General Technical Characteristics

General Information

ADM–1 is a new generation Add/Drop Synchronous Multiplexer with STM–1 electrical or optical line interfaces.

The core of the ADM–1 is the MOST Unit (Mux Controller Optical Switch Tributary), which supports the following features:

- *management of up to eight STM–1 streams (compliant with ITU–T Rec. G.707);*
- *management of cross–connections at VC–12, VC–2, VC–3, VC–4 and VC–2–nc Virtual Container levels with a total cross–connect capacity of 8 STM–1 equivalents;*
- *control of the whole equipment;*
- *timing of the whole equipment;*
- *management of up to four Data Communication Channels;*
- *management of F interface for Local Controller connection.*

The MOST Unit can be equipped with up to two line terminal interfaces (optical or electrical) and a tributary module.

The tributary module can be of the following types:

- *16x1.5/2Mbit/s Tributary Sub–unit;*
- *32x1.5/2Mbit/s Tributary Sub–unit*;
- *1x34Mbit/s Tributary sub–unit;*
- *1x140/STM–1 G.703 Electrical Tributary sub–unit.*

For simple applications a single MOST Unit can be used (i.e. a single regenerator or an ADM with up to thirty–two 1.5/2Mbit/s tributaries) but when more complex performances are required (i.e. the management of a greater number of tributaries or of a Q interface) ADM–1 can be equipped with a second MOST Unit and with the following units:

- *1.5/2Mbit/s – 34Mbit/s – 45Mbit/s – 140Mbit/s Plesiochronous Tributary Units;*
- *STM–1 Optical and Electrical Tributary Unit;*
- *Communication Unit (Q Interface, 8 DCC Channels);*
- *Auxiliary Unit (EOW, 64kbit/s G.703 and Nx64kbit/s V.11 Channels).*

The general characteristics, the structure and all the functions supplied by the equipment agree with ITU–T recommendations G.958, G.781, G.782, G.783, G.784, G.823, G.825, G.826 and G.813.

ADM–1 follows ITU–T Q.811 and Q.812 recommendations when a Q interface is available.

For the electrical interfaces (line and tributary) the equipment agrees with ITU–T recommendation G.703.

The ADM–1 equipment operates on single–mode optical fibres. The optical fibres must meet ITU–T recommendations G.652, G.653 or G.654.

The ADM–1 Equipment agrees also with safety rules, defined in IEC950, EN41003, EN60950, IEC364 and IEC825 recommendations.

The width of a ADM–1 sub–rack is about half a standard ETS 300–119/3 sub–rack. Then a standard ETS 300–119/4 rack can house up to six ADM–1 sub–racks.

Configuration

The system can be set in four possible configurations:

STM–1 Terminal Multiplexer (with possibility of the 1+1 protection)	multiplexes / demultiplexes tributary signals into / from one (two using MS Protection) STM–1 lines.
STM–1 Add–Drop Multiplexer	adds / drops or re–transmit in transit signals from two (four using MS Protection) STM–1 line interfaces into tributary interfaces.
STM–1 Double Regenerator	regenerates two STM–1 line signals (each MOST acts as a single regenerator).
STM–1 DXC	operates as a small crossconnect for up to eight STM–1 streams.

Equipment Structure

The ADM–1 consists of one wired subrack, in which both traffic and common parts units can be fitted.

Subrack

From the physical point of view, the equipment subrack (H=450 x W=219.5 x D=245mm) is designed according to the ETSI 300 119 requirements (see Fig. 1.1–1).

The ADM–1 subrack is organized into two physical areas: the first one is reserved for traffic and common part units; the second one is reserved for connection units.

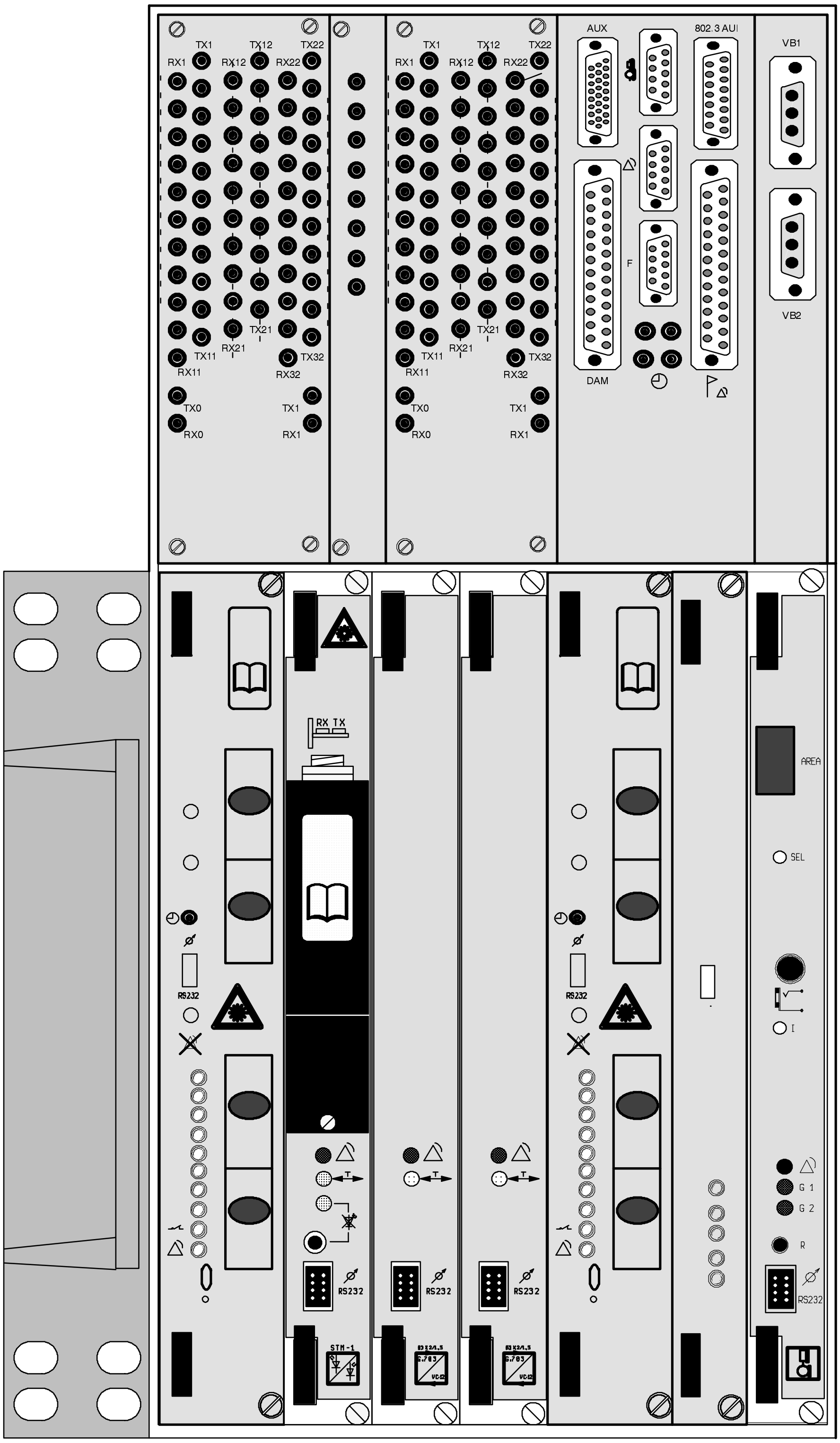


Fig. 1.1–1 *ADM–1 subrack*

Common Part Units

The common part units provide equipment supervision, auxiliary channels, cross connections and synchronisation management.

In detail:

- ***MOST Unit:***

  supports the management of the SDH frame, of the cross connections and of the timing of the equipment.
  This unit can be equipped with up to two STM–1 line modules (electrical/optical) and one tributary module.
  One of the following Tributary modules can be installed on the MOST Unit:

  - *16x1.5/2Mbit/s Tributary Sub–unit*
  - *32x1.5/2Mbit/s Tributary Sub–unit*
  - *1x34Mbit/s Tributary sub–unit*
  - *140/STM–1 Electrical Tributary Sub–unit*

Up to two MOST Units can be fitted in one sub–rack.

- ***Communication Unit***

  allows the management of the Q interface for connecting the ADM–1 to a Network Management Centre and of up to eight DCCs;

- ***Auxiliary Unit***

  allows the management of EOW channels and 64kbit/s auxiliary channels (V11 and G.703).

Interchangeable Traffic Units

Line and tributary units are present in the subrack in dedicated positions.

The subrack has been designed to guarantee a high flexibility in the use of these slots, which can be equipped with different types of units in order to achieve different equipment configurations.

The available interfaces are:

- ***STM–1 G.703 Electrical/Mux Unit***

  can manage one STM–1 stream with electrical line interface;

- ***STM–1 Optical/Mux Unit***

  can manage one STM–1 stream with optical line interface (FC/PC and SC/PC);

- ***1x140Mbit/s / STM–1 (with VC–12 handling) G.703 Tributary Unit***

  can manage one STM–1 stream or one 140Mbit/s G.703 stream; in case of STM–1 tributary stream the equipment can perform connections at TU–12 level;

- ***63x1.5/2 Mbit/s Tributary Unit***

  can accept up to sixty–three 1.5Mbit/s or 2Mbit/s tributaries and performs mapping/de–mapping of G.703 channels into/from TU–12 level;

- ***32x1.5/2Mbit/s G.703 Tributary Unit***

  can accept up to thirty–two 1.5Mbit/s or 2Mbit/s tributaries and performs mapping/de–mapping of G.703 channels into/from TU–12 level;

- ***3x34Mbit/s Tributary Unit***

  can accept up to three 34Mbit/s tributaries and performs mapping/de–mapping of G.703 channels into/from TU–3 level;

- ***3x45Mbit/s Tributary Unit***

  can accept up to three 45Mbit/s tributaries and performs mapping/de–mapping of G.703 channels into/from TU–3 level.

Transmitted Streams

The transmitted 155Mbit/s synchronous streams have a frame structure conforming to ITU–T Recommendation G.707 and are obtained by applying the multiplexing methods specified in ETSI Recommendation ETS 300 147.

Interfaces

The optical 155Mbit/s interfaces are in accordance with ITU–T Recommendation G.957.

1.5 – 2 – 34 – 45 – 140 and 155Mbit/s electrical interfaces are in compliance with ITU–T Recommendation G.703.

Transmission Media

The ADM–1 equipment operates on single–mode optical fibres. The optical fibres must meet ITU–T Recommendations G.652, G.653 or G.654.

G.652 fibres allow an optimized dispersion at 1300nm wavelength, while G.653 fibres are optimized, in terms of dispersion, at 1550nm wavelength.
G.654 fibres allows an optimized attenuation at 1550nm wavelength.

The equipment can be fitted with optical plug–in units for 1300nm or 1550nm, as required.

Automatic Laser Shutdown

To reduce the risk of danger to personnel due to the laser light from an interrupted link, Optical Units have a laser shutdown circuit which automatically switches off the laser transmitter of the faulty regeneration section. Operation is in accordance with ITU–T Recommendation G.958 (Fig. 1.1–2).

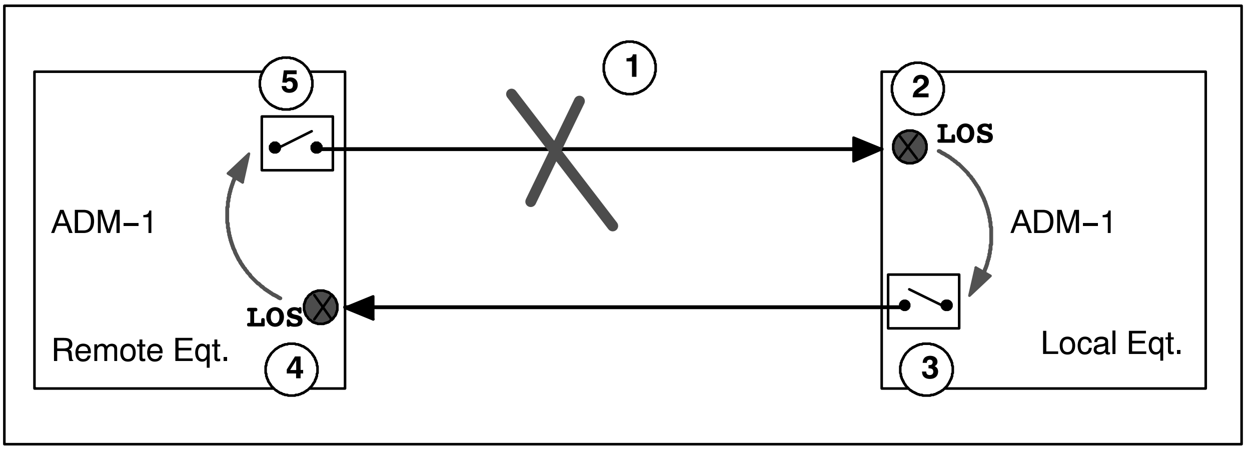


Fig. 1.1–2 *Automatic laser shutdown device activation*

The interruption of one of the two fibres in a line section (1) is detected on the receive side (2) (Loss Of Signal alarm). If the signal at the optical receiver is missing for longer than 550ms±50ms, the laser transmitter (3) of the opposite direction is shut down in the local equipment. That causes the LOS detection (4) in the remote station and the optical protection activation (5).

When the fibre is restored laser transmitters are automatically and cyclically activated every 60sec to 300sec for 2sec (Automatic Restart). It is also possible to perform a manual restart of the laser pressing a push–button on the front panel of the unit (this procedure can be used whenever there is no need for the operator to wait till the Automatic Restart procedure has been completed). The optical transmitter is then reactivated for 2sec.
When an equipment receives a valid signal, the laser transmitter of the opposite direction is immediately returned to continuos service.

The optical protection device can be disabled in order to measure transmitted and received power levels at the optical interfaces. A test restart can be performed by pressing the push–button on the front panel of the unit. The laser transmitter is switched on (forced switch–on) for 90sec.

Fig. 1.1–3 shows the flow–chart of the optical protection device.

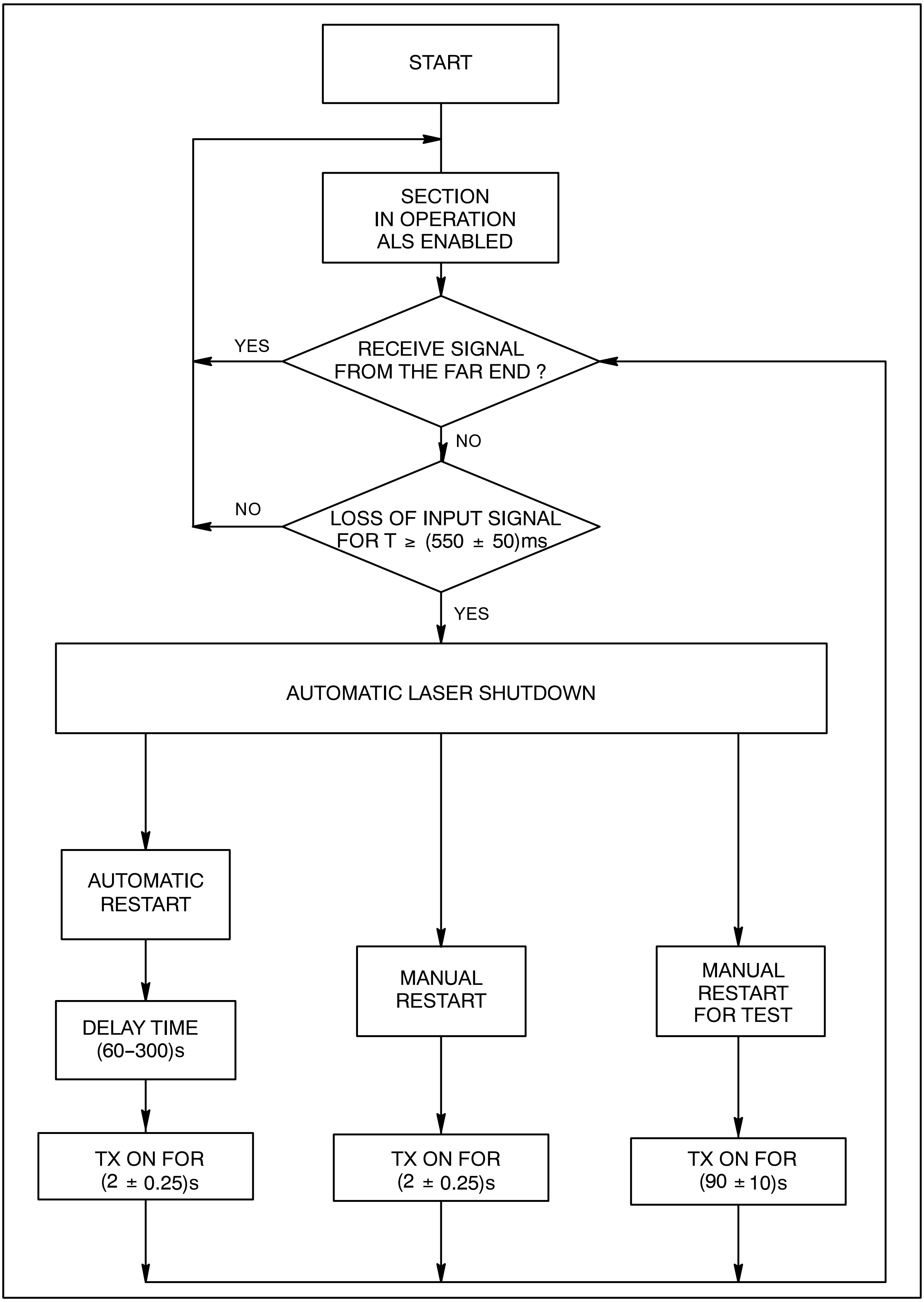


Fig. 1.1–3 *Flow–chart of the automatic laser shutdown device*

Cross Connection Function

Cross connection configurations define how the incoming/outgoing traffic should be multiplexed/demultiplexed and allocated to/taken from the channels of STM–1 frame Virtual Container (VC). The configuration procedure is realized by means of the Local Controller software.

The ADM–1 matrix (which is included in the MOST Unit) can make interconnections between line and tributary side at TU–12, TU–2, TU–3 and AU–4 synchronous level, as defined by ETSI recommendation ETS 300 147.

ADM–1 can manage the following kind of cross connection:

♦ ***unidirectional:*** *(Fig. 1.1–4) a one–way connection between:*
  - *line and tributary*
  - *line and line*
  - *tributary and line*
  - *tributary and tributary*

♦ ***bidirectional****: (Fig. 1.1–5) a two–way connection between:*
  - *line and line*
  - *line and tributary*
  - *tributary and tributary*

♦ ***broadcast:*** *(Fig. 1.1–6) connection of a line or tributary incoming signal to several outputs (tributary or line side);*

♦ ***concatenated:****(Fig. 1.1–7) the concatenation is a procedure whereby a multiplicity of Virtual Containers is associated one with another, with the result that their combined capacity can be used as a single container across which the bit sequence integrity is maintained. ;*

♦ ***monitor:*** *(Fig. 1.1–8) an incoming tributary signal is conveyed both to a test port and to its normal user port; using this kind of cross connection any type of cross connection can be monitored without interfering with the traffic;*

♦ ***loop back:*** *(Fig. 1.1–9) a one way connection between the same traffic port;*

♦ ***split access:*** *(Fig. 1.1–10) connection of an incoming tributary signal to a test port, providing a test signal on the corresponding output traffic port.*

♦ ***dropped:*** *(Fig. 1.1–11 and Fig. 1.1–12) two incoming channels* (Worker *and* Protection) *are conveyed to their relevant output ports; the drop leg is connected to the* Worker *channel and protected by the* Protection *channel.*

Unidirectional Cross Connections

In Fig. 1.1–4 two unidirectional cross connections are illustrated.

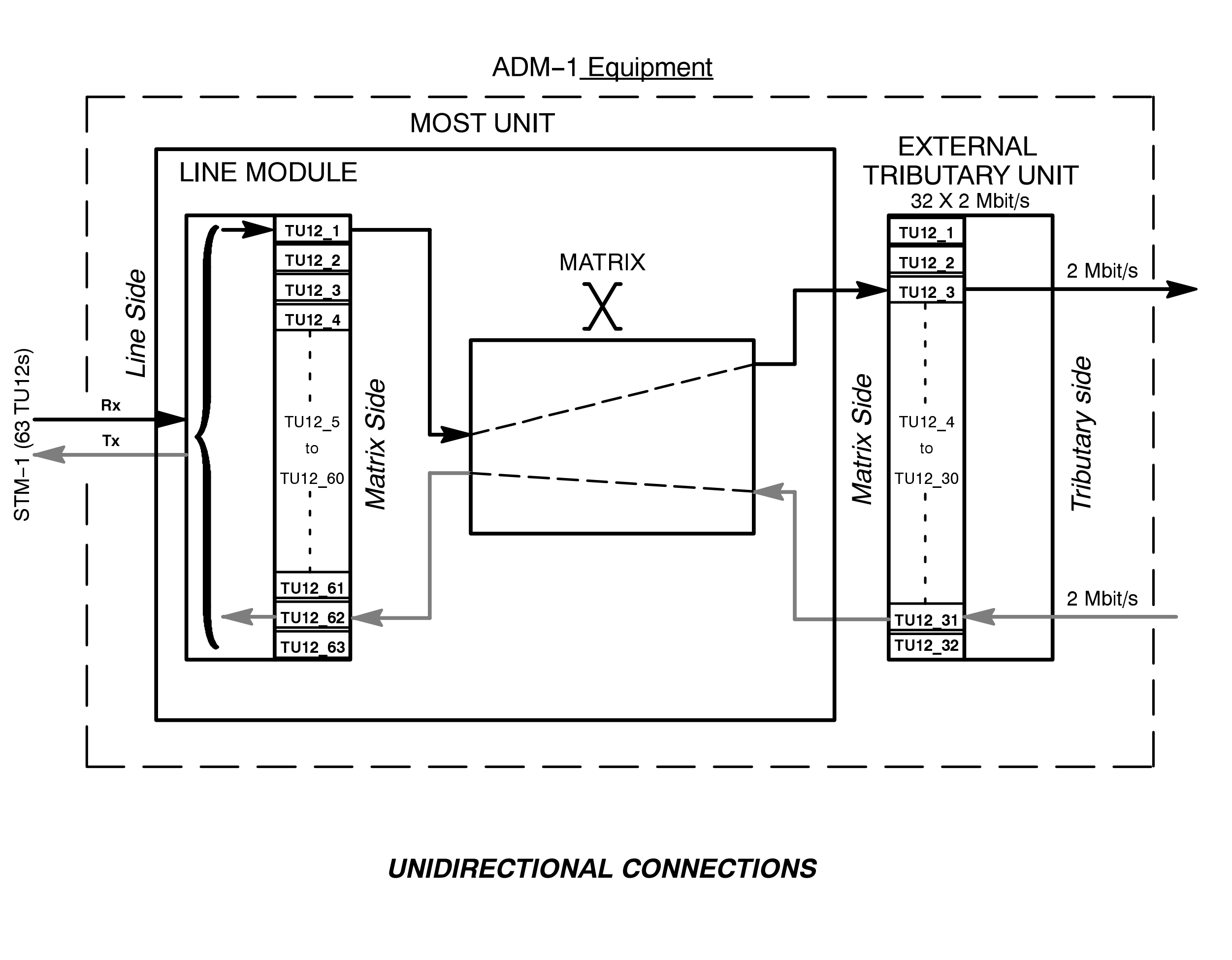


Fig. 1.1–4 *Example of line–tributary and tributary–line ONE–WAY connections*

Streams move only in one direction, from line side to the tributary side or vice versa and channels work only in reception or only in transmission. The other direction is available for another connection.

In the example **TU12_1** from line side is cross–connected with **TU12_3** to the tributary side (Rx connection) and **TU12_31** from tributary side is cross–connected with **TU12_62** to line side (Tx connection).

This is the typical connection used for adding streams to STM–1 frame or dropping streams from it.

In this example an External Tributary Unit has been used. The same type of cross connection is also available with a Tributary Module housed on the MOST Unit.

Bidirectional Cross Connections

In Fig. 1.1–5 a bidirectional cross connection is illustrated.

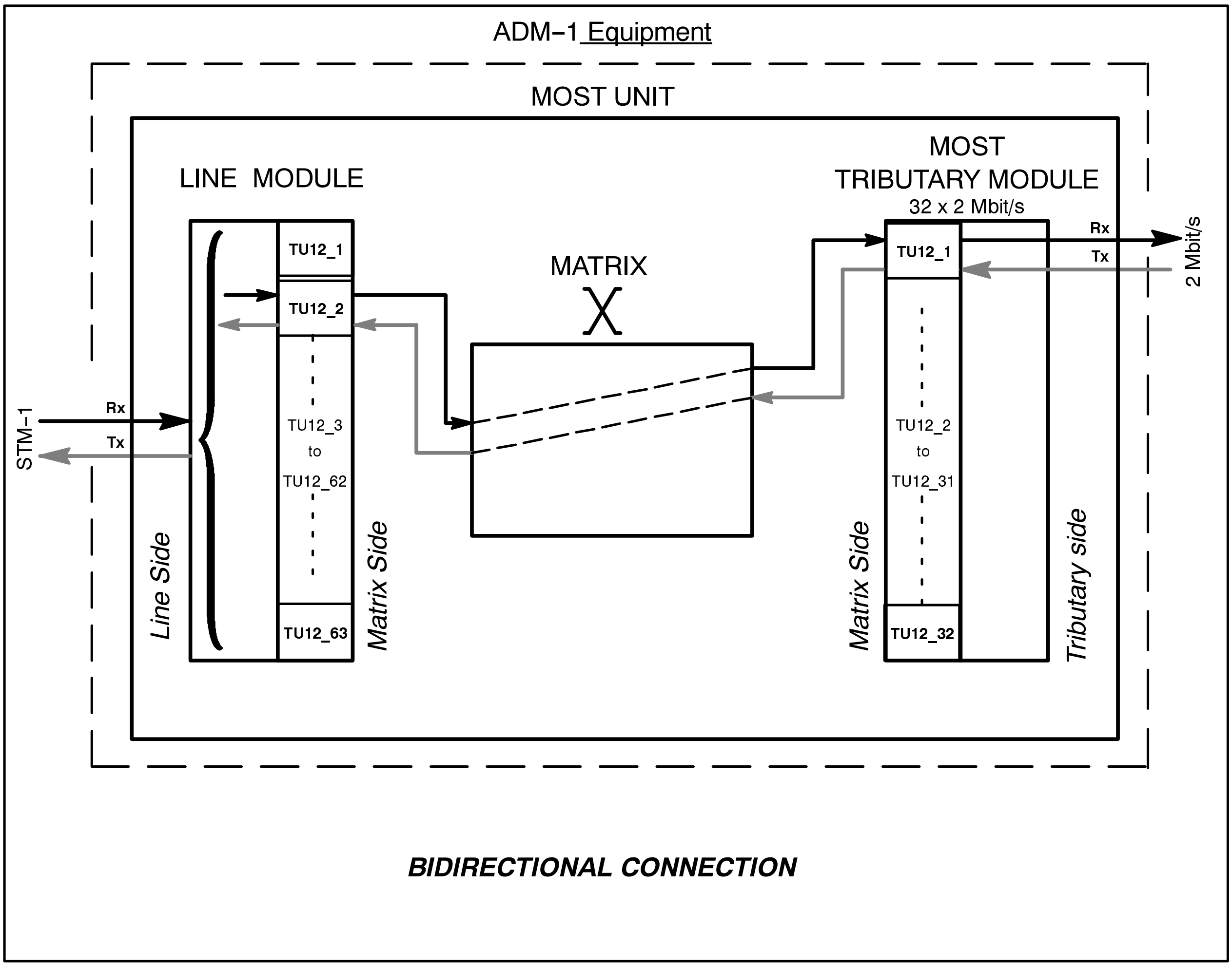


Fig. 1.1–5 *Example of line–tributary TWO–WAYS connection*

In this kind of cross connection channels work in both directions at the same time. In the example **TU12_2** line side is cross connected with **TU12_1** tributary side.

Both channels transmit and receive; stream moves in two directions: from/to line side and from/to tributary side.

This is the typical connection used to perform streams add–drop from/to the STM–1 frame.

In this example a MOST Tributary Module has been used. The same type of cross connection is also available with an External Tributary Unit.

Broadcast Cross Connections

In Fig. 1.1–6 a broadcast connection is illustrated.

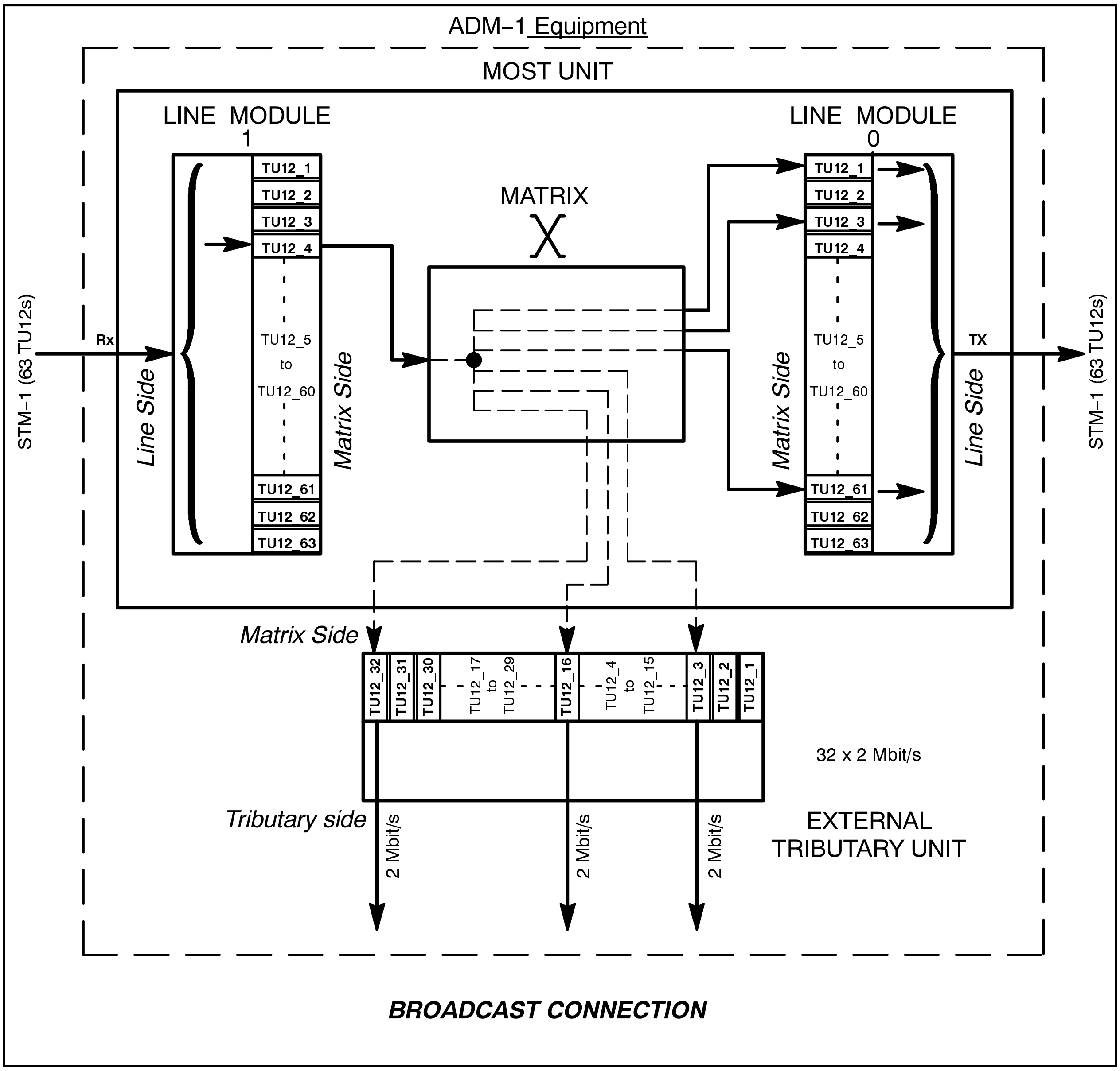


Fig. 1.1–6 *Example of broadcast connections.*

This kind of cross connection is composed by an unidirectional transmission connection and several unidirectional receive connections.

The single transmitting connection is the **MASTER Tx** while the different receiving connections are the **SLAVE Rx** and they are called ”LEG” of the broadcast connection.

In the example **TU12_4** on line 1 is the master of the broadcast connection and **TU12_1, TU12_3, TU12_61** on line 0 and **TU12_3, TU12_16, TU12_32** on tributary side are *legs* of the broadcast connection.

In this example an External Tributary Unit has been used. The same type of cross connection is also available with a Tributary Module housed on the MOST Unit.

Concatenated Cross Connections

In Fig. 1.1–7 concatenated cross connections are illustrated.
An incoming signal, allocated into the STM–1 outgoing frame using a **VC–2–5c** virtual container which is composed by five concatenated VC–2 containers, is passed through to the other line interface.

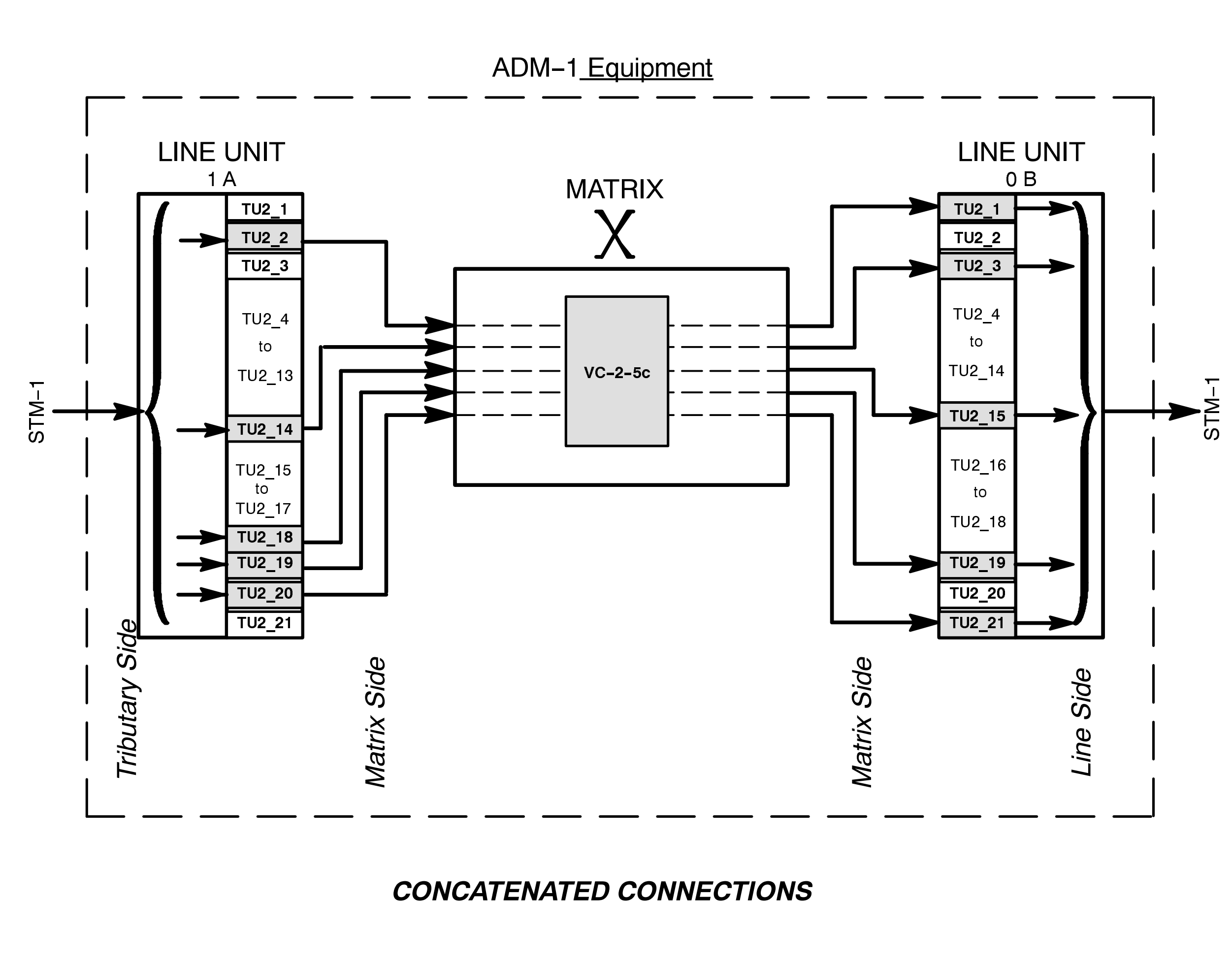


Fig. 1.1–7 *Example of concatenated connections.*

In this kind of connection an incoming tributary signal is demapped and passed to the matrix unit in form of n TU–2 channels. The Matrix unit provides to concatenate them in a **VC–2–nc**. The adopted concatenation is the virtual option (as specified in ETS 300 147 and G.707).

In the example a channel allocated in the incoming STM–1stream using 5 different TU–2 channels: **TU2_2, TU2_14, TU2_18, TU_19** and **TU2_20**, is passed through to the other line interface, as a VC–2–5c, using the outgoing TU–2 channels: **TU2_1, TU2_3, TU2_15, TU_19** and **TU2_21.** These tributary units are launched with the same pointer value and kept in a single higher order VC–4.
The number of concatenated VC–2 can be from 2 to 21 in the same VC–4.

Monitor Connections

In Fig. 1.1–8 monitor connections are illustrated.
The incoming tributary signal is connected both to its output port and to a test access port. The use of the monitor access function does not influence the traffic.

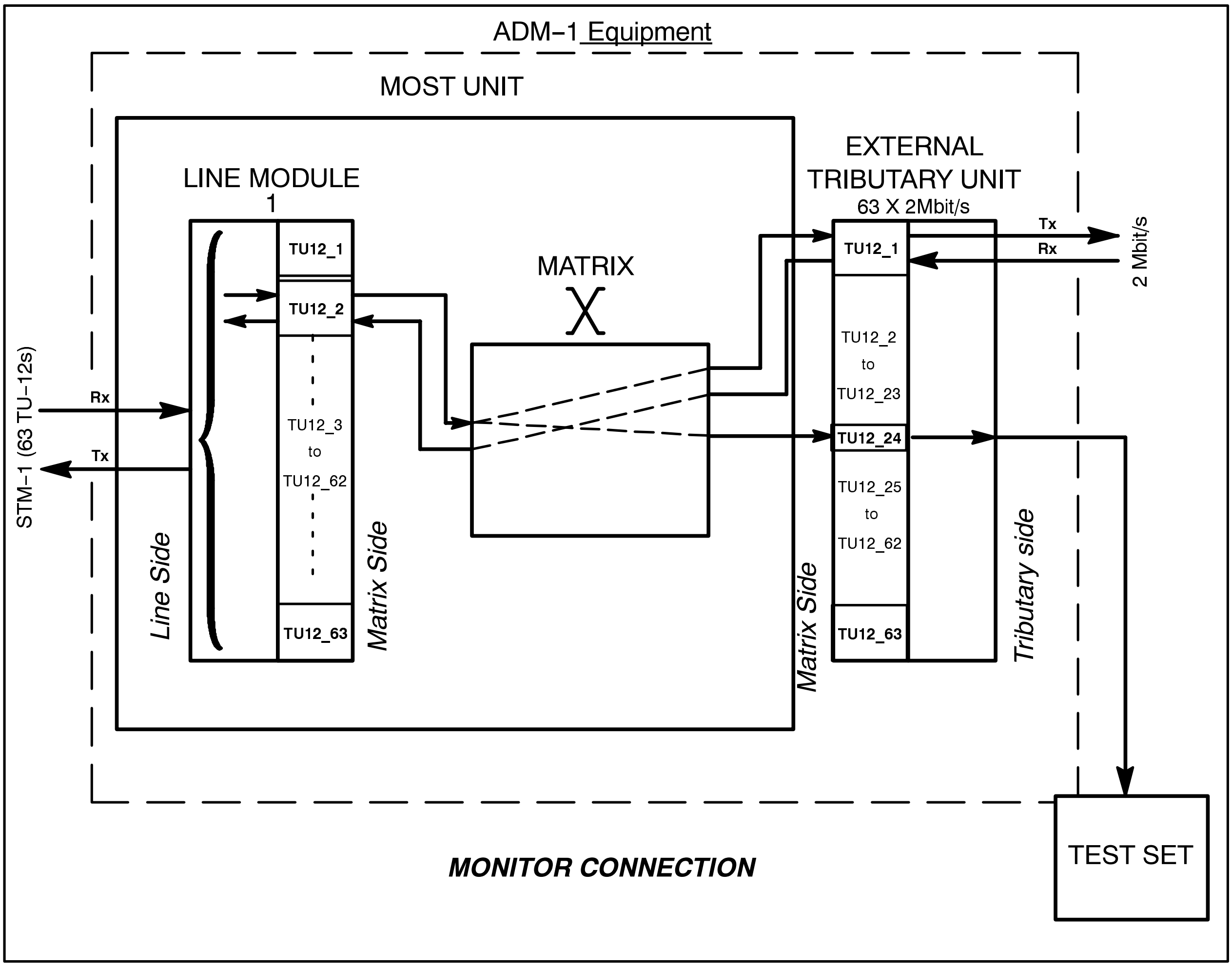


Fig. 1.1–8 *Example of monitor connections*

This is the typical connection used for monitoring the single tributary channel.

In the example the channel **TU12_2** incoming from the line west is split both to the **TU12_1** in the tributary unit and to the **TU12_24** of the same tributary used as monitor port.

Loop Back Connections

In Fig. 1.1–9 loop back connections are illustrated.
The incoming tributary signal can be looped back to the same tributary port.

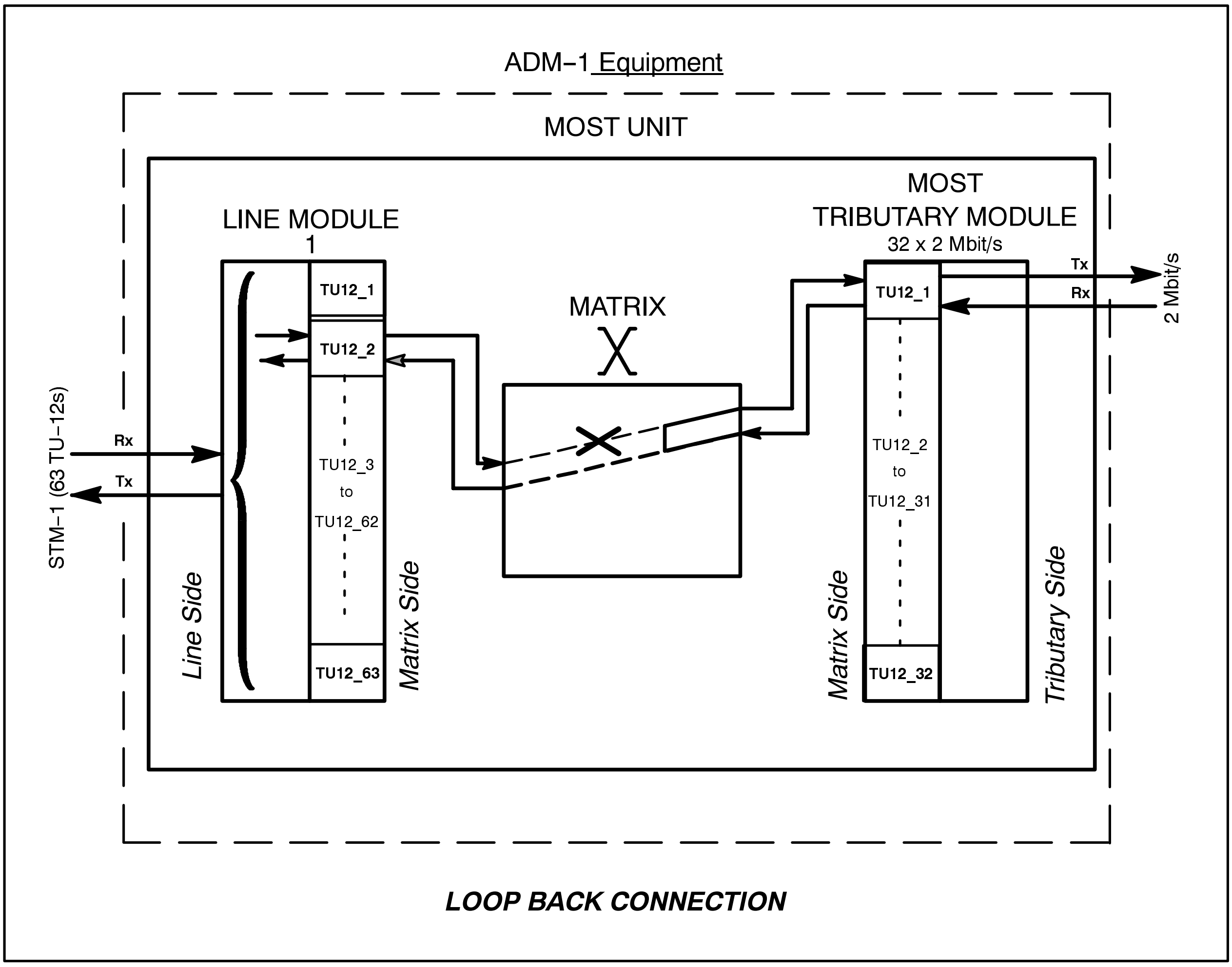


Fig. 1.1–9 *Example of loop back connections*

This is the typical connection used for testing the single tributary port.

In the example the channel **TU12_1** in the tributary unit is cross connected with the corresponding channel of the same tributary unit.

Split Access Connections

In Fig. 1.1–10 split access connections are illustrated.
The incoming tributary signal is connected to a test access port while a test signal is sent to the corresponding output traffic port. When the split access is released, the original connection is re–established.

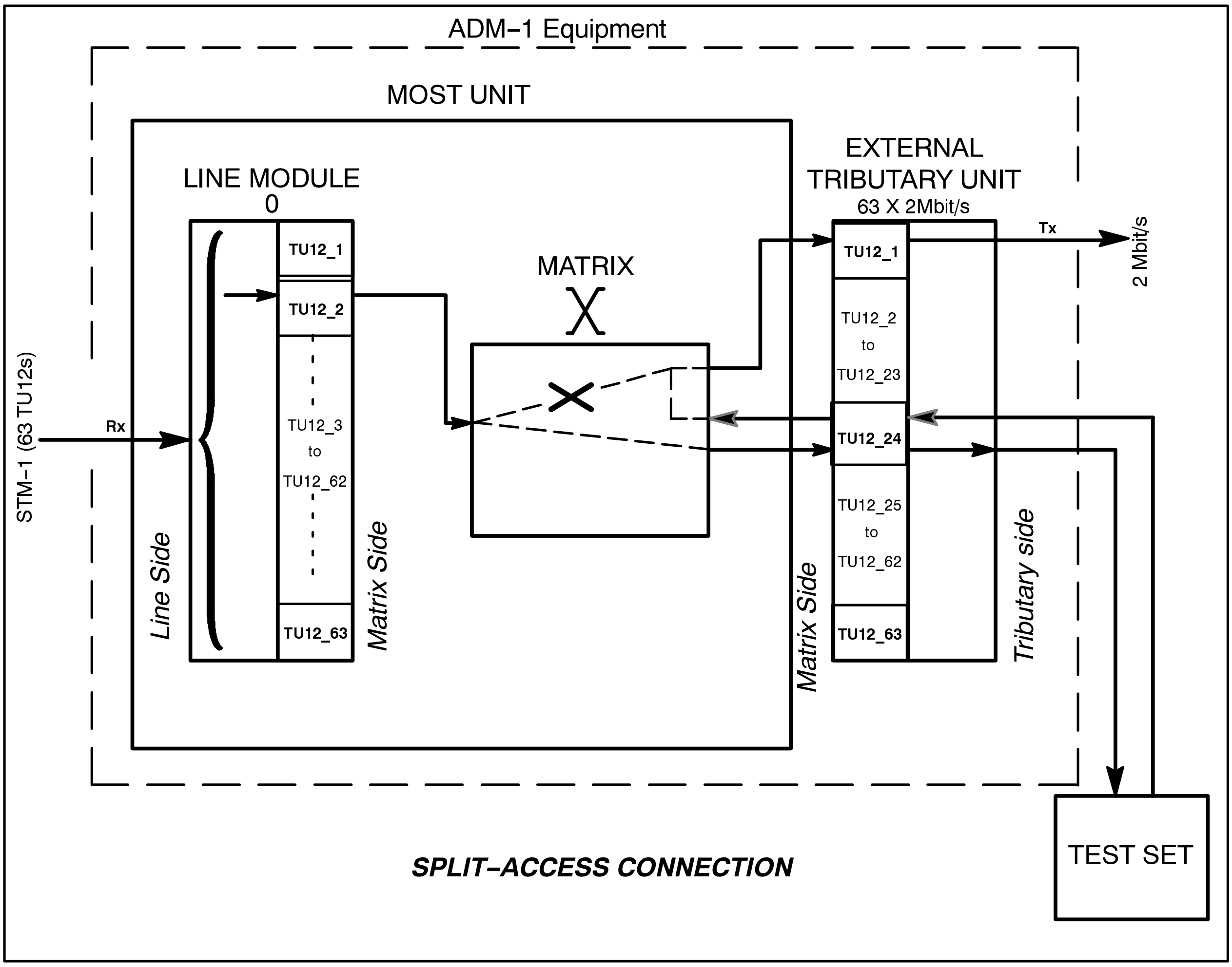


Fig. 1.1–10 *Example of split–access connections*

This is the typical connection used to split the single tributary signal for test purposes.

In the example the channel **TU12_2** incoming from the line 0 (connected previously to the **TU12_1** in the tributary unit) is sent to **TU12_24** used as monitor port; using the same TU channel a test signal is transmitted to **TU12_1** in order to replace the original traffic signal.

Dropped Connections

Special facility designed for SNC protection of unidirectional or bidirectional paths.

The two incoming channels *Worker* and *Protection* are conveyed to their relevant output ports; the drop leg is connected to the *Worker* channel and protected by the *Protection* channel.

Unidirectional Dropped Connection

In Fig. 1.1–11 an example of Unidirectional Dropped Connection (UDC) is illustrated.

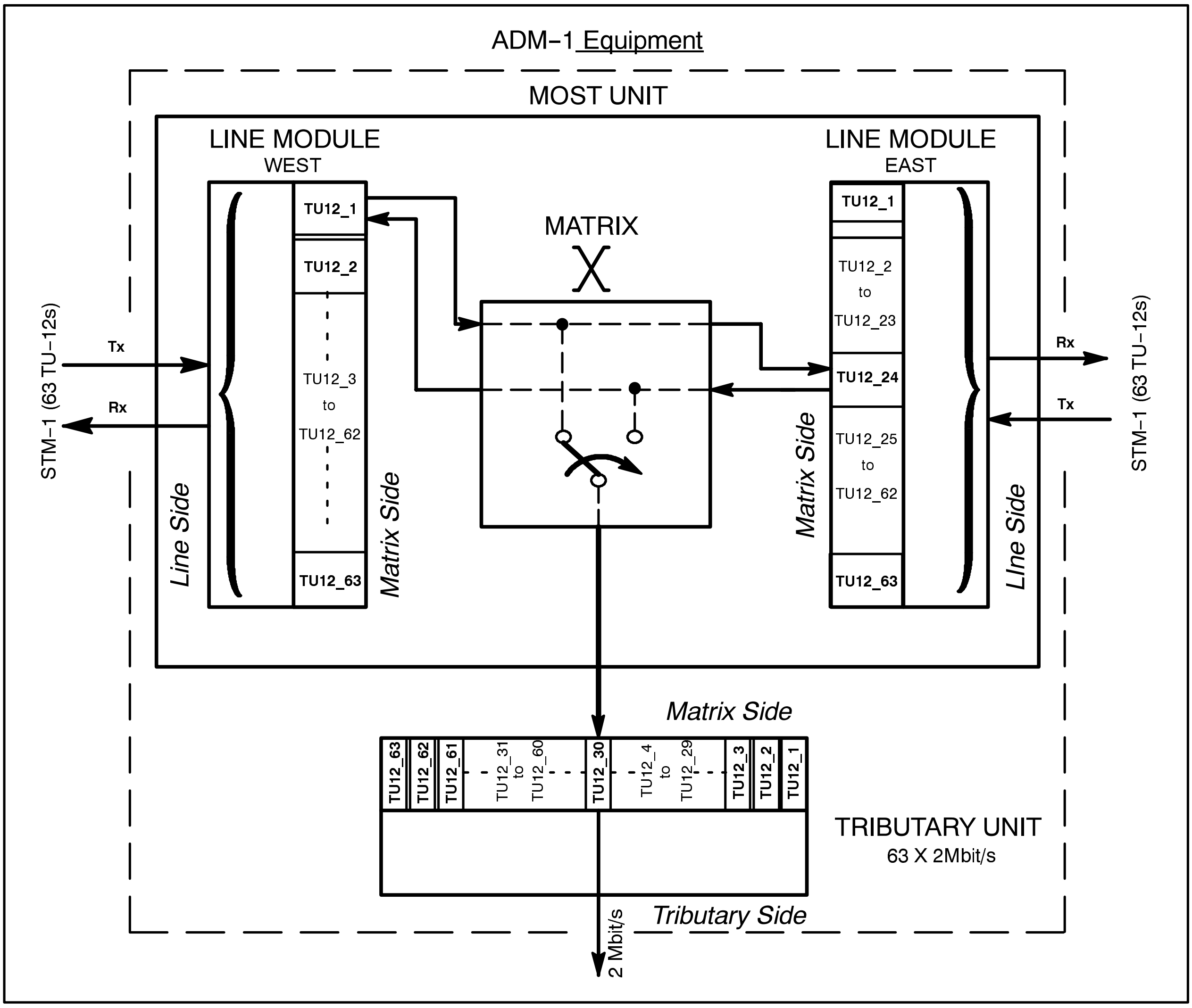


Fig. 1.1–11 *Example of unidirectional dropped connection connection*

In the example (Fig. 1.1–11) the channel **TU12_1** (UCD_W) incoming to the line 1 is connected to the channel **TU12_24** outgoing from the line 0 and the channel **TU12_24** (UCD_P) incoming to the line 0 is connected to **TU12_1** outgoing from the line 1. The matrix is able to choose one of the two channels and connects it to the channel **TU12_30** (UDC) outgoing from the tributary unit.

Bidirectional Dropped Connection

In Fig. 1.1–12 an example of Bidirectional Dropped Connection (BDC) is illustrated.

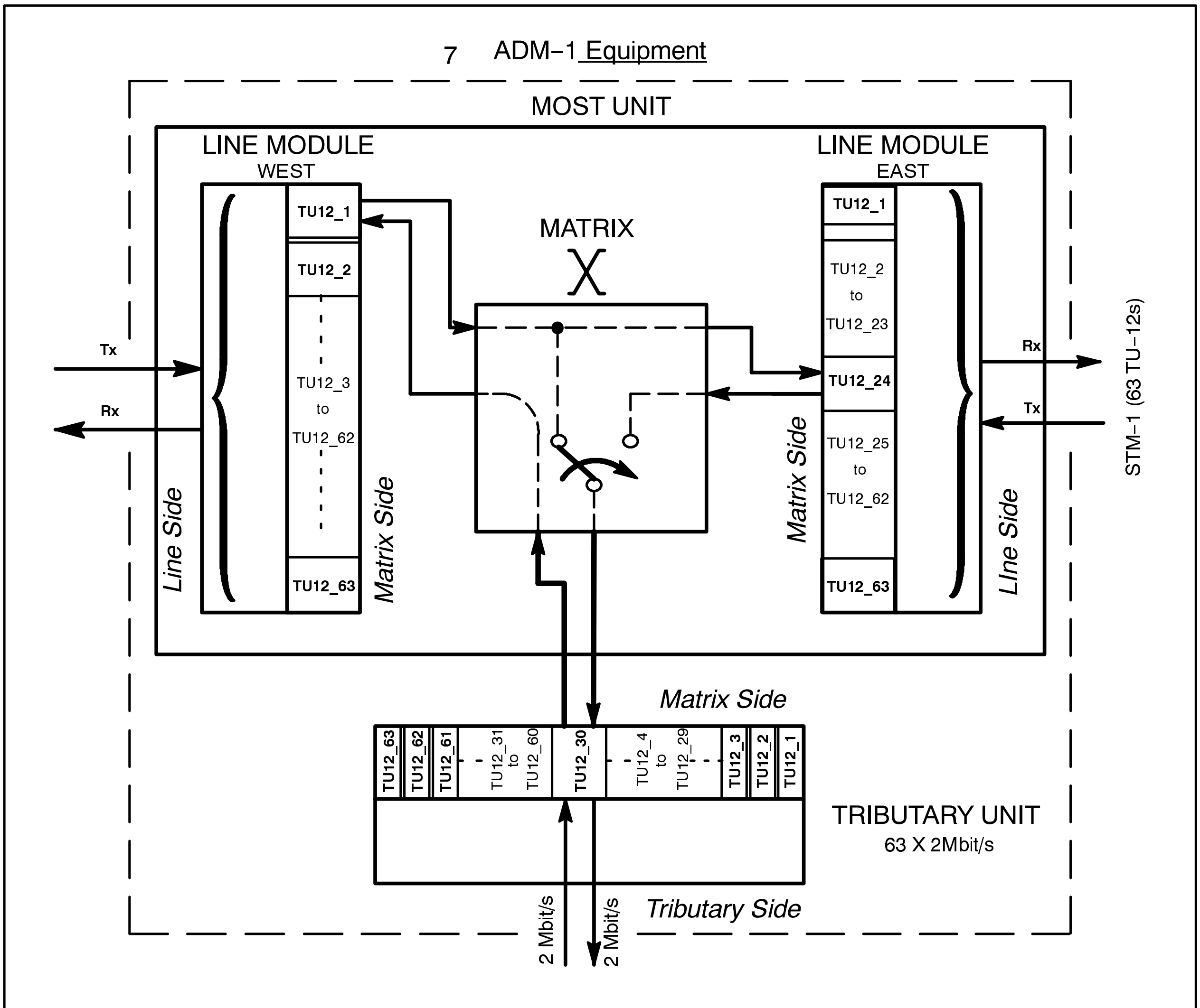


Fig. 1.1–12 *Example of bidirectional dropped connection*

In the example (Fig. 1.1–12) the channel **TU12_1** (BCD_W) incoming to the line 1 is connected to the channel **TU12_24** outgoing from the line 0 and the channel **TU12_24** (BCD_P) incoming to the line 0 is available as protection channel. The matrix is able to choose one of the two channels and connects it to the channel **TU12_30** (BCD) outgoing from the tributary unit.

The channel **TU12_30** incoming to the tributary unit is connected to the channel **TU12_1** outgoing from the line 1.

Switching Criteria

In both cases (unidirectional or bidirectional dropped connections), the line modules monitor the tributary signals (**TU12_1** and **TU12_24**, in the above examples) and, if a failure is detected on the selected one, a message is sent to the matrix in order to perform the switch and to select the other signal.

Please refer to the ”Subnetwork Connection and Path Protection” paragraph for further details of the protection switching criteria.

Synchronisation

The ADM–1 synchronisation architecture is designed to support several timing schemes.
It is based on the concentration of timing sources and their distribution on the MOST Unit which acts as Master by receiving different clock sources, as listed below.

Three different MOST Units are available: the MOST Unit Type 2, the MOST Unit Type 2S and the MOST Unit Type 3.

MOST Unit Type 2, MOST Unit Type 2S and MOST Unit Type 3 Internal Sources

The system is provided with an internal oscillator, working in the following modes:

- *Free–Running*

  the Timex on the Master MOST Unit supplies an internal clock signal, which can be selected as MASTER CLOCK for the equipment, with the stability specified by ITU–T Recommendation G.813.

- *Holdover*

  the Timex on the Master MOST Unit samples the in–use source frequency and extracts its average value, which is then stored in a proper memory. If the selected sources are not longer available, the unit will synchronize its own oscillator using this stored value.
  The holdover stability is in accordance with ITU–T Recommendation G.813.

MOST Unit Type 2

The following clock sources can be managed:

- *two external input sources (EXT1 and EXT2).*
  The system can be supplied with two different 2048kHz G.703 external synchronisation signals;

- *seven tributary sources (one source from T1, T2, TMA, TMB, two sources from T3 and one selected among the second source of T1, T2, TMA and TMB;*

- *four line sources (L0MA, L1MA, L0MB and L1MB).*

The Timex on the Master MOST Unit Type 2 makes a selection from the synchronisation sources and distributes them to the appropriate in service circuits according to the configuration supplied by the Controller.

Fig. 1.1–13 shows the synchronisation architecture for the MOST Unit Type 2.

NOTICE *The clock references are sent in parallel to both switches. It is the Controller in Master status that enables the clock extraction by its relevant switch.*

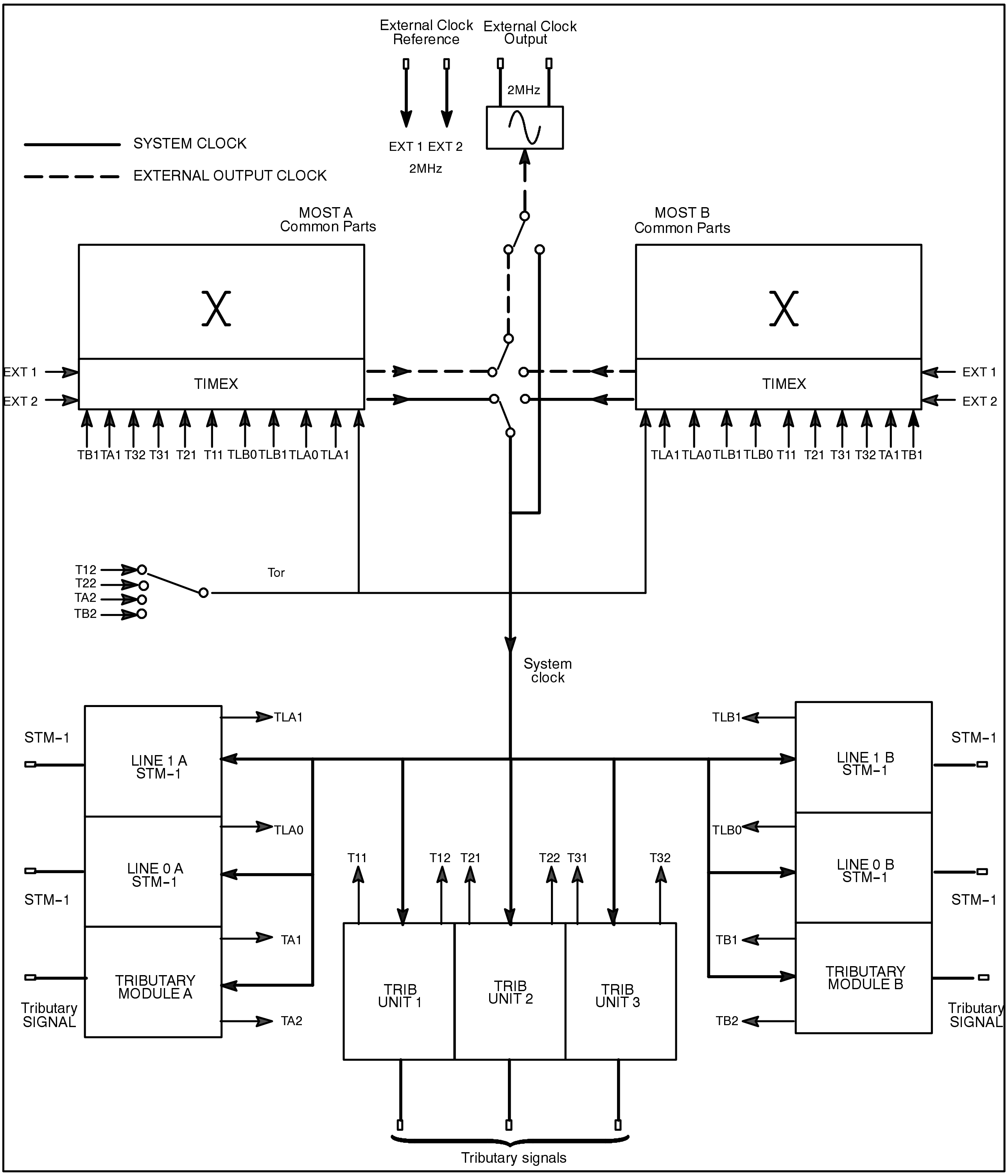


Fig. 1.1–13 MOST Unit Type 2 Synchronisation Architecture

MOST Unit Type 2S

The following clock sources can be managed:

- *two external input sources (EXT1 and EXT2).*
  The system can be supplied with two different external synchronisation signals; these signals can be:
  - *2048kbit/s HDB3 (with SSM management)*
  - *2048kHz*
- *seven tributary sources (one source from T1, T2, TMA, TMB, two sources from T3 and one selected among the second source of T1, T2, TMA and TMB;*
- *four line sources (L0MA, L1MA, L0MB and L1MB).*

The Timex on the Master MOST Unit Type 2S makes a selection from the synchronisation sources and distributes them to the appropriate in service circuits according to the configuration supplied by the Controller.

Fig. 1.1–14 shows the synchronisation architecture for these types of MOST Unit.

NOTICE *The clock references are sent in parallel to both switches. It is the Controller in Master status that enables the clock extraction by its relevant switch.*

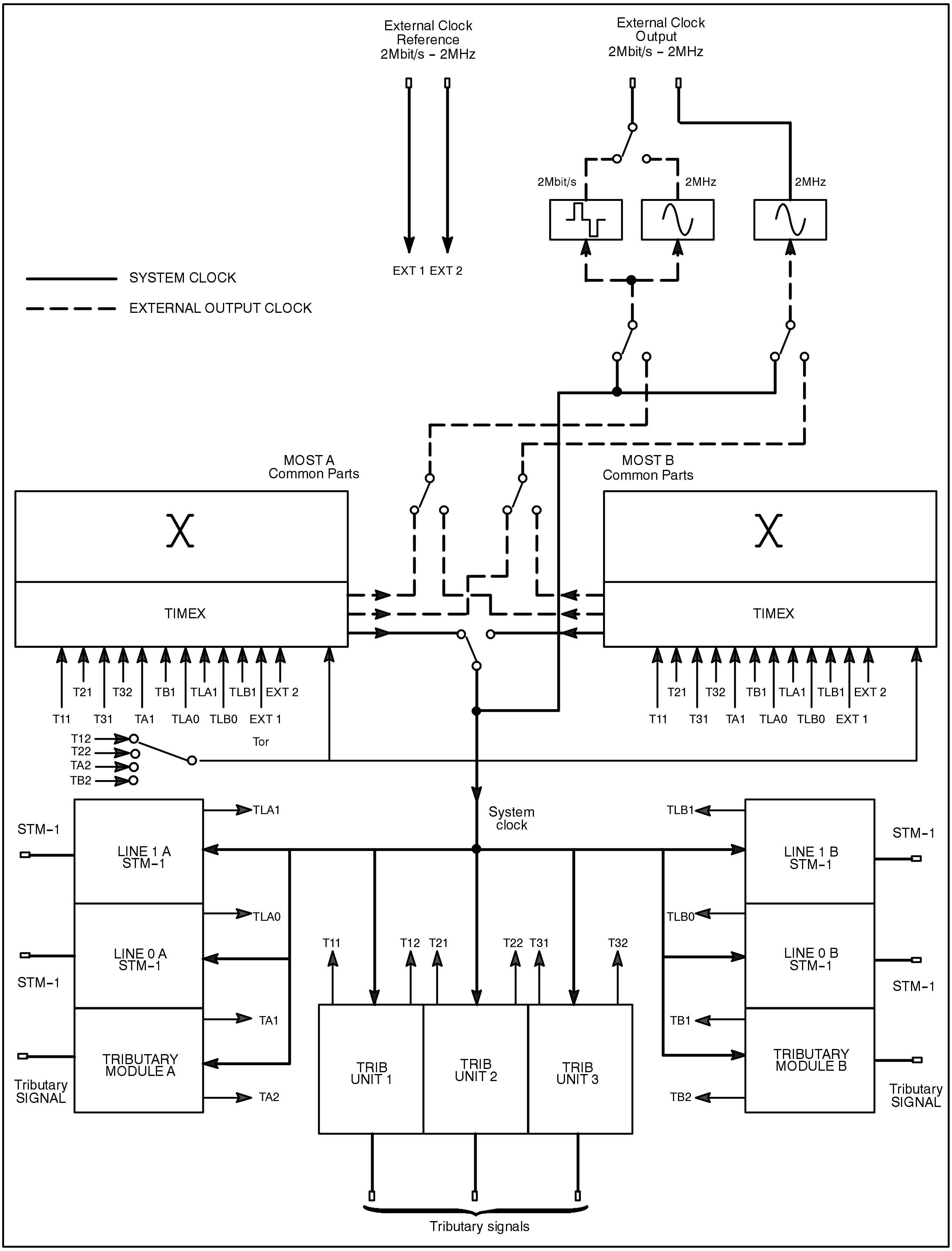


Fig. 1.1–14 *MOST Unit Type 2S Synchronisation Architecture*

MOST Unit Type 3

The following clock sources can be managed:

- *two external input sources (EXT1 and EXT2).*
  The system can be supplied with two different external synchronisation signals; these signals can be:
  - *2048kbit/s HDB3 (with SSM management)*
  - *2048kHz*
- *ten tributary sources (two sources from T1, T2, TMA and TMB);*
- *four line sources (L0MA, L1MA, L0MB and L1MB).*

The Timex on the Master MOST Unit Type 3 makes a selection from the synchronisation sources and distributes them to the appropriate in service circuits according to the configuration supplied by the Controller.

Fig. 1.1–15 shows the synchronisation architecture for these types of MOST Unit.

NOTICE *The clock references are sent in parallel to both switches. It is the Controller in Master status that enables the clock extraction by its relevant switch.*

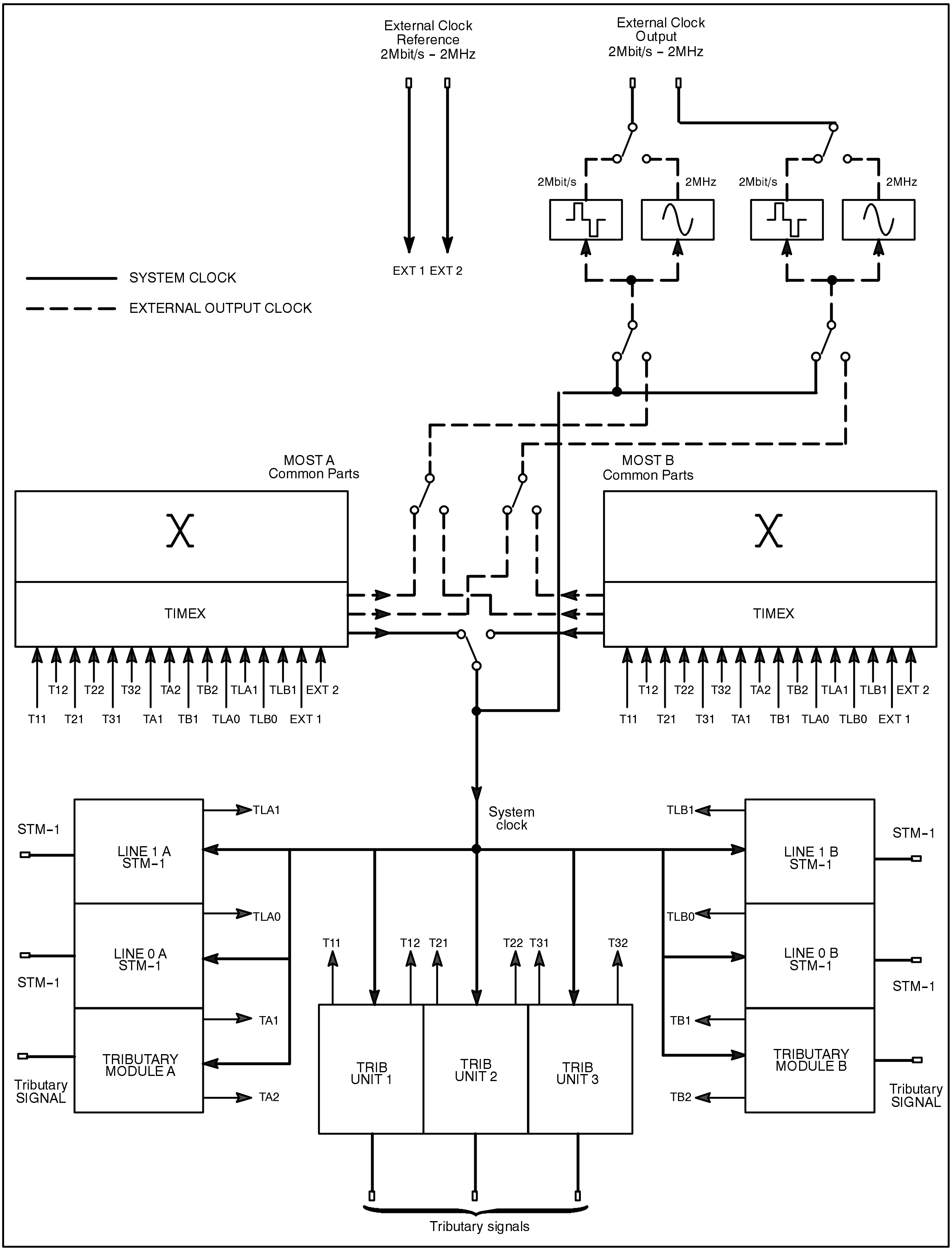


***Fig. 1.1–15** MOST Unit Type 3 Synchronisation Architecture*

Selection of Synchronisation Sources

When the equipment has different synchronisation sources, in case of fail of the active one it is possible to select another source.

The method for selecting the different sources is based either on a priority table or on a quality algorithm.

The priority table includes all the possible synchronisation sources and associates to each of them a priority value. The system selects the highest priority source; if this source fails, the system will automatically select, in the table, the available source with the highest priority.

The quality information is represented within a table as well. Each valid synchronisation source is represented as an entry of this table, together with its priority value and its quality level.

This quality information can be either extracted from the incoming STM–1 signal or set by the Local Controller (or NMC). When the use of quality algorithm is enabled, as soon as a higher quality source becomes available, it is automatically selected as the in–use synchronisation source.

Depending on the type of synchronisation source, the main fail criteria are:

- STM–1 source
  LOS (Loss Of incoming Signal)
  LOF (Loss Of Frame)
  MS–AIS (Multiplex Section Alarm Indication Signal)
  MS–EXC (Multiplex Section Excessive Bit Error Ratio)

- *2048kHz and 2048kbit/s external input source*
  LOS (Loss Of incoming Signal)
  AIS (Alarm Indication Signal) (for 2048kbit/s only)

- *2048kbit/s tributary source*
  LOS (Loss Of incoming Signal)
  AIS (Alarm Indication Signal)
  2Mbit/s EXC (2Mbit/s Input Excessive Bit Error Ratio)

Other criteria for changing the in use synchronisation source (not necessarily including a failure of this source) can be:

- *a decrease of quality level received on byte S1 (SSM – Synchronisation Status Message) of the STM–1 data, under a threshold value*

- *out of frequency of ±9.2 ppm (OOF – Out Of Frequency) detected on the active synchronisation source*

Timing Configurations

The ADM–1 is capable of supporting the following timing configurations:

- *external timing: the clock reference is extracted from an external timing source;*
- *tributary timing: the clock reference is extracted from a tributary port;*
- *line timing: the clock reference is extracted from a line signal;*
- *internal timing: the clock reference is provided by the system internal oscillator.*

In case of regenerator configurations:

- *through timing: the line timing is passed, through the system, from east to west lines and vice versa.*

External Synchronisation Output

Dedicated PLL circuits are used for generating two external 2MHz or 2Mbit/s HDB3 output signals.

The MOST Unit Type 2 can handle one single PLL circuit generating two parallel external 2MHz output signals. The MOST Unit Type 2S is provided with two PLL circuits generating two different 2MHz and 2Mbