IEC-104/101 Gateway

Teldat-Dm 802-I

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Chapter 1 Introduction

1.1 Introduction

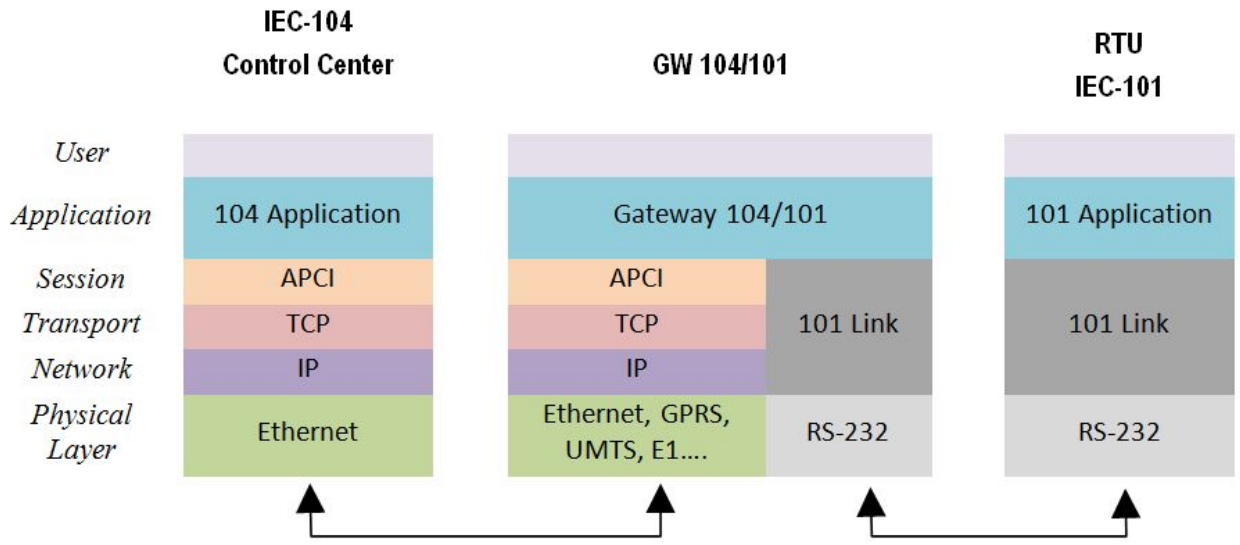
This document describes the operating and configuration mode for the IEC-60870-5-104 Gateway, from now on known as 104 and the IEC-60870-5-101, from now on known as 101, which the Teldat routers implement. This Gateway will be referred to as **GW104/101** throughout this manual.

IEC 101 (IEC 60870-5-101) is an international standard prepared by TC57 for the monitoring of power systems, control systems and associated communications. It is fully compliant with IEC 60870-5-1 and IEC 60870-5-5 standard and its use is in series for remote asynchronous channels between DTE and DCE. The standard is suitable for multiple configurations such as point to point, star, MultiDropper, etc.

The 101 is a telecontrol protocol for devices that communicate through a serial port, be this an RS-232 (point-to-point) or an RS-485 (point to multipoint). The 104 is an extension of the IEC-60870-5-101. The 104 defines how 101 should be transmitted over IP networks.

The **GW104/101** purpose is to provide access to the RTU IEC-101 from the IEC-104 Control Centers. The **GW104/101** also adapts the messages to simplify 104/101interoperability

The following schema shows the different elements making up a scenario containing **GW104/101** , as well as the different levels of protocols used.



Teldat routers supporting **GW104/101** need to have at least one asynchronous serial port.

The GW can handle as many asynchronous serial ports as the router has, provided that these ports are compatible with the GW.

You need to configure each of the serial ports that are going to participate in the GW in the router and you also need to configure the GW104 protocol. You must also configure the possible 104 agents in the GW protocol, which allow you to establish connections with the possible Control Centers.

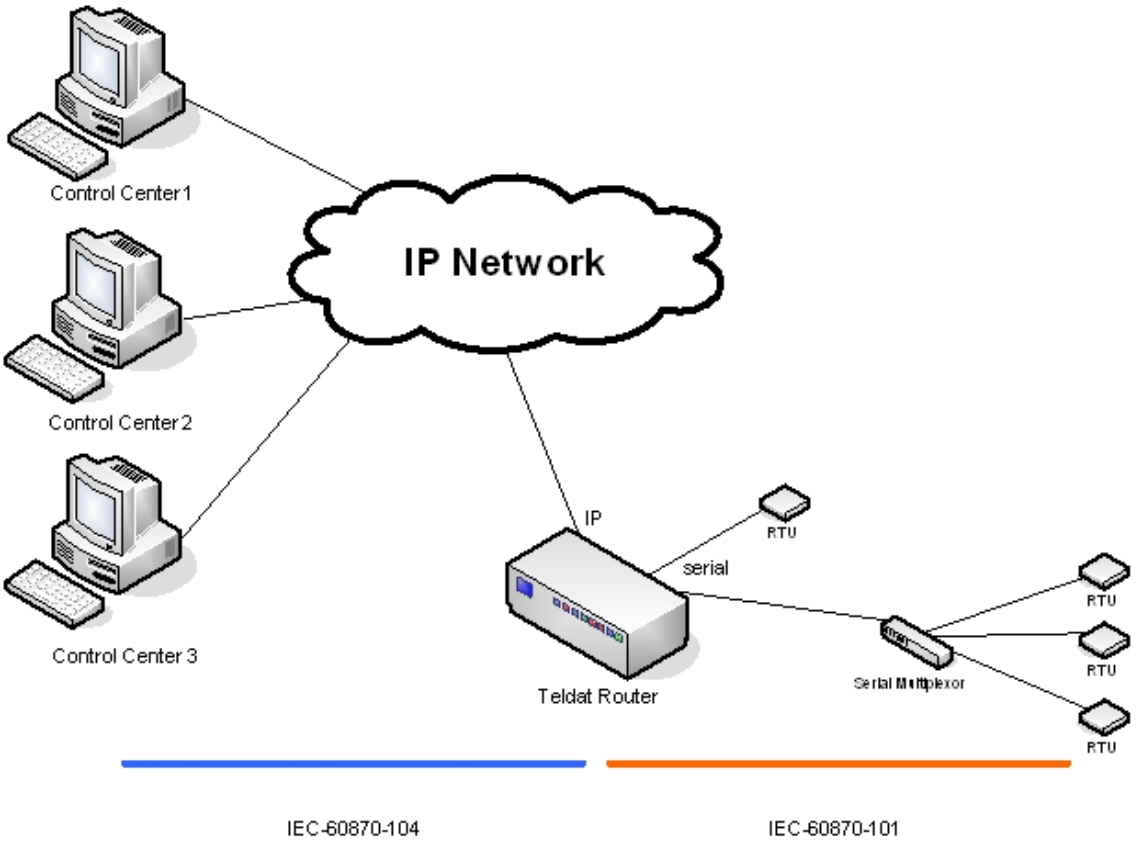
When the device starts up, the 101 interfaces that participate in the GW are identified and are internally associated so that both the user data and the control commands can flow between the GW, the 104 agents and the 101 interfaces.

Connection to multiple Control Center is supported and up to 4 simultaneous connections with each one of them. From these 4 sessions, only one can be active, the rest will be in test mode.

The **GW104/101** supports two types of 101 connections per serial interface:

- Point-to-point.
- Point-to-Multipoint.

The following figure shows a basic interconnection schema for the different elements that participate in a generic application with Teldat Routers' GW104/101:



Basic interconnection schema

The TCP/IP connections to the 104 Agents Control Centers allow you to select, if required, the VRF you wish to operate over. Each Control Center can pertain to a different VRF.

The router permits monitoring and configuration via SNMP, both for the GW104 and the 101 interfaces.

1.2 IEC-60870-5

IEC 60870 parte 5 is one of the IEC 60870 set of standards which define systems used for telecontrol (supervisory control and data acquisition) in electrical engineering and the power system automation applications. Part 5 provides a communication profile for sending basic telecontrol messages between two systems which uses permanently connected data circuits between the systems.

The IEC Technical Committee 57 have developed a protocol standard for telecontrol, teleprotection, and associated telecommunications for electric power systems. The result of this work is IEC 60870-5. Five documents specify the base IEC 60870-5:

- IEC 60870-5-1 Transmission Frame Formats.
- IEC 60870-5-2 Data Link Transmission Services.
- IEC 60870-5-3 General Structure of Application Data.
- IEC 60870-5-4 Definition and Coding of Information Elements.
- IEC 60870-5-5 Basic Application Functions.

The Committee has also generated companion standards:

- IEC 60870-5-101 Transmission Protocols, companion standards especially for basic telecontrol tasks.
- IEC 60870-5-102 Companion standard for the transmission of integrated totals in electric power systems.
- IEC 60870-5-103 Transmission Protocols to access the protection device.
- IEC 60870-5-104 Transmission Protocols, Network access for IEC 60870-5-101 using standard transport profiles (TCP/IP).

1.3 IEC 60870-5-101

IEC 60870-5-101 [IEC101] is a standard for power system monitoring, control and associated communications for telecontrol, teleprotection and associated telecommunications for electric power systems. This is completely compatible with IEC 60870-5-1to IEC 60870-5-5 standards and uses standard asynchronous serial between DTE and DCE. This standard is suitable for multiple configurations such as point-to-point and multipoint, etc.

1.3.1 Features

- Supports unbalanced (only master initiated message) & balanced (can be master/slave initiated) modes of data transfer.
- Link address and ASDU addresses are provided for classifying the end station and different segments under the same.
- Data is classified into different information objects and each information object is provided with a specific address.
- Facility to classify the data into high priority (class-1) and low priority (class-2) and transfer the same using separate mechanisms.
- Possibility of classifying the data into different groups (1-16) to get the data according to the group by issuing specific group interrogation commands from the master & obtaining data under all the groups by issuing a general interrogation.
- Cyclic & Spontaneous data updating schemes are provided.
- Facility for time synchronization.
- Schemes for transfer of files.

1.3.2 Frame Format

IEC 101 uses the following character format:

- 1 Start bit
- 8 Data bits
- 1 Parity bit
- 1 Stop bit:

FT1.2 (defined in IEC 60870-5-1) is used for the IEC 101 frame format which is suitable for *asynchronous* communication with *hamming distance* of 4. This uses 3 types of frame formats

- Frame with variable length ASDU
- Frame with fixed length
- Single character

Single character frames are used for acknowledgments (ACK/NACK). Fixed length frames are used for sending commands. Variable length frames are used for sending data.

The details of variable length frame are given below:

IEC 101 Frame Format, Variable length		
Data unit	**Name**	**Function**
Start Frame	Start Character	*Indicates start of Frame*
	Length Field (*2)	*Total length of Frame*
	Start Character (repeat)	*Repeat provided for reliability*
	Control Field	*Indicates control functions like message direction*
	Link Address (*0,1 or 2*)	*Normally used as the device / station address*
Data Unit Identifier	Type Identifier	*Defines the data type which contains specific format of information objects*
	Variable Structure Qualifier	*Indicates whether type contains multiple information objects or not*
	COT (*1 or 2*)	*Indicates causes of data transmissions like spontaneous or cyclic*
	ASDU Address (*1 or 2*)	*Denotes separate segments and its address inside a device*
Information Object 1	Information Object Address (*1 or 2 or 3*)	*Provides address of the information object element*
	Information Elements (n)	*Contains details of the information element depending on the type*
Information Object-2	••••	
••••	••••	
Information Object- n		
Stop Frame	Checksum	*Used for Error checks*
	Stop Char	*Indicates end of a frame*

1.3.3 Types Supported

- Single indication without / with timestamps.
- Double indication without / with timestamps.
- Step position information without / with timestamps.
- Measured value – normalized, scaled, short floating point without / with timestamps.
- Bitstring of 32 bit without / with timestamps.
- Integrated totals (counters) without / with timestamps.
- Packed events (start & tripping) of protection equipments
- Single commands
- Double commands
- Regulating step command
- Set point commands of various data formats
- Bitstring commands
- Interrogation commands
- Clock synchronization & delay acquisition commands
- Test & reset commands

1.4 IEC 60870-5-104

IEC 60870-5-104 (IEC 104) protocol is an extension of IEC 101 protocol with the changes in transport, network, link & physical layer services to suit the complete network access.

The standard uses an open *TCP/IP* interface to network to have connectivity to the LAN (*Local Area Network*) and routers with different facility (*ISDN*, *X.25*, *Frame relay* etc) can be used to connect to the WAN (*Wide Area Network*).

Application layer of IEC 104 is preserved the same as that of IEC 101 with some of the data types and facilities not used.

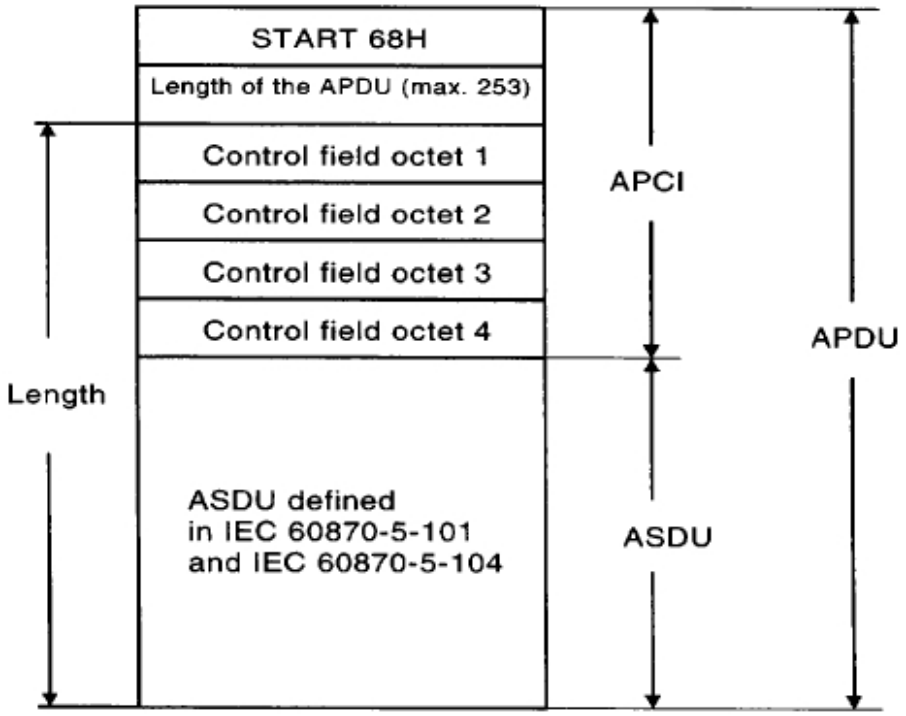
There are two separate link layers defined in the standard, which is suitable for data transfer over Ethernet & serial line (PPP - *Point-to-Point Protocol*). The control field data of IEC104 contains various types of mechanisms for effective handling of network data synchronization

1.4.1 APCI (Application Protocol Control Information)

The TCP protocol is aimed at data packets, consequently a start and end message mechanism isn't defined to delimit each IEC 101 ASDU (Application Service Data Unit).

In IEC-104 the APDU (Application Protocol Data Unit) messages are divided into APCI (Application Protocol Control Information) and ASDU.

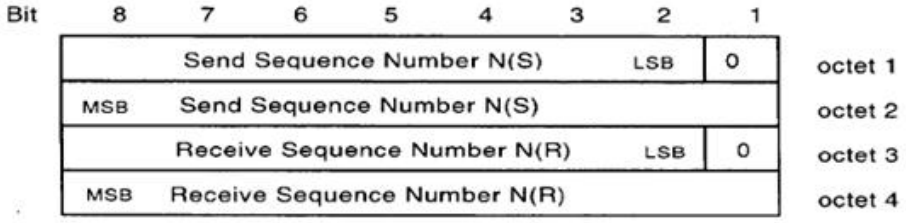
To detect the start and end of the ASDU, IEC 104 has defined a PCI which consists of: a start character for the frame, a length field from APDU and a control field.



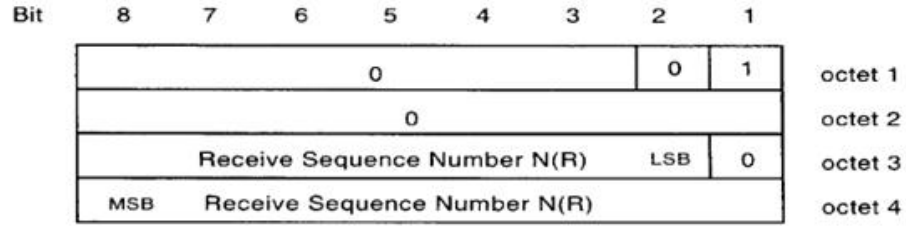
APCI	Application Protocol Control Information
APDU	Application Protocol Data Unit
ASDU	Application Service Data Unit

68H is the start character. The second field corresponds to the APDU length, which represents the four bytes from the control fields plus the ASDU length.

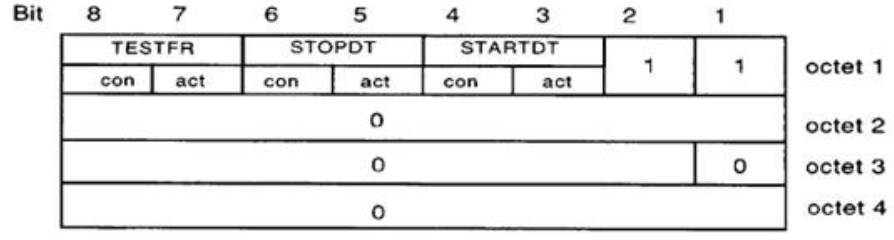
The control fields define the information needed to protect against message loss and duplication. Additionally, these indicate the type of format transmitted, information transfer format (format I), supervision frame (S) and control frame (U).



Control field for format I



Control field for format S



Control field for format U

1.4.2 Control timers

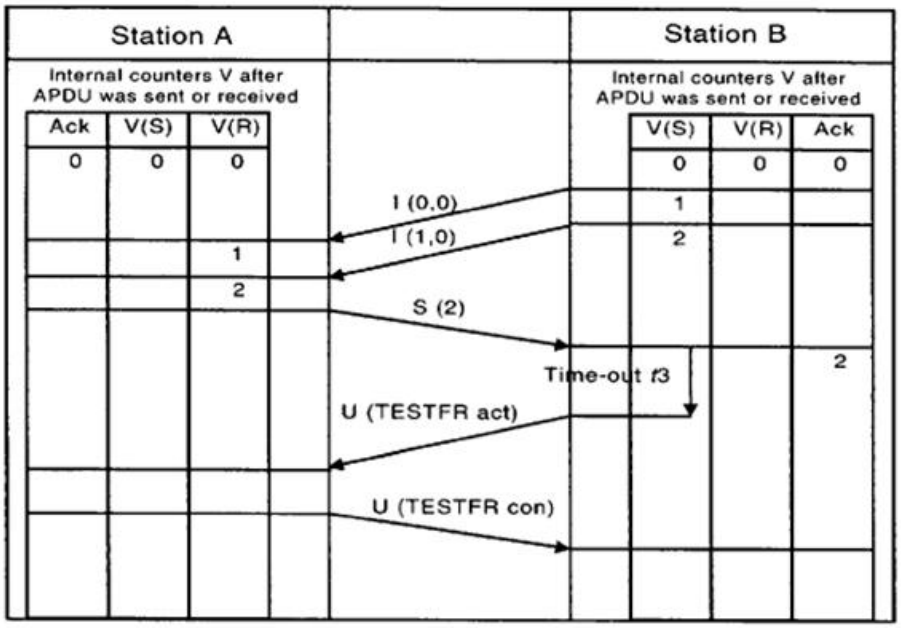
IEC 60870-5-104 defines four timers for link maintenance.

- T0 Corresponds to the connection establishment wait time.

- T1 Test APDUs sending wait time.

- T2 Wait time to detect inactivity, when there is no data exchange.

- T3 Wait time to send the test frames in cases where the inactivity state is prolonged. This situation is shown in the following figure where station B has sent two I frames to station A and this latter has acknowledged them through an S frame. When station B receives this acknowledgement frame, the T3 timer restarts. If the T3 value times out and a frame hasn't been received from station A, station B sends a U communication to verify connectivity with station A.



1.4.3 Application Data: General structure

The notation for each ASDU is specified in a hierarchical order, offering the possibility to use a global notation and specifications for different companion standards.

1.4.3.1 Level 1 Information Class:

- Information Monitor: M

- Information Control: C

- Parameters: P

- File transfer: F

1.4.3.2 Level 2 Information Class

- Information Monitor:

  Example: Single Point Information M_SP

  Example: Measurement M_ME

- Information Control:

  Example: Double_Command C_DC

- Parameters:

  Example: Measurement Parameters P_ME

- File transfer:

Example: Directory F_DR

1.4.3.3 Level 3 Information Class

The third level is used for different companion Standards; this defines the specific ASDU type, the use of timestamps.

The first letter at this level indicates whether this is with time or not, the second specifies the type, each Companion Standard can define its own type in alphabetical order.

Standard Measurements with time: M_ME_TA

Floating Point Measurements without time: M_ME_NB

1.4.4 Features

The features used in the IEC 60870-5-104 standard are defined in the IEC 60870-5-5 specification and permits communication from the control station, equivalent to the client, and the control station or server.

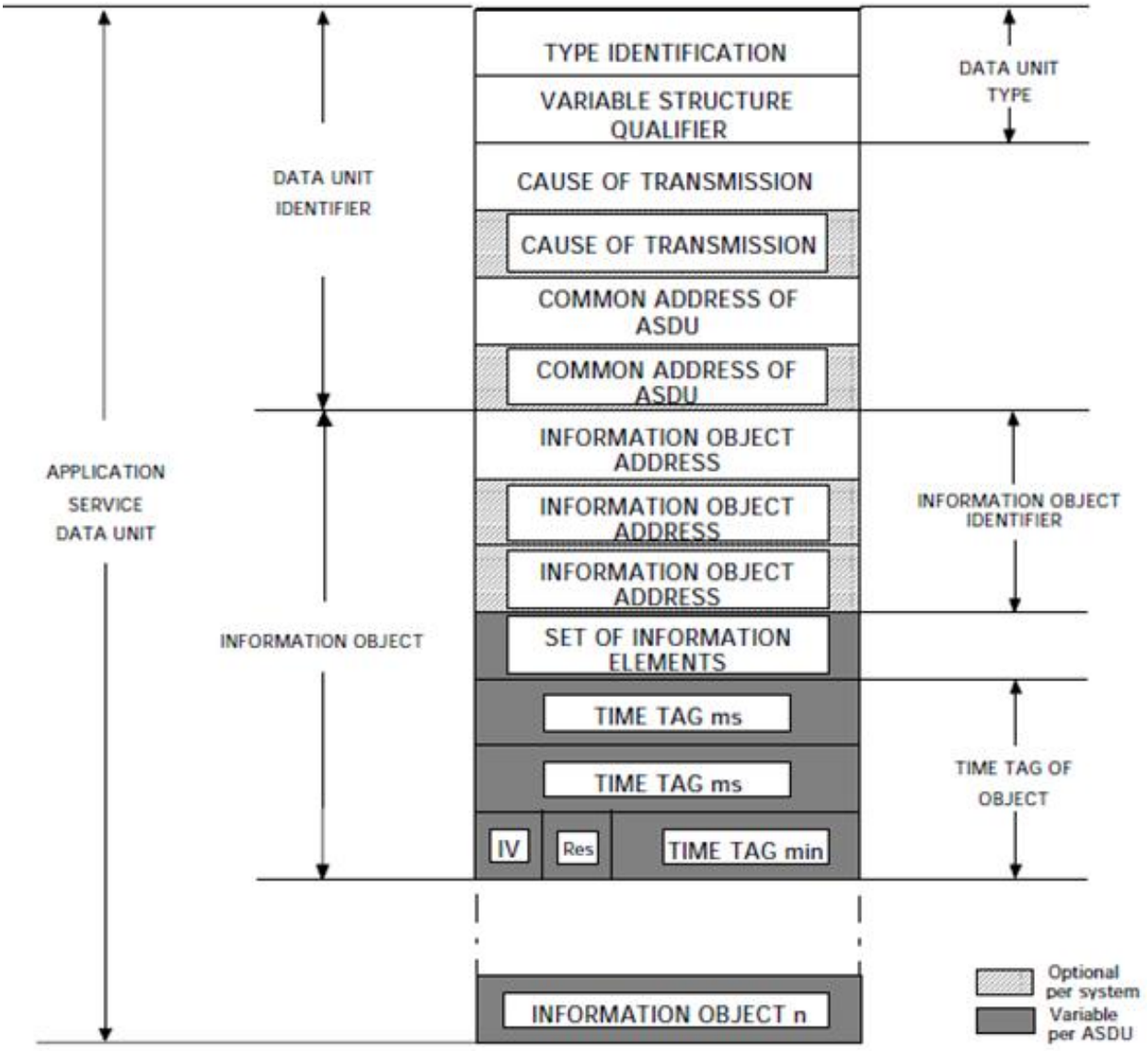
1.4.5 Events Acquisition

The updating of the value for the information objects in a substation is automatically reported to the control station.

1.4.6 ASDU application layer data unit

The ASDU is made up of a block for the Unit Identifier Data and one or more information objects, as shown in the following figure.

The unit identifier data block always has the same structure for all the ASDUs. The ASDU information objects are always the same structure and type; this is defined in the TYPE IDENTIFICATION field.



1.4.6.1 Type Identification

This defines the structure, type and the format of an information object. All information objects for a specific ASDU have the same structure, type and format.

MONITOR DIRECTION:

<1> M_SP_NA_1 (Single-point Information)

<3> M_DP_NA_1 (Double-point Information)

<5> M_ST_NA_1 (Step Position Information)

<7> M_BO_NA_1 (Bitstring of 32 bit)

<9> M_ME_NA_1 (Measured value, normalized value)

<11> M_ME_NB_1 (Measured value, scaled value)

<13> M_ME_NC_1 (Measured value, short floating point number)

<15> M_IT_NA_1 (Integrated Totals)

<20> M_PS_NA_1 (Packet single-point Information w status change detection)

<21> M_ME_ND_1 (Measured value, normalized value w quality descriptor)

<70> M_EI_NA_1 (End of initialization)

With timestamp

<30> M_SP_TB_1 (Single-point information with time tag CP56time2a)

<31> M_DP_TB_1 (Double-point information with time tag CP56time2a)

<32> M_ST_TB_1 (Step position information with time tag CP56time2a)

<33> M_BO_TB_1 (Bitstring of bit with time tag CP56time2a)

<34> M_ME_TD_1 (Measured value, normalized value with time tag CP56time2a)

<35> M_ME_TE_1 (Measured value, scaled value with time tag CP56time2a)

<36> M_ME_TF_1 (Measured value, short floating point value with time tag CP56time2a)

<37> M_IT_TB_1 (Integrated Totals with time tag CP56time2a)

<38> M_EP_TD_1 (Event of protection equipment with time tag CP56time2a)

<39> M_EP_TE_1 (Packed start events of protection equipment with time tag CP56time2a)

<40> M_EP_TF_1 (Packed output circuit information of protection equipment with time tag CP56time2a)

CONTROL DIRECTION

<45> C_SC_NA_1 (Single command)

<46> C_DC_NA_1 (Double command)

<47> C_RC_NA_1 (Regulating step command)

<48> C_SE_NA_1 (Set point command, normalized value)

<49> C_SE_NB_1 (Set point command, scaled value)

<50> C_SE_NC_1 (Set point command, short floating point number)

<51> C_BO_NA_1 (Bitstring of 32 bits)

<100> C_IC_NA_1 (Interrogation Command)

<101> C_CI_NA_1 (Counter Interrogation Command)

<102> C_RD_NA_1 (Read Command)

<103> C_CS_NA_1 (Clock Synchronization Command)

<105> C_RP_NA_1 (Reset Process Command)

1.4.6.2 Variable Structure Qualifier

This contains the type of sequence and the number of Information objects. SQ=0 Each Information Object has its respective IOA.

SQ: 1 only has the first IOA.

Number: Number of Objects in the ASDU.

1.4.6.3 Cause of Transmission:

T= Test

P/N = (0/1) Conformation Positive or Negative.

<1> periodic, cyclic

<2> Background scan

<3> spontaneous

<4> initialized

<5> requested

<6> activation

<7> activation confirmation

<8> deactivation

<9> deactivation confirmation

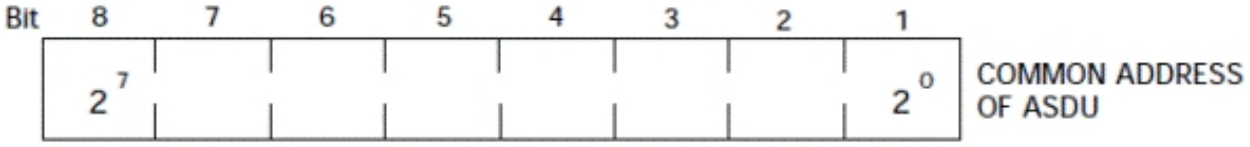
<10> activation termination

<20> interrogated by general interrogation

<21> interrogated by group 1 – 16

1.4.6.4 ASDU Common Address

This is determined by a fixed system parameter (1 or 2 bytes), corresponding to the station address, as shown in the following figure.

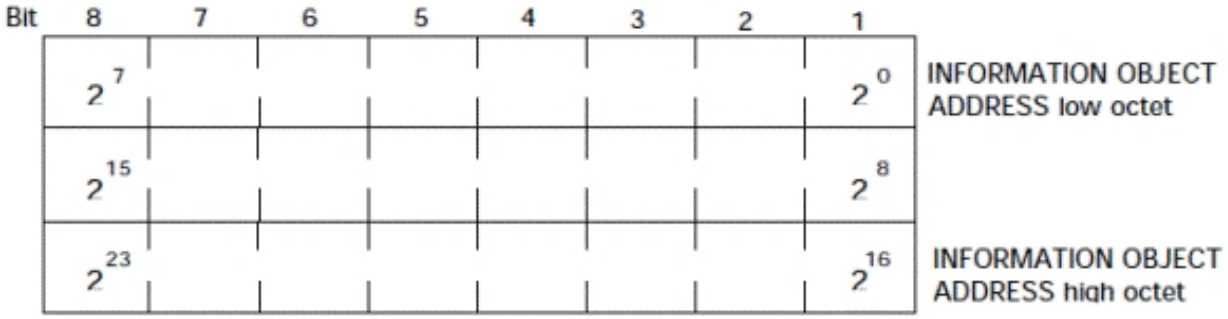


1.4.6.5 Information Object Address

The Information Object Address field can have a length of one, two or three bytes; it's a configurable parameter and identical for all the system.

This address is used as a destination address for frames to control and as source to monitor.

In all cases, the first byte corresponds to the least significant. When the address is configured with a zero value, it is considered irrelevant. The rest of the possible addresses might be available.



1.5 GW104/101 Characteristics

The IEC-101 Interface supports the following features:

- Type of serial interface supported:

  RS-232

- Protocols for asynchronous serial line:

  IEC 60870-5-101 BALANCED

- Character format supported:

  start + 8 data + parity + 1 stop

- Types of parity supported:

  PAR

- Types of links:

  Point to Point

  Point to Multipoint

- SNMP:

Monitoring

Configuration

The IEC-104 Agent supports the following features:

- Multiple Control Center Connections:

  There is no established limit; this only depends on the capacity of the router

- Multiple sessions connection per Control Center:

  Up to 8

- Compatible with VRFs

  You can associate each Agent to a VRF

- SNMP:

  Monitoring

  Configuration

Chapter 2 Configuring the IEC-101 Interface

2.1 NET IEC-101

The **IEC-101** interfaces allow you to connect **Teldat** devices to devices that use IEC-60870-5-101 protocol to participate in the GW104/101 functionality.

To configure a GW104/101, you first need to define the serial interfaces (net) participating in the GW.

The **IEC-101** interfaces over a serial line, in Teldat devices, are always RS-232. No other types of interfaces are implemented.

2.1.1 IEC-101 Parameters

The IEC-101 interface basic parameters that can be configured are as follows:

add-rtu	Adds an RTU for Multilink mode
asdu-common-address	Configures an ASDU common Address (for non multilink mode)
baudrate	Configures the rate for a serial interface
link-address	Configures an IEC-101 Link Address (for non multilink mode)
link-address-size	Configures the IEC-101 Link Address size
long-frame-response	Enables long frame response towards the RTUs
multilink-mode	Enables the point to multipoint mode towards the RTUs
no	Negates a command or sets the default values
num-buffers	Configures the number of IEC-101 buffers transmission
originator-address	Configures the originator address
retransmissions-max	Configures the maximum number of retransmissions
retransmissions-time	Configures the time between retransmissions (msec.)
rx-timeout	Configures the frame reception time (msec.)
synchronization-time	Configures the synchronization period time (min.)
test-link-time	Configures the line test period (sec.)
test-link-type	Configures the type of line test: 0(none)/1(test)/2(status)

2.2 Configuring the IEC-101parameters

To enter in the configuration process, carry out the following steps:

(1) At the (*) prompt, enter **PROCESS 4** or **P 4**. This will take you to the configuration prompt *Config*>.

```
*P 4
Config>
```

(2) Enter the **LIST DEVICES** command. This will show all the interfaces the device has assigned as IEC-101.

```
Config>list devices

Interface            Connector     Type of interface
ethernet0/0          GE0/FE0/LAN1  GigabitEthernet interface
ethernet0/1          GE1/FE1/LAN2  GigabitEthernet interface
x25-node             ---           Router->Node
atm1/0               SLOT1         Generic ATM
serial2/0            SLOT2 IEC-101 GW Interface
serial2/1            SLOT2         Synchronous Serial Line
serial2/2            SLOT2         Synchronous Serial Line
Config>
```

(3) The interfaces that can be configured in IEC-101 mode are SERIAL interfaces: these are listed as “serialX/X” in the device. It’s possible on startup that the device doesn’t have the required interfaces configured as IEC-101. To do this you need to execute the **SET DATA-LINK** command followed by that shown in the following example:

```
Config> list devices
```

```
Interface            Connector     Type of interface
ethernet0/0          GE0/FE0/LAN1  GigabitEthernet interface
ethernet0/1          GE1/FE1/LAN2  GigabitEthernet interface
x25-node             ---           Router->Node
atm1/0               SLOT1         Generic ATM
serial2/0            SLOT2 IEC-101 GW Interface
serial2/1            SLOT2         Synchronous Serial Line
serial2/2            SLOT2         Synchronous Serial Line
Config> set data-link iec-101-gw serial2/1
Config>list devices

 Interface            Connector     Type of interface
ethernet0/0          GE0/FE0/LAN1  GigabitEthernet interface
ethernet0/1          GE1/FE1/LAN2  GigabitEthernet interface
x25-node             ---           Router->Node
atm1/0               SLOT1         Generic ATM
serial2/0            SLOT2 IEC-101 GW Interface
serial2/1            SLOT2 IEC-101 GW Interface
serial2/2            SLOT2         Synchronous Serial Line
Config>
```

(4) Subsequently enter the command **NETWORK** followed by the name of the IEC-101 interface you wish to configure. This then changes to the configuration menu for the indicated IEC-101 Interface. The # character is used in the generic examples to indicate the name.

```
Config>NETWORK #
-- IEC-101 Gateway Interface Configuration --
IEC101-# Cfg>
```

If the interface was serial0/0 for example, the following would appear:

```
Config>network serial0/0
-- IEC-101 Gateway Interface Configuration --
IEC101-serial0/0 Cfg>
```

There are certain commands that are common to all the device interfaces. These commands are not explained in here: you can find the descriptions for them in the following manual: **Dm772-I Common Configuration Interfaces**.

This section numerates and describes the IEC-101 net configuration commands. All the IEC-101 configuration commands must be entered at the IEC-101 (IEC-101-# Cfg>) prompt.

Command	**Function**
? (HELP)	Lists the configuration commands or lists any parameter associated with a command.
add-rtu	Adds an RTU for the Multilink mode.
asdu-common-address	Configures the ASDU common Address (for the non multilink mode)
baudrate	Configures the serial interface rate
link-address	Configures IEC-101 Link Address (for the non multilink mode)
link-address-size	Configures the IEC-101 Link Address size
long-frame-reponse	Enables long frame response towards the RTUs
multilink-mode	Enables the point to multipoint mode towards the RTUs
no	Negates a command or sets the default values
num-buffers	Configures the number of IEC-101 buffers transmission
originator-address	Configures originator address
retransmissions-max	Configures the maximum number of retransmissions
retransmissions-time	Configures the time between retransmissions (msec.)
rx-timeout	Configures the frame reception time (msec.)
synchronization-time	Configures the synchronization period time (min.)
test-link-time	Configures the line test period (sec.)
test-link-type	Configures the type of line test: 0(none)/1(test)/2(status)

2.2.1 ? (HELP)

The **?** (HELP) command lists all the available commands. You can also enter a **?** after a specific command to view its options.

Syntax:

```
IEC101-# Cfg>?
```

Example:

```
IEC101-serial2/0 Cfg>?
  add-rtu                 Adds a RTU for Multilink mode
  asdu-common-address     Configure ASDU common Address(for no multilink mode)
  baudrate                Configure serial interface baudrate
  debug-level             Set debug level(BIT):
                          TX(5),RX(4),LSLV(3),LMST(2),ASDU(1),GW(0)
  description             Enter interface description
  link-address            Configure IEC-101 Link Address(for no multilink mode)
  link-address-size       Configure IEC-101 Link Address size
  long-frame-reponse      Enable sends long frame responses to RTU's
  multilink-mode          Enable RTU's multilink mode
  no                      Negate a command or set its defaults
  num-buffers             Configure number of IEC-101 transmission buffers
  originator-address      Configure originator address
  retransmissions-max     Configure max. retransmissions number
  retransmissions-time    Configure retransmission time (msec.)
  rx-timeout              Configure input frame timeout(msec.)
  shutdown                Change state to administratively down
  synchronization-time    Configure synchronization period time(min.)
  test-link-time          Configure test link period time(sec.)
  test-link-type          Configure test link type 0(none)/1(test)/2(status)
  update                  Update a level indicator
  exit
IEC101-serial2/0 Cfg>
```

2.2.2 ADD-RTU

Permits you to add the Link Address for an RTU participating in a multilink connection.

In multilink mode, the address is used to add it to the Link Address field and in the ASDU Common Address field.

This command must be executed as many times as the number of RTUs that are going to be included in the point-to-multipoint line. Each entry will have a unique RTU address, i.e., it cannot be repeated.

This parameter is only active when the IEC-101 interface is configured in multilink mode.

Syntax:

```
IEC101-serial2/0 Cfg>add-rtu ?
  <1..65534>    RTU Link address
```

Example:

```
IEC101-serial2/0 Cfg>add-rtu 400
IEC101-serial2/0 Cfg>add-rtu 401
```

2.2.3 ASDU-COMMON-ADDRES

This parameter permits you to configure the ASDU Common Address that is included in the messages sent to the RTU.

This parameter is only active when the IEC-101 interface is **NOT** configured in multilink mode.

You can configure values between 1 and 65534. Default is 1.

Syntax:

```
IEC101-serial2/0 Cfg>asdu-common-address ?
```

```
  <1..65534>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>asdu-common-address 4566
IEC101-serial2/0 Cfg>
```

2.2.4 BAUDRATE

Permits you to configure the asynchronous reception and transmission rate for the serial interface.

This parameter is only active when the IEC-101 interface is **NOT** configured in multilink mode.

You can configure standard rate values between 300 and 57600. Default is 9600.

Syntax:

```
IEC101-serial2/0 Cfg>baudrate ?
  <300..57600>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>baudrate 1200
IEC101-serial2/0 Cfg>
```

2.2.5 debug-level

Permits you to enable debugging events for the IEC-101 interface.

You can enable different events; to do this you need to use the bit level. The entered value must be HEXADECIMAL:

TX(5), RX(4), LSLV(3), LMST(2), ASDU(1), GW(0)

By default the debugging events are disabled.

Syntax:

```
IEC101-serial2/0 Cfg>debug-level ?
  <hex 0..ff>    Hexadecimal value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>debug-level 03
IEC101-serial2/0 Cfg>
```

2.2.6 LINK-ADDRES

This parameter configures the Link Address parameter included in the messages sent to the RTU.

This parameter is only active when the IEC-101 interface is **NOT** configured in multilink mode.

You can configure values between 1 and 65534. Default is 1.

Syntax:

```
IEC101-serial2/0 Cfg>link-address ?
  <1..65534>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>link-address 43434
IEC101-serial2/0 Cfg>
```

2.2.7 LINK-ADDRES-SIZE

This parameter configures the size of the Link Address field included in the messages sent to the RTU.

You can configure values 1 and 2. Default is 2.

Syntax:

```
IEC101-serial2/0 Cfg>link-address-size ?
```

```
  <1..2>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>link-address-size 2
IEC101-serial2/0 Cfg>
```

2.2.8 long-frame-reponse

This parameter enables the sending of long-frame messages to the RTUs.

Syntax:

```
IEC101-serial2/0 Cfg>long-frame-response ?
  <cr>
```

Example:

```
IEC101-serial2/0 Cfg>long-frame-response
IEC101-serial2/0 Cfg>
```

2.2.9 multilink-mode

This parameter enables the point-to-multipoint operating mode. In this mode the serial interface can only communicate with multiple RTUs.

In point-to-multipoint mode, you need to use the *add-rtu* command to add the RTUs. Through this command you create an entry with an associated address. You can create as many entries as RTUs going to participate in the multipoint. This address is used to add it to the Link Address field and to the ASDU Command Address field in the sent messages.

When the point-to-multipoint mode is **NOT** enabled, then the serial interface can only communicate with one RTU. In this case the *link-address* command configures the address used to add it to the Link Address field in the sent messages. And the *asdu-common-address* command configures the address used to add it to the ASDU Common Address field in the sent messages.

Syntax:

```
IEC101-serial2/0 Cfg>multilink-mode ?
  <cr>
```

Example:

```
IEC101-serial2/0 Cfg>multilink-mode
IEC101-serial2/0 Cfg>
```

2.2.10 NO

Use this command to disable features or to set the default values for some parameters.

Syntax:

```
IEC101-serial2/0 Cfg>no ?
  add-rtu               Adds a RTU for Multilink mode
  description           Enter interface description
  long-frame-reponse    Enable sends long frame responses to RTU's
  multilink-mode        Enable RTU's multilink mode
  shutdown              Change state to administratively down
  update                Update a level indicator
```

2.2.10.1 NO ADD-RTU

Eliminates the entry indicated in the command address, from the list of RTUs participating in the multilink.

Example:

```
IEC101-serial2/0 Cfg>no add-rtu 400
IEC101-serial2/0 Cfg>
```

2.2.10.2 NO LONG-FRAME-RESPONSE

Disables the *long-frame-response* option.

Example:

```
IEC101-serial2/0 Cfg>no long-frame-response
IEC101-serial2/0 Cfg>
```

2.2.10.3 NO MULTILINK-MODE

Disables the point-to-multipoint mode.

Example:

```
IEC101-serial2/0 Cfg>no multilink-mode
IEC101-serial2/0 Cfg>
```

2.2.11 NUM-BUFFERS

This parameter configures the number of buffers pending transmission to the RTU. Each buffer will store an IEC-101 message, received from 104 agents, waiting until they can be sent to the RTU.

You can configure values between 1 and 1024. Default is 16.

Syntax:

```
IEC101-serial2/0 Cfg>num-buffers ?
  <1..1024>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>num-buffers 32
IEC101-serial2/0 Cfg>
```

2.2.12 ORIGINATOR-ADDRESS

This parameter configures the address included in the Originator Address field for the 101 messages that are transmitted to the RTU.

You can configure values between 1 and 65534. Default is 1.

Syntax:

```
IEC101-serial2/0 Cfg>originator-address ?
  <1..65534>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>originator-address 4577
IEC101-serial2/0 Cfg>
```

2.2.13 RETRANSMISSION-MAX

This parameter configures the maximum number of times an IEC-101 message is retransmitted to the RTU.

You can configure values between 1 and 300. Default is 2.

Syntax:

```
IEC101-serial2/0 Cfg>retransmissions-max ?
  <1..300>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>retransmissions-max 5
IEC101-serial2/0 Cfg>
```

2.2.14 RETRANSMISSION-TIME

This parameter configures the time between retransmissions of an IEC-101 message to the RTU.

The configuration unit is in milliseconds.

You can configure values between 1 and 10000. Default is 200.

Syntax:

```
IEC101-serial2/0 Cfg>retransmissions-time ?
  <1..10000>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>retransmissions-time 400
IEC101-serial2/0 Cfg>
```

2.2.15 RX-TIMEOUT

This parameter configures the maximum time to receive an IEC-101 message from the RTU. The timer starts when the first character is received; consequently, the whole message must be received in a time inferior to that configured in this parameter.

The configuration unit is in milliseconds.

You can configure values between 1 and 10000. Default is 500.

Syntax:

```
IEC101-serial2/0 Cfg>rx-timeout ?
  <1..10000>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg> rx-timeout 400
IEC101-serial2/0 Cfg>
```

2.2.16 SYNCHRONIZATION-TIME

This parameter configures the period of time that must occur so an IEC-101 synchronized time message is sent to the RTU. The synchronization message is sent periodically.

The configuration unit is in minutes.

You can configure values between 1 and 43200. Default is 43200.

Syntax:

```
IEC101-serial2/0 Cfg>synchronization-time ?
  <1..43200>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg> synchronization-time 120
IEC101-serial2/0 Cfg>
```

2.2.17 TEST-LINK-TIME

This parameter configures the period of time that must occur so an IEC-101 Test message is sent to the RTU. The Test message is sent periodically.

The configuration unit is in seconds.

You can configure values between 1 and 86400. Default is 3600.

Syntax:

```
IEC101-serial2/0 Cfg>test-link-time ?
  <1..86400>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>test-link-time 240
IEC101-serial2/0 Cfg>
```

2.2.18 TEST-LINK-TYPE

This parameter configures the period that the line test message type must be sent to the RTU.

The following values are permitted:

0 # The line Test is not executed.

1 # An IEC-101 TEST message is sent.

2 # An IEC-101 STATUS message is sent.

Default is 0 (The line test is not executed).

Syntax:

```
IEC101-serial2/0 Cfg>test-link-type ?
  <0..2>    Value in the specified range
```

Example:

```
IEC101-serial2/0 Cfg>test-link-type 1
IEC101-serial2/0 Cfg>
```

2.2.19 EXIT

Use the **EXIT** command to return to the previous prompt level.

Syntax:

```
IEC101-serial2/0 Cfg>exit
```

Example:

```
IEC101-serial2/0 Cfg>exit
Config>
```

2.3 Show Config

Show Config is a configuration console tool that allows you to list the commands needed to configure the router from a blank configuration (no conf).

This command can be used to both copy configurations as well as list them, or simply to view them.

Show Config starts from a defined internal default configuration, generating commands from the configuration which differ from this.

Show Config can incorporate commentaries that are placed after a semi colon (';')

This command can be executed from any menu, displaying the configuration entered in all the submenus that hang from the current menu.

Example:

The following example shows an IEC-101 interface:

```
IEC101-serial2/0 Cfg>show conf
; Showing Menu and Submenus Configuration for access-level 15 ...
; ATLAS360 Router 15 25 Version 10.8.18-Alfa

     link-address 43434
     multilink-mode
     asdu-common-address 4566
     add-rtu 222
     add-rtu 333
     add-rtu 3434
     add-rtu 400
     add-rtu 401
```

```
;
      originator-address 1
      baudrate 1200
      synchronization-time 33333
      num-buffers 32
      long-frame-reponse
      debug-level 3
;
IEC101-serial2/0 Cfg>
```

With the list of commands obtained in **SHOW CONFIG**, you can copy, edit and modify so it can be used as a template for subsequent configurations.

Chapter 3 Monitoring the IEC-101 Interface

3.1 Monitoring

To enter in the IEC-101 monitoring process, carry out the following steps:

(1) At the (*) prompt, enter **PROCESS 3** or **P 3**. This will take you to the configuration prompt +.

```
*P 3
+
```

(2) At the (+) prompt, enter the command **NETWORK** followed by the number identifying the IEC-101 interface you wish to monitor. The # character is used in the generic examples to indicate the number.

```
+NETWORK #
-- IEC-101 Gateway Console -
IEC101GW -#+
```

If the interface was **serial2/0** for example, the following would appear:

```
+NETWORK serial2/0
-- IEC-101 Gateway Console --
IEC101GW-serial2/0+
```

This section numerates and describes the IEC-101 monitoring commands. All the IEC-101 monitoring commands must be entered at the IEC-101 (IEC-101-# +) prompt.

Command	Function
? (HELP)	Lists the available commands or their options.
LIST	Lists the statistics information.
EXIT	Permits you to exit the IEC101 monitoring environment.

3.1.1 ? (HELP)

The **?** (HELP) command lists all the available commands included at the normal prompt level. You can also enter a **?** after a specific command to view its options.

Syntax:

```
IEC101GW -#+?
```

Example:

```
IEC101GW-serial2/0+?
  list    List IEC-101 interface information
  exit
IEC101GW-serial2/0+
```

3.1.2 LIST

Lists all the statistics for the interface traffic and the signal states.

Syntax:

```
IEC101GW-serial2/0+list
```

Example:

```
IEC101GW-serial2/0+list

 CONFIGURATION INFO:
 ASDU common address       : 222
 Link address              : 222
 Link address size         : 2
 Originator address        : 1
 Baud rate                 : 9600
 Max. num. retransmission  : 2
 Retransmission time       : 200
```

```
 Rx timeout                : 500
 Link test type            : none
 Link test time            : 3600
 Sinchronitation time      : 33333
 Number Tx buffers         : 10
 Long frame responses      : enable
 Multilink Mode            : enable

 RTU's STATUS:
 Link Addr  Status    MasterState     SlaveState
 --------- -------- --------------- --------------
     222   ACTIVE   MASTERLINKAVAIL SLAVELINKAVAIL
     333   ACTIVE   MASTERLINKAVAIL SLAVELINKAVAIL
    3434   ACTIVE   MASTERLINKAVAIL SLAVELINKAVAIL

 SERIAL STATUS:
 Tx messages queue to 101 : 0
 Rx bytes                 : 759
 Rx messages              : 50
 Rx CRC error messages    : 0
 Tx bytes                 : 725
 Tx messages              : 105
 Tx congestion            : 0

IEC101GW-serial2/0+
```

Chapter 4 IEC-101 Interface Events

4.1 Monitoring the IEC-101 Interface Events

Permits you to monitor the events that occur over one or various IEC-101 interfaces in real time, when the events logging system is enabled for this protocol.

The way to enable them from the configuration menu is as follows:

```
*PROCESS 4
User Configuration
Config>EVENT
-- ELS Config --
ELS Config>ENABLE TRACE SUBSYSTEM I101 ALL
ELS Config>EXIT
Config>SAVE
Save configuration [n]? Y
Saving configuration...OK
Config>
```

In the same way, you can enable the events from the monitoring menu at any point, without the latter needing to be saved in the configuration, in the following way:

```
*PROCESS 3
Console Operator
+EVENT
-- ELS Monitor --
ELS>ENABLE TRACE SUBSYSTEM I101 ALL
ELS>EXIT
+
```

To view the events once they are enabled, enter the following:

```
*PROCESS 2
07/05/11 12:53:49  I101.001 Rx Data from Ser.Term. 19 bytes, ifc serial2/0
07/05/11 12:53:49  I101.010 Data Rx from ifc serial2/0 (addr:222,19 bytes):
 68 0D 0D 68 73 DE 00 64 01 03 00 DE 00 00 00 00
 14 AB 16

07/05/11 12:53:49  I101.009 Data Tx to ifc serial2/0 (addr:222,6 bytes):
 10 80 DE 00 5E 16

07/05/11 12:53:51  I101.001 Rx Data from Ser.Term. 19 bytes, ifc serial2/0
07/05/11 12:53:51  I101.010 Data Rx from ifc serial2/0 (addr:222,19 bytes):
 68 0D 0D 68 53 DE 00 64 01 03 00 DE 00 00 00 00
 14 8B 16

07/05/11 12:53:51  I101.009 Data Tx to ifc serial2/0 (addr:222,6 bytes):
 10 80 DE 00 5E 16

07/05/11 12:53:54  I101.001 Rx Data from Ser.Term. 19 bytes, ifc serial2/0
07/05/11 12:53:54  I101.010 Data Rx from ifc serial2/0 (addr:222,19 bytes):
 68 0D 0D 68 73 DE 00 64 01 03 00 DE 00 00 00 00
 14 AB 16

07/05/11 12:53:54  I101.009 Data Tx to ifc serial2/0 (addr:222,6 bytes):
 10 80 DE 00 5E 16

07/05/11 12:53:56  I101.001 Rx Data from Ser.Term. 19 bytes, ifc serial2/0
07/05/11 12:53:56  I101.010 Data Rx from ifc serial2/0 (addr:222,19 bytes):
 68 0D 0D 68 53 DE 00 64 01 03 00 DE 00 00 00 00
 14 8B 16

07/05/11 12:53:56  I101.009 Data Tx to ifc serial2/0 (addr:222,6 bytes):
 10 80 DE 00 5E 16
```

```
07/05/11 12:53:58  I101.001 Rx Data from Ser.Term. 19 bytes, ifc serial2/0
07/05/11 12:53:58  I101.010 Data Rx from ifc serial2/0 (addr:222,19 bytes):
 68 0D 0D 68 73 DE 00 64 01 03 00 DE 00 00 00 00
 14 AB 16

07/05/11 12:53:58  I101.009 Data Tx to ifc serial2/0 (addr:222,6 bytes):
 10 80 DE 00 5E 16
```

This list of events avialable for the IEC-101 interface depends on the software versión. Each distribution of the software versión is accompanied by its available group of events.

Chapter 5 Configuring the GW104 Protocol

5.1 GW104 PROTOCOL

The GW104 protocol permits the Teldat devices to interconnect Control Centers that operate with IEC-104 with RTUs that operate in IEC-101. The IEC-104 agents are defined in the GW104, which permit TCP/IP access from various Control Centers.

The GW104 detects all the IEC-101 interfaces in a device and associates them to the GW104/101.

In the GW104/101 the GW global parameters are configured on one part and on the other, the parameters for each of the 104 agents associated to each Control Center.

The GW104 supports VRFs.

Each IEC-104 agent can pertain to a different VRF.

5.1.1 GW-104 Parameters

The configurable global parameters for the GW104 protocol are as follows:

101-always-on	101 agents always on
104-always-on	104 agents always on
asdu-common-address	Configures the value for the ASDU Common Address field
asdu-common-address-size	Configures the size of the ASDU Common Address field
cause-of-transfer-size	Configures the size of the Cause of Transfer field
enable	Enables the GW IEC104/101 feature
info-object-address-size	Configures the size of the Information Object Address field
ioa-10000	Enables IOA 10000 sending
ioa-10007	Enables IOA 10007 sending
orig-filter	Enables Control Center filtering through Orig. Address

The configurable parameters for each IEC-104 agent are as follows:

alarm-buffer	Length of the alarm message queue
control-center-ip-address	Control Center IP addresses for agent filtering
k	Maximum number of messages sent without confirmation
local-tcp-port	Local listening TCP port for the IEC-104 agent
t0	Time for connection establishment
t1	Timeout for the SEND or TEST APDUs
t2	Timeout for the unconfirmed data messages
t3	Time to send S messages after long periods of inactivity
vrf	Associated VRF identifier
w	Maximum number of messages received without sending confirmation

5.2 Configuring the GW104 parameters

To enter in the configuration process, carry out the following steps:

(1) At the (*) prompt, enter **PROCESS 4** or **P 4**. This will take you to the configuration prompt *Config*>.

```
*P 4
Config>
```

(2) Enter the **protocol gw104** command. This accesses the GW104 protocol configuration menu.

```
Config>protocol gw104

-- GW IEC-104 Configuration --
GW104 config>
```

Command	Function
? (HELP)	Lists the configuration commands or lists any parameter associated to a particular command
101-ALWAYS-ON	101 agents always on
104-ALWAYS-ON	104 agents always on
AGENT	IEC-104 agent configuration menus
ASDU-COMMON-ADDRESS	Configures the value for the ASDU Common Address field
ASDU-COM-MON-ADDRESS-SIZE	Configures the size of the ASDU Common Address field
CAUSE-OF-TRANSFER-SIZE	Configures the size of the Cause of Transfer field
ENABLE	Enables the GW IEC104/101 feature
INFO-OBJECT-ADDRESS-SIZE	Configures the size of the Information Object Address field
IOA-10000	Enables IOA 10000 sending
IOA-10007	Enables IOA 10007 sending
NO	Negates a command or sets its default value
ORIG-FILTER	Enables Control Center filtering through Orig. Address

5.2.1 ? (HELP)

The **?** (HELP) command lists all the available commands. You can also enter a **?** after a specific command to view its options.

Syntax:

```
IEC101-# Cfg>?
```

Example:

```
GW104 config>?
  101-always-on               101 agents always ON
  104-always-on               104 agents always ON
  agent                       IEC-104 agent instance configuration
  asdu-common-address         Set ASDU Common Address field value
  asdu-common-address-size    Set ASDU Common Address field size
  cause-of-transfer-size      Set Cause of Transfer field size
  debug-level                 Set debug level(BIT):
                              FWC(6),FWD(5),TX(4),RX(3),ASDU(2),APCI(1),TCP(0)
  enable                      Enable GW IEC104/101 functionality
  info-object-address-size    Set Information Object Address field size
  ioa-10000                   Enable use IOA 10000
  ioa-10007                   Enable use IOA 10007
  no                          Negate a command or set its defaults
  orig-filter                 Enable C.C. orig. address filter
  exit
GW104 config>
```

5.2.2 101-ALWAYS-ON

This command enables the activation of the IEC-101 interfaces independently of whether the connection with at least one Control Center is established.

If this command is not activated, you need to establish a 104 connection with at least one Control Center.

Syntax:

```
GW104 config>101-always-on ?
  <cr>
```

Example:

```
GW104 config>101-always-on
GW104 config>
```

5.2.3 104-ALWAYS-ON

This command enables the activation of the IEC-104 agents independently of whether the IEC-101 connection with at least one RTU is established.

If this command is not activated, you need to establish a 101 connection with at least one RTU.

Syntax:

```
GW104 config>104-always-on ?
  <cr>
```

Example:

```
GW104 config>104-always-on
GW104 config>
```

5.2.4 AGENT

This command permits you to create a configuration instance for an IEC-104 agent's parameters, associated to a Control Center. On entering this command, you access the IEC-104 agent configuration submenu. If the instance is already created, this command lets you access the menu to view it or modify it.

The number of agents that can be created only depends on the resources of the router being used.

Syntax:

```
GW104 config>agent ?
  <1..20 chars>    IEC-104 agent instance name
```

Example:

```
GW104 config>agent MAIN

-- IEC-104 Agent instance configuration --
GW104 agent config>
```

You can configure the following parameters in the IEC-104 agents:

Command Functions

Command	Function
? (HELP)	Lists the configuration commands or lists any parameter associated to a particular command
ALARM-BUFFER	Length of the alarm message queue.
CONTROL-CENTER:IP-ADDRESS	Control Center IP address for agent filtering.
K	Maximum number of messages sent without confirmation.
LOCAL-TCP-PORT	Local listening TCP port for the IEC-104 agent.
NO	Negates a command or sets its default value.
T0	Time for connection establishment.
T1	Timeout for the SEND or TEST APDUs.
T2	Timeout for the unconfirmed data messages.
T3	Time to send S messages after long periods of inactivity.
VRF	AssociatedVRF identifier.
W	Maximum number of messages received without sending confirmation.

5.2.4.1 ? (HELP)

The **?** (HELP) command lists all the available commands. You can also enter a **?** after a specific command to view its options.

Syntax:

```
GWC104 agent config>?
```

Example:

```
GWC104 agent config>?
  alarm-buffer                 Alarm buffer queue length
  control-center-ip-address    Control Center IP address for agent filter
  k                            Max. number of send messages without
                               confirmation
  local-tcp-port               Local TCP port for IEC-104 agent listen
  no                           Negate a command or set its defaults
  t0                           Establish connection timeout(sec.)
  t1                           SEND or TEST APDU type timeout(sec.)
  t2                           No data message confirmation timeout(sec)
  t3                           Sending S message timeout on long inactivity
                               periods(sec.)
  vrf                          Configure link to VRF
  w                            Max. number of received messages confirmed
  exit
GWC104 agent config>
```

5.2.4.2 ALARM-BUFFER

Permits you to configure the number of buffers to use in an alarm message queue. Each buffer can only contain one alarm.

The messages pending to be sent to the Control Center, associated to this agent, are stored in the message queue.

This parameter can take values between 1 and 64. Default is 10.

Syntax:

```
GW104 agent config>alarm-buffer ?
  <1..64>    Value in the specified range
```

Example:

```
GW104 agent config>alarm-buffer 20
GW104 agent config>
```

5.2.4.3 CONTROL-CENTER-IP-ADDRESS

This parameter configures the Control Center's IP address.

In some scenarios, the Control Center may have various IP addresses; through this command you can enter up to 8 IP addresses for the Control Center.

This parameter is used to 'filter' the Control Centers' TCP sessions in order to be able to associate them to the appropriate agent.

By default this parameter is empty. It is essential that you enter at least one address of the associated Control Center so the agent operates correctly.

Syntax:

```
GW104 agent config>control-center-ip-address ?
  <a.b.c.d>    Ipv4 format
```

Example:

```
GW104 agent config>control-center-ip-address 192.168.3.23
GW104 agent config>
```

5.2.4.4 K

This parameter configures the K parameter defined in the IEC-60870-5-104 standard. It represents the maximum number of messages that can be sent to the Control Center without receiving confirmation.

This parameter can take values between 1 and 33767. Default is 12.

Syntax:

```
GW104 agent config>k ?
  <1..33767>    Value in the specified range
```

Example:

```
GW104 agent config>k 10
GW104 agent config>
```

5.2.4.5 LOCAL-TCP-PORT

This parameter configures the local listening TCP port for the IEC-104 agent.

The Control Centers must establish TCP sessions with the port configured with this parameter

This parameter can take values between 1 and 65535. Default is 2404.

Syntax:

```
GW104 agent config>local-tcp-port ?
  <1..65535>    Value in the specified range
```

Example:

```
GW104 agent config>local-tcp-port 4016
GW104 agent config>
```

5.2.4.6 NO

This command is used to disable functions or to set the default values for some parameters.

Syntax:

```
GW104 agent config>no ?
  control-center-ip-address    Control Center IP address for agent filter
  vrf                          Configure link to default VRF
```

5.2.4.6.1 NO CONTROL-CENTER-IP-ADDRES

Sets the parameter to its default value (0.0.0.0).

Example:

```
GW104 agent config>no control-center-ip-address
GW104 agent config>
```

5.2.4.6.2 NO VRF

Sets the parameter to its default value (VRF_MAIN).

Example:

```
GW104 agent config>no vrf
GW104 agent config>
```

5.2.4.7 T0

This parameter configures the T0 parameter defined in the IEC-60870-5-104 standard. It represents the maximum time to establish connection with the Control Center.

This unit is in seconds.

This parameter can take values between 1 and 255. Default is 20.

Syntax:

```
GW104 agent config>t0 ?
  <1..255>    Value in the specified range
```

Example:

```
GW104 agent config>t0 10
GW104 agent config>
```

5.2.4.8 T1

This parameter configures the T1 parameter defined in the IEC-60870-5-104 standard. It represents the timeout for the SEND or TEST APDUs.

This unit is in seconds.

This parameter can take values between 1 and 255. Default is 15.

Syntax:

```
GW104 agent config>t1 ?
  <1..255>    Value in the specified range
```

Example:

```
GW104 agent config>t1 7
GW104 agent config>
```

5.2.4.9 T2

This parameter configures the T2 parameter defined in the IEC-60870-5-104 standard. It represents the timeout for the unconfirmed data messages.

This unit is in seconds.

This parameter can take values between 1 and 255. Default is 10.

Syntax:

```
GW104 agent config>t2 ?
  <1..255>    Value in the specified range
```

Example:

```
GW104 agent config>t2 7
GW104 agent config>
```

5.2.4.10 T3

This parameter configures the T3 parameter defined in the IEC-60870-5-104 standard. It represents the time to send S messages after long period of idle time.

This unit is in seconds.

This parameter can take values between 1 and 255. Default is 20.

Syntax:

```
GW104 agent config>t3 ?
  <1..255>    Value in the specified range
```

Example:

```
GW104 agent config>t3 7
GW104 agent config>
```

5.2.4.11 VRF

This command permits you to select the VRF that the agent being configured pertains to.

Syntax:

```
GW104 agent config>vrf ?
  <1..32 chars>    VPN Routing/Forwarding instance name
```

Example:

```
GW104 agent config>vrf main_data
GW104 agent config>
```

5.2.4.12 W

This parameter configures the W parameter defined in the IEC-60870-5-104 standard. It represents maximum number of messages received from the Control Center that do not need a confirmation message to be sent.

This parameter can take values between 1 and 33767. Default is 8.

Syntax:

```
GW104 agent config >w ?
  <1..33767>    Value in the specified range
```

Example:

```
GW104 agent config>w 9
GW104 agent config>
```

5.2.4.13 EXIT

Use the **EXIT** command to return to the previous prompt level.

Syntax:

```
GW104 agent config>exit
```

Example:

```
GW104 agent config>exit
GW104 config>
```

5.2.5 ASDU-COMMON-ADDRESS

This parameter configures the ASDU Common Address field value, which is included in the messages sent to the Control Center.

You can configure values between 1 and 65534. Default is 1.

Syntax:

```
GW104 config>asdu-common-address ?
  <1..65534>    Value in the specified range
```

Example:

```
GW104 config>asdu-common-address 4566
GW104 config>
```

5.2.6 ASDU-COMMON-ADDRESS-SIZE

This parameter permits you to configure the ASDU Common Address field length, which is included in the messages sent to the Control Center.

This parameter also affects the IEC101-GW Interfaces associated to the GW104/101, both the 101 and the 104 agents take this value.

You can configure the values 1 or 2. Default is 2.

Syntax:

```
GW104 config>asdu-common-address-size ?
  <1..2>    Value in the specified range
```

Example:

```
GW104 config>asdu-common-address-size 1
GW104 config>
```

5.2.7 CAUSE-OF-TRANSFER-SIZE

This parameter permits you to configure the Cause of Transfer field length, which is included in the messages sent to the Control Center.

This parameter also affects the IEC101-GW Interfaces associated to the GW104/101, both the 101 and the 104 agents take this value.

You can configure the values 1 or 2. Default is 2.

Syntax:

```
GW104 config>cause-of-transfer-size ?
  <1..2>    Value in the specified range
```

Example:

```
GW104 config>cause-of-transfer-size 1
GW104 config>
```

5.2.8 debug-level

Permits you to enable the GW104 Protocol debugging events.

You can enable different events; to do this you need to configure the bit level. The entered value must be in HEXADECIMAL:

FWC(6),FWD(5),TX(4),RX(3),ASDU(2),APCI(1),TCP(0)

By default the debugging events are disabled.

Syntax:

```
GW104 config>debug-level ?
  <hex 0..ff>    Hexadecimal value in the specified range
```

Example:

```
GW104 config>debug-level 03
GW104 config>
```

5.2.9 ENABLE

This command enables the GW104/101 feature. It is essential that this command is entered in the configuration so the GW104/101can operate.

By default the GW104/101 is disabled.

Syntax:

```
GW104 config>enable ?
  <cr>
```

Example:

```
GW104 config>enable
GW104 config>
```

5.2.10 INFO-OBJECT-ADDRESS-SIZE

This parameter permits you to configure the Info Object Address field length, which is included in the messages sent to the Control Center.

This parameter also affects the IEC101-GW Interfaces associated to the GW104/101, both the 101 and the 104 agents take this value.

You can configure values between 1 and 3. Default is 2.

Syntax:

```
GW104 config>info-object-address-size ?
  <1..3>    Value in the specified range
```

Example:

```
GW104 config> info-object-address-size 2
GW104 config>
```

5.2.11 IOA-10000

This parameter permits you to enable the sending of the RTUs activation/deactivation alarms. When this command is enabled, when it establishes the link with an RTU, it sends a simple alarm with value “1” (On) to the Control Center, set to equal 10.000; this indicates that the remote is connected. The moment that an RTU stops being accessible and is considered disconnected, a simple alarm set equal to 10.000 with the value “0” (Off) is sent to the Control Center.

By default this parameter is disabled.

Alarm sending can be carried out in various formats: below there is a list of the supported formats:

- IOA with timestamp
- GI only
- IOA with timestamp included on GI
- IOA without timestamp
- IOA without timestamp included on GI

Syntax:

```
GW104 config>ioa-10000 ?
  <cr>                          Set use IOA with time stamp
  ioa-with-timestamp            Set use IOA with time stamp
  gi-only                       Set use GI only
  ioa-with-timestamp-on-gi      Set use IOA with time stamp included on GI
  ioa-without-timestamp         Set use IOA without time stamp
  ioa-without-timestamp-on-gi   Set use IOA without time stamp included on GI
```

5.2.11.1 <CR>

Configure the IOA mode with timestamp. This command is maintained for compatibility reasons; this option is the same as “ioa-with-timestamp”.

Example:

```
GW104 agent config>ioa-10000
GW104 agent config>
```

5.2.11.2 IOA-WITH-TIMESTAMP

Configures the IOA mode with timestamp.

Example:

```
GW104 agent config>ioa-10000 ioa-with-timestamp
GW104 agent config>
```

5.2.11.3 GI-ONLY

Configure the GI only mode.

Example:

```
GW104 agent config>ioa-10000 gi-only
GW104 agent config>
```

5.2.11.4 IOA-WITH-TIMESTAMP-ON-GI

Configures the IOA mode with timestamp included on GI.

Example:

```
GW104 agent config>ioa-10000 ioa-with-timestamp-on-gi
GW104 agent config>
```

5.2.11.5 IOA-WITHOUT-TIMESTAMP

Configures the IOA mode without timestamp.

Example:

```
GW104 agent config>ioa-10000 ioa-without-timestamp
GW104 agent config>
```

5.2.11.6 IOA-WITHOUT-TIMESTAMP-ON-GI

Configures the IOA mode without timestamp included on GI.

Example:

```
GW104 agent config>ioa-10000 ioa-without-timestamp-on-gi
GW104 agent config>
```

5.2.12 IOA-10007

This parameter permits you to enable rollover alarm sending from the buffer for alarms pending to be sent to the Control Center. When a disconnection from the Control Center is produced, or there are communication problems with it, all the alarms generated or received from the RTUs should be maintained. If a queue runs out of space, the oldest messages are eliminated. When a reconnection occurs with the Control Center, a rollover On/Off alarm is inserted in a simple digital form with the IOA 10.007 Start/Final rollover timestamp.

By default this parameter is disabled.

Syntax:

```
GW104 config>ioa-10007 ?
  <cr>
```

Example:

```
GW104 config>ioa-10007
GW104 config>
```

5.2.13 NO

This command is used to disable features or to set the default values for some parameters.

Syntax:

```
GW104 config>no ?
  101-always-on    101 agent always OFF
  104-always-on    104 agent always ON
  agent            IEC-104 agent instance configuration
  enable           Enable GW IEC104/101 functionality
  ioa-10000        Enable use IOA 10000
  ioa-10007        Enable use IOA 10007
  orig-filter      Enable C.C. orig. address filter
```

5.2.13.1 NO 101-ALWAYS-ON

This disables the parameter.

Example:

```
GW104 config>no 101-always-on
GW104 config>
```

5.2.13.2 NO 104-ALWAYS-ON

This disables the parameter.

Example:

```
GW104 config>no 104-always-on
GW104 config>
```

5.2.13.3 NO AGENT

Eliminates or deletes an IEC-104 agent. To eliminate an agent, you must indicate its name after the command.

Example:

```
GW104 config>no agent MAIN
GW104 config>
```

5.2.13.4 NO ENABLE

Disables the GW104/101 feature.

Example:

```
GW104 config>no enable
GW104 config>
```

5.2.13.5 NO IOA-10000

This disables the parameter.

Example:

```
GW104 config>no ioa-10000
GW104 config>
```

5.2.13.6 NO IOA-10007

This disables the parameter.

Example:

```
GW104 config>no ioa-10007
GW104 config>
```

5.2.13.7 NO ORIG-FILTER

This disables the parameter.

Example:

```
GW104 config>no orig-filter
GW104 config>
```

5.2.14 ORIG-FILTER

This command enables the message filtering based on the value of the Originator Address field.

When this parameter is enabled, the GW behaves in the following way:

(1) All the messages received from the RTUs with Originator Address equal to 0x00 are sent to all the active Control Centers and with Originator address <= 0x3F.

(2) All the messages received from the RTUs with Originator Address different to 0x00 are only sent to the Control Center that has the same value as the Originator Address.

(3) One particular case arises for the range of Originator Address addresses for connected Control Centers, comprising of 0x40 and 0x4E. In this case, communication is carried out with the SEND NO REPLAY service.

(4) Another case arises when an alarm is received from an RTU with Originator Address 0x4F. This alarm is sent to all Connected Centers with Originator address between 0x40 and 0x4E.

The following table summarizes these requirements:

Types of Control Centers depending on the Originator Address	Spontaneous cause Originator Address from RTUs	Type of service using 101
0x01.. 0x3F	0x00	SEND/CONFIRM
0x40.. 0x4E	0x4F	SEND/NO_REPLY

By default this parameter is disabled.

Syntax:

```
GW104 config>orig-filter ?
  <cr>
```

Example:

```
GW104 config>orig-filter
GW104 config>
```

5.2.15 EXIT

Use the **EXIT** command to return to the previous prompt level.

Syntax:

```
GW104 config>exit
```

Example:

```
GW104 config>exit
Config>
```

5.3 Show Config

Show Config is a configuration console tool that allows you to list the commands needed to configure the router from a blank configuration (no conf).

This command can be used to both copy configurations as well as list them, or simply to view them.

Show Config starts from a defined internal default configuration, generating commands from the configuration which differ from this.

Show Config can incorporate commentaries that are placed after a semi colon (';')

This command can be executed from any menu, displaying the configuration entered in all the submenus that hang from the current menu.

Example:

The following example shows the GW104 Protocol:

```
; Showing Menu and Submenus Configuration for access-level 15 ...
; ATLAS360 Router 15 25 Version 10.8.25

      agent pp
; -- IEC-104 Agent instance configuration --
         control-center-ip-address 192.168.212.33
         alarm-buffer 28
      exit
;
      agent kk
; -- IEC-104 Agent instance configuration --
         control-center-ip-address 192.168.213.153
         alarm-buffer 50
      exit
;
      enable
      104-always-on
      101-always-on
      ioa-10000
      orig-filter
      info-object-address-size 3
GW104 config>
```

With the list of commands obtained in **SHOW CONFIG**, you can copy, edit and modify so it can be used as a template for subsequent configurations.

Chapter 6 Monitoring the GW104 Protocol

6.1 Monitoring

To enter in the IEC-101 monitoring process, carry out the following steps:

1. At the (*) prompt, enter **PROCESS 3** or **P 3**. This will take you to the configuration prompt +.

```
*P 3
+
```

2. At the (+) prompt, enter the command **PROTOCOL GW104** .

```
+protocol gw104
-- Gateway IEC-104 monitor --
GW-104+
```

This section numerates and describes the GW104 monitoring commands. All the GW104 monitoring commands must be entered at the GW104 prompt.

Command	Function
? (HELP)	Lists the available commands or their options.
LIST	Lists the statistics information.
EXIT	Permits you to exit the IEC101 monitoring environment.

6.1.1 ? (HELP)

The **?** (HELP) command lists all the available commands included at the normal prompt level. You can also enter a **?** after a specific command to view its options.

Syntax:

```
GW-104+?
```

Example:

```
GW-104+?
  list    List IEC-104 agents information
  exit
GW-104+
```

6.1.2 LIST

Lists all the traffic statistics and the GW104 active configuration parameters.

Syntax:

```
SCADA-serial0/0+LIST ?
ALL
STATISTICS
SIGNAL-CHANGES
TCP
TRANSACTIONS
SCADA-serial0/0+
```

Example:

```
GW-104+list
---------- IEC-104/101 GW GLOBAL INFO -------------

 CONFIGURATION INFO:
 Gateway status            : ENABLED
 IEC-104 always ON         : YES
 IEC-101 always ON         : YES
 Cause of transfer size    : 2
 Info Body Address size    : 2
```

```
 ASDU Common Address size  : 2
 ASDU Common Address       : 1
 Use IOA 10000             : IOA with time stamp
 Use IOA 10007             : NO
 Originator Address filter : DISABLED

 AGENT TCP STATISTICS INFO:
 Open sessions             : 1
 Remote close sessions     : 0
 Local close sessions      : 0
 Rx bytes                  : 39940
 Rx packets                : 6655
 Tx bytes                  : 3377873
 Tx packets                : 53233

-------------- IEC-104 AGENT INFO -----------------

 CONFIGURATION INFO:
 IEC-104 agent name        : principal
 Base TCP port             : 2404
 Control Center IP address : 192.168.1.10
 Parmeter K                : 16
 Parmeter W                : 8
 Parmeter T0               : 20
 Parmeter T1               : 30
 Parmeter T2               : 15
 Parmeter T3               : 30
 Alarm buffer queue leng   : 10

 AGENT TCP STATISTICS INFO:
 Messages from 101 queued    : 0
 Messages from 101 discarted : 0
 Total Rx bytes              : 39940
 Total Rx packets            : 6655
 Total Tx bytes              : 3377873
 Total Tx packets            : 53233
 Total Tx congestion         : 0
 Open sessions               : 1
 Max. simulta. open sessions : 1
 Total opened sessions       : 1
 Remote close sessions       : 0
 Local close sessions        : 0

 TCP SESSION INFO:
   STATE   REMOTE IP ADDR. REM.PORT  ESTABLISH TIME   104-LEV
 --------- --------------- -------- ----------------- -------
 ESTAB     192.168.1.10    3634     09:16:45 06/07/11 STARTED
 RxBytes/RxPackets: 39940/6655
 TxBytes/TxPackets/TxCongestion: 3377873/53233/0

remota GW-104+
```

Chapter 7 GW104 Protocol Events

7.1 Monitoring the GW104 Protocol Events

Permits you to monitor the events that occur over one or various IEC-101 interfaces in real time, when the events logging system is enabled for this protocol.

The way to enable them from the configuration menu is as follows:

```
*PROCESS 4
User Configuration
Config>EVENT
-- ELS Config --
ELS Config>ENABLE TRACE SUBSYSTEM GW104 ALL
ELS Config>EXIT
Config>SAVE
Save configuration [n]? Y
Saving configuration...OK
Config>
```

In the same way, you can enable the events from the monitoring menu at any point, without the latter needing to be saved in the configuration, in the following way:

```
*PROCESS 3
Console Operator
+EVENT
-- ELS Monitor --
ELS>ENABLE TRACE SUBSYSTEM GW104 ALL
ELS>EXIT
+
```

To view the events once they are enabled, enter the following:

```
*PROCESS 2
07/06/11 07:58:41  GW104.004 TCP Session Opened. rem. IP: 192.168.213.153, rem. Port: 1915
07/06/11 07:59:01  GW104.011 TCP Data Rx (addr:192.168.213.153,6 bytes):
 68 04 07 00 00 00

07/06/11 07:59:01  GW104.001 Rx TCP U frame type STARTDT_ACT: 6 bytes. rem. IP: 192.168.213.153, Port: 2404
07/06/11 07:59:01  GW104.012 Agent kk START on channel 1
07/06/11 07:59:01  GW104.019 TCP Tx U frame to C.C. 192.168.213.153, 6 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,6 bytes):
 68 04 0B 00 00 00

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:0/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 00 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:1/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 02 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:2/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 04 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:3/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 06 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:4/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 08 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:5/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
```

```
 68 0E 0A 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:01  GW104.009 TCP Tx I frame(Ns:6/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:01  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 0C 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:7/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 0E 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:8/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 10 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:9/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 12 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:10/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 14 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:11/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 16 00 00 00 64 01 03 00 DE 00 00 00 00 14

07/06/11 07:59:02  GW104.011 TCP Data Rx (addr:192.168.213.153,6 bytes):
 68 04 01 00 10 00

07/06/11 07:59:02  GW104.017 Rx TCP S frame(Nr:8): 6 bytes. rem. IP: 192.168.213.153, Port: 2404
07/06/11 07:59:02  GW104.009 TCP Tx I frame(Ns:12/Nr:0) to C.C. 192.168.213.153, 16 bytes,
07/06/11 07:59:02  GW104.010 TCP Data Tx (addr:192.168.213.153,16 bytes):
 68 0E 18 00 00 00 64 01 03 00 DE 00 00 00 00 14
```

This list of events available for the GW104 Protocol depends on the software version. Each software version distribution is accompanied by its available group of events.

Chapter 8 GW104/101 Configuration Example

8.1 GW104/101Configuration Example

In the following example, the configuration of two IEC-101GW interfaces has been created. One of these in multi-point and the other in point to point.

The connectivity with two IEC-104 Control Centers is configured.

```
; Showing Menu and Submenus Configuration for access-level 15 ...
; ATLAS360 Router 15 25 Version 10.8.18-Alfa

   log-command-errors
   no configuration
   set data-link sync serial2/2
   set data-link iec-101-gw serial2/0
   set data-link iec-101-gw serial2/1
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.21.15 255.255.254.0
;
   exit

;
   network serial2/0
; -- IEC-101 Gateway Interface Configuration --
      multilink-mode
      add-rtu 222
      add-rtu 333
      add-rtu 3434
      add-rtu 400
      add-rtu 401
;
      originator-address 1
      baudrate 1200
      synchronization-time 455
      num-buffers 32
      long-frame-reponse
;
   exit
;
   network serial2/1
; -- IEC-101 Gateway Interface Configuration --
      link-address 343
      asdu-common-address 343
      baudrate 2400
   exit
;
   event
; -- ELS Config --
      enable trace subsystem GW104 ALL
      enable trace subsystem I101 ALL
   exit
;
   protocol gw104
; -- GW IEC-104 Configuration --
      agent MAIN
; -- IEC-104 Agent instance configuration --
         control-center-ip-address 192.168.212.33
         alarm-buffer 28
      exit
;
      agent SECONDARY
; -- IEC-104 Agent instance configuration --
```

```
         control-center-ip-address 192.168.213.153
         alarm-buffer 50
      exit
;
      enable
      104-always-on
      101-always-on
      ioa-10000
      orig-filter
      info-object-address-size 3
   exit
;
;
;
;
;
;
;
;
   dump-command-errors
   end
Config>
```