range is from 0 to 255. The value "255" corresponds to a card occupancy level of 100%.
Time zone		The time zone the device works with is configured with this parameter.
	(UTC+01:00) Europe/Berlin Other UTC time zones	The time zone to be used is selected here. There are several time zones with identical UTC deviations. In some of these time zones, summer/winter time switchover is at a different time. One of the "Generic Time Zone w/o DST" time zones must be selected so that no automatic time changeovers are carried out. If this setting is changed, the router will restart directly after the application has been programmed!
Use NTP server		This parameter determines whether an NTP server should be used. It is only taken into account in operation as a clock.
	No	No NTP server is used. The system time serves as a reference.
	Yes	An NTP server is used.
NTP configuration		
		Only available when an NTP server is used.
NTP server address		This parameter defines the host name or the IP address of the NTP server to be used. When using a manual IP address for the router, a DNS server must be parametrised so that defining a host name is possible.

NTP interval (min)	**60** 1..65535	This parameter determines at which interval the time should be synchronised to the NTP server. The information is in minutes.

5 Appendix

5.1 Operation as an area or line coupler

Topology

As an area / line coupler, the KNX IP router transmits telegrams between a lower-level line and the IP network. The function of the device is defined as follows with the physical address:

- Area coupler (AC) B.0.0 ($1 \leq B \leq 15$)
- Line coupler (LC) B.L.0 ($1 \leq B \leq 15$, $1 \leq L \leq 15$)

Fundamentally, the KNX IP router can be used as a line coupler or an area coupler (cf. Figure 4).

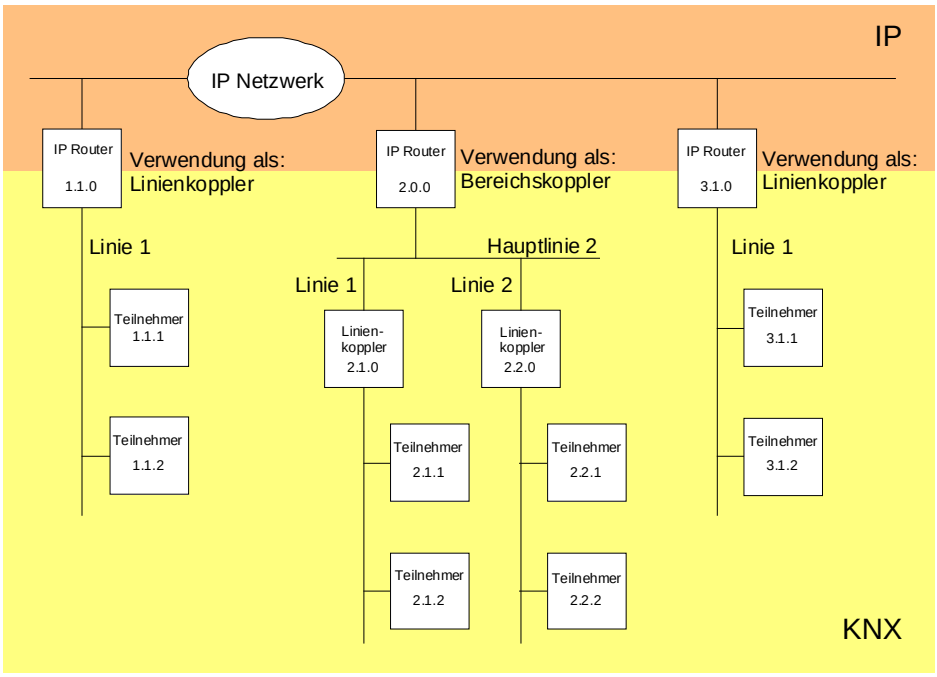

Figure 4: KNX IP router as an area or line coupler

If the KNX IP router is used as an area coupler with the physical address x.0.0 (x = 1 to 15), no additional IP routers may be used topologically 'lower than' this IP router as a line coupler x.y.0 (y = 1 to 15 – same area address) (cf. Figure 5).

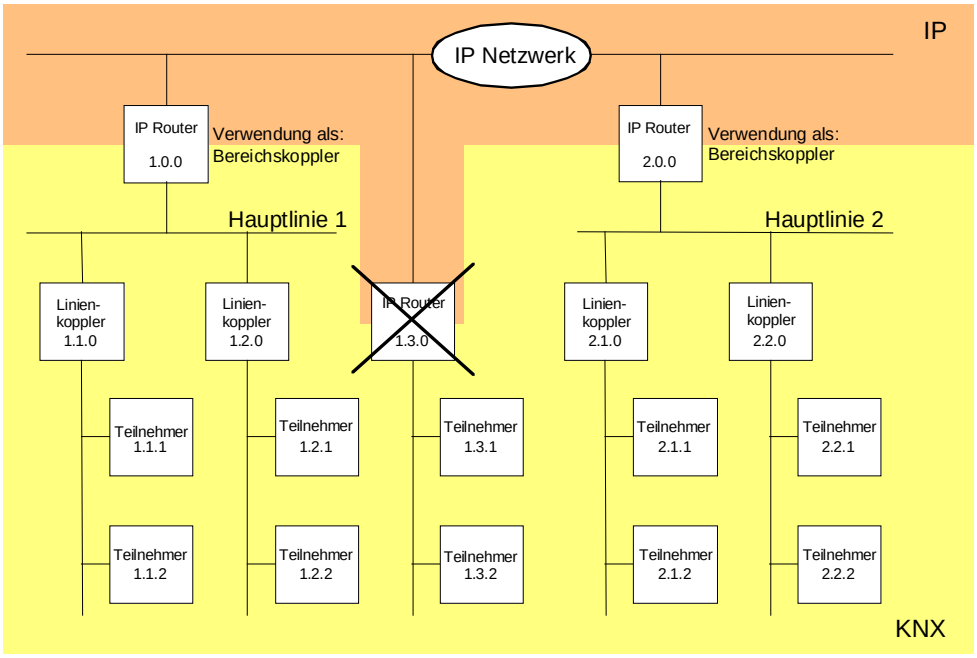

Figure 5: KNX IP router as an area coupler

If the KNX IP router is used as a line coupler with the physical address x.y.0 (x = 1 to 15, y = 1 to 15), no additional IP routers with the same area address x.0.0 may be used 'higher ' in the system (cf. Figure 6).

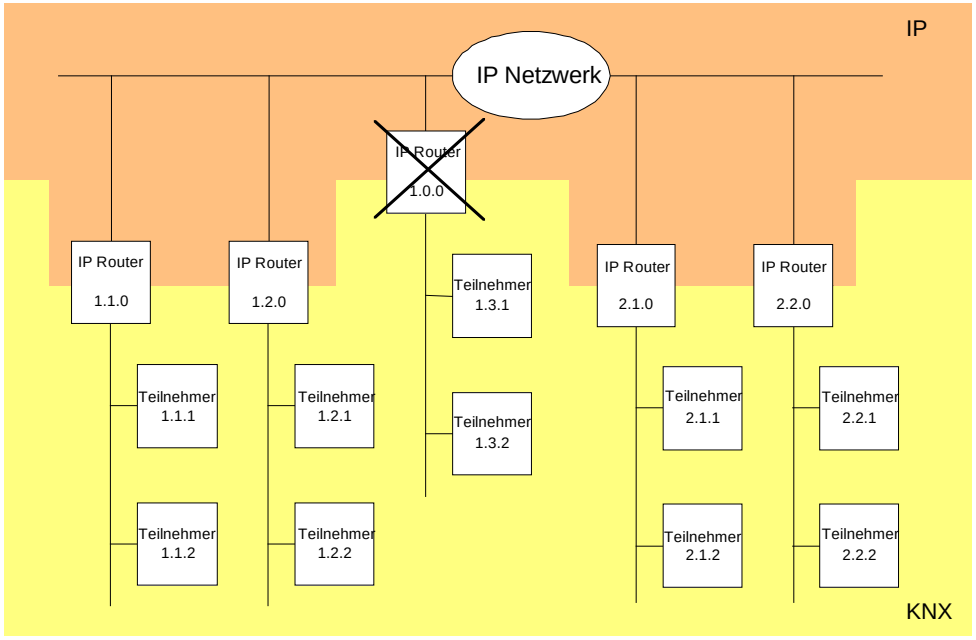

Figure 6: KNX IP router as a line coupler

Note:
Error-free functioning of the KNX IP router as an area or line coupler (KNXnet/IP routing) requires network components which support IP multicasting. In particular, network / LAN routers must be able to be set or already be set to forward IP multicasting datagrams. For KNXnet/IP routing, the IP multicast address 224.0.23.12 is reserved internationally for this purpose.

6 License Agreement KNX IP router Software

Hereinafter are the contract terms for your use of the software as the "licensee".
By accepting this agreement and installing the KNX IP router software or putting the KNX IP router into use, you conclude an agreement with Gira, Giersiepen GmbH & Co KG and agree to be legally bound to the terms of this agreement.

6.1 Definitions

Licensor: Gira, Giersiepen GmbH & Co KG, Radevormwald, Germany
Licensee: The legal recipient of the KNX IP router software
Firmware: Software which is embedded on the KNX IP router hardware and enables operation of the KNX IP router.
KNX IP router Software: The KNX IP router software denotes all of the software provided for the KNX IP router product, including the operating data. This particularly includes the firmware and the product database.

6.2 Subject matter of the agreement

The subject matter of this agreement is the KNX IP router software provided on data carriers or through downloads, as well as the corresponding documentation in written and electronic form.

6.3 Rights of use of the KNX IP router software

The licensor grants the licensee the non-exclusive, non-transferable right to use the KNX IP router software for an unlimited time in accordance with the following conditions for the purposes and applications specified in the valid version of the documentation (which shall be provided in printed form or also as online help or online documentation).
The licensee is obliged to ensure that each person who uses the program only does so as part of this license agreement and observes this license agreement.

6.4 Restriction of rights of use

6.4.1 The licensee is not authorised to use, copy, process or transfer the KNX IP router software in whole or in part in any way other than described herein. Excluded from this is one (1) copy, which shall be produced by the licensee exclusively for archiving and backup purposes.

6.4.2 The licensee is not authorised to apply reverse-engineering techniques to the KNX IP router software or to convert the KNX IP router software to another form. Such techniques particularly include disassembly (conversion of an executable program's binary machine code into an assembler language which can be read by humans) or decompilation (conversion of binary computer code or assembler instructions into source code in the form of high-level programming language).

6.4.3 The firmware may only be installed and used on the hardware (KNX IP router) approved by the licensor.

6.4.4 The KNX IP router software may not be passed on to third parties, nor may it be made accessible to third parties.

6.4.5 The licensee is not authorised to rent or lease the KNX IP router software or grant sublicenses for the program.

6.4.6 The licensee requires written approval from the licensor to create and distribute software which is derived from the KNX IP router software.

6.4.7 The mechanisms of the license management and copying protection of the KNX IP router software may not be analysed, published, circumvented or disabled.

6.5 Ownership, confidentiality

6.5.1 The KNX IP router software and the documentation (which shall be provided in printed form or also as online help or online documentation) are business secrets of the licensor and/or the object of copyright and/or other rights and shall continue to belong to the licensor. The licensee shall observe these rights.

6.5.2 Neither the software nor the data backup copy nor the documentation (which shall be provided in printed form or also as online help or online documentation) may be passed on to third parties at any point in time, in whole or in part, for a charge or free of charge.

6.6 Changes, additional deliveries

The KNX IP router software and the documentation (which shall be provided in printed form or also as online help or online documentation) shall be subject to possible changes by the licensor.

6.7 Warranty

The KNX IP router software shall be delivered together with software from third parties as listed in section 11. No warranty is provided for software from third parties.

6.7.1 The KNX IP router software and the documentation (which shall be provided in printed form or also as online help or online documentation) shall be provided to the licensee in the respective valid version. The warranty period for the KNX IP router software is twenty-four (24) months. During this time the licensor shall provide the following warranty:

- The software shall be free of material and manufacturing defects when turned over to the customer.
- The software shall function in accordance with the documentation included with it in the respective valid version.
- The software shall be runnable on the computer stations specified by the licensor.

The warranty shall be fulfilled with the supply of spare parts.

6.7.2 Otherwise, no warranty shall be provided for the freedom from faults of the KNX IP router software and its data structures from defects. Nor does the warranty cover defects due to improper use or other causes outside the influence of the licensor. Any additional warranty claims shall be excluded.

6.8 Liability

The licensor shall not be liable for damages due to loss of profit, data loss or any other financial loss resulting as part of the use of the KNX IP router software, even if the licensor is aware of the possibility of damage of that type.
This limitation of liability applies to all compensation claims on the part of the Licensee, regardless of the legal grounds. In any case, liability is limited to the purchase price of the product.

The exclusion of liability does not apply to damage caused by premeditation or gross negligence on the part of the licensor. Furthermore, claims based on the statutory regulations for product liability shall remain intact.

6.9 Applicable law

This agreement is subject to the laws of the Federal Republic of Germany.
The place of jurisdiction is Cologne, Germany.

6.10 Termination

This agreement and the rights granted herein shall end if the licensee fails to fulfil one or more provisions of this agreement or terminates this agreement in writing. The KNX IP router software and the documentation handed over (which is provided in printed form or also as online help or online documentation) including all copies shall in this case be returned immediately and without being requested to do so. No claim to reimbursement of the price paid shall be accepted in this case.
The license for use of the KNX IP router software shall expire upon the termination of the agreement. In this case, the KNX IP router product must be taken out of operation. Further use of the KNX IP router without a license is precluded.
The start-up software and the visualisation software must be uninstalled and all copies must be destroyed or returned to the licensor.

6.11 Subsidiary agreements and changes to the agreement

Subsidiary agreements and changes to the agreement shall be valid only if made in writing.

6.12 Exception

All rights not expressly mentioned in this agreement are reserved.

7 Open Source Software

This product uses software from third-party sources by the following authors.

Aleksey Sanin
Anthony Green
Carnegie Mellon University
Clark Cooper
Daniel Veillard
Digital Equipment Corporation
Expat maintainers
Free Software Foundation, Inc.
Intel Corporation
Internet Systems Consortium
Jean-loup Gailly
Julian Seward
libpcap maintainers
Mark Adler
Phil Katz
Philip Hazel
Red Hat Software, Inc
Regents of the University of California
Thai Open Source Software Center Ltd
The D-Bus Authors
The OpenSSL Project
University of Cambridge

This product uses software from third-party sources which are used within the scope of the GNU General Public License (GPL) or Lesser GNU General Public License LGPL.

The software packages used in this product which are licensed under the GPL/LGPL are described in the following.

Software package	U-Boot
Version of the software	2012.07
Supplier	http://www.denx.de/wiki/U-Boot/WebHome
License	GNU GPL, Version 2, June 1991
Copyright notice	Copyright © 2000-2010 by Wolfgang Denk et al.

Software package	GNU/Linux
Version of the software	3.2.20
Supplier	http://kernel.org
License	GNU GPL, Version 2, June 1991
Copyright notice	Copyright © 1992-2010 by Linus Torvalds et al.

Software package	Avahi
Version of the software	0.6.31
Supplier	http://avahi.org
License	GNU LGPL, Version 2.1, February 1999
Copyright notice	Copyright © 2010 Avahi developers

Software package	Buildroot
Version of the software	2012.11.1
Supplier	http://buildroot.org
License	GNU GPL, Version 2, June 1991
Copyright notice	Copyright © 1999-2005 Erik Andersen, 2006-2012 Buildroot developers

Software package	Busybox
Version of the software	1.20.2
Supplier	http://busybox.org
License	GNU GPL, Version 2, June 1991
Copyright notice	Copyright © 2004-2014 Busybox developers

Software package	e2fsprogs
Version of the software	1.42.6
Supplier	http://e2fsprogs.sourceforge.net
License	GNU GPL, Version 2, June 1991 GNU LGPL, Version 2.1, February 1999
Copyright notice	Copyright © 2007 Theodore Ts'o

Software package	fuse
Version of the software	2.9.2
Supplier	http://fuse.sourceforge.net
License	GNU GPL, Version 2, June 1991 GNU LGPL, Version 2.1, February 1999
Copyright notice	Copyright © 2001-2007 Miklos Szeredi

Software package	GLib
Version of the software	2.30.3
Supplier	http://developer.gnome.org/glib/
License	GNU LGPL, Version 2.1, February 1999
Copyright notice	Copyright © 2010 the Glib Team

Software package	GNU C Library (GLIBC)
Version of the software	2.15
Supplier	http://www.gnu.org/software/libc/
License	GNU LGPL, Version 2.1, February 1999
Copyright notice	Copyright © 1996-2010 by Roland McGrath et al. http://sourceware.org/glibc/wiki/MAINTAINERS

Software package	kmod
Version of the software	11
Supplier	
License	GNU GPL, Version 2, June 1991
Copyright notice	

Software package	libdaemon
Version of the software	0.14
Supplier	
License	GNU LGPL, Version 2.1, February 1999
Copyright notice	

Software package	mtd-utils
Version of the software	1.5.0
Supplier	
License	GNU GPL, Version 2, June 1991
Copyright notice	

Software package	udev
Version of the software	182
Supplier	
License	GNU GPL, Version 2, June 1991
Copyright notice	

Software package	util-linux
Version of the software	2.20.1
Supplier	
License	GNU GPL, Version 2, June 1991
Copyright notice	

The license texts of the GPL and LGPL are available via the following web page:
http://www.gnu.org/licenses/licenses.html

License text: Gira does not assume any liability or provide a warranty for this software.

The source code for this software can be obtained via the e-mail address info@gira.de.

This offer is valid for three years after the discontinuation of the service for this product.

7.1 GNU GPL, Version 2, June 1991

GNU GENERAL PUBLIC LICENSE
Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation, Inc.,
51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA
Everyone is permitted to copy and distribute verbatim copies
of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license, which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

GNU GENERAL PUBLIC LICENSE
TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law:

that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of

Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgement or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent

license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING

OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w' and `show c'; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program
`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License.

7.2 GNU LGPL, Version 2.1, February 1999

```
 GNU LESSER GENERAL PUBLIC LICENSE
 Version 2.1, February 1999

 Copyright (C) 1991, 1999 Free Software Foundation, Inc.
 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA
 Everyone is permitted to copy and distribute verbatim copies
 of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts
 as the successor of the GNU Library Public License, version 2, hence
 the version number 2.1.]

 Preamble

 The licenses for most software are designed to take away your
freedom to share and change it. By contrast, the GNU General Public
Licenses are intended to guarantee your freedom to share and change
free software--to make sure the software is free for all its users.

 This license, the Lesser General Public License, applies to some
specially designated software packages--typically libraries--of the
Free Software Foundation and other authors who decide to use it. You
can use it too, but we suggest you first think carefully about whether
this license or the ordinary General Public License is the better
strategy to use in any particular case, based on the explanations below.

 When we speak of free software, we are referring to freedom of use,
not price. Our General Public Licenses are designed to make sure that
you have the freedom to distribute copies of free software (and charge
for this service if you wish); that you receive source code or can get
it if you want it; that you can change the software and use pieces of
it in new free programs; and that you are informed that you can do
these things.

 To protect your rights, we need to make restrictions that forbid
distributors to deny you these rights or to ask you to surrender these
rights. These restrictions translate to certain responsibilities for
you if you distribute copies of the library or if you modify it.

 For example, if you distribute copies of the library, whether gratis
or for a fee, you must give the recipients all the rights that we gave
you. You must make sure that they, too, receive or can get the source
code. If you link other code with the library, you must provide
complete object files to the recipients, so that they can relink them
with the library after making changes to the library and recompiling
it. And you must show them these terms so they know their rights.

 We protect your rights with a two-step method: (1) we copyright the
library, and (2) we offer you this license, which gives you legal
permission to copy, distribute and/or modify the library.

 To protect each distributor, we want to make it very clear that
there is no warranty for the free library. Also, if the library is
modified by someone else and passed on, the recipients should know
that what they have is not the original version, so that the original
author's reputation will not be affected by problems that might be
introduced by others.

 Finally, software patents pose a constant threat to the existence of
any free program. We wish to make sure that a company cannot
effectively restrict the users of a free program by obtaining a
restrictive license from a patent holder. Therefore, we insist that
any patent license obtained for a version of the library must be
consistent with the full freedom of use specified in this license.

 Most GNU software, including some libraries, is covered by the
```

ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

GNU LESSER GENERAL PUBLIC LICENSE
TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work

under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the

Sections above.

b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

11. If, as a consequence of a court judgement or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the library's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>

This library is free software; you can redistribute it and/or
modify it under the terms of the GNU Lesser General Public
License as published by the Free Software Foundation; either
version 2.1 of the License, or (at your option) any later version.

```
 This library is distributed in the hope that it will be useful,
 but WITHOUT ANY WARRANTY; without even the implied warranty of
 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU
 Lesser General Public License for more details.

 You should have received a copy of the GNU Lesser General Public
 License along with this library; if not, write to the Free Software
 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your
school, if any, to sign a "copyright disclaimer" for the library, if
necessary. Here is a sample; alter the names:

 Yoyodyne, Inc., hereby disclaims all copyright interest in the
 library `Frob' (a library for tweaking knobs) written by James Random Hacker.

 <signature of Ty Coon>, 1 April 1990
 Ty Coon, President of Vice

That's all there is to it!
```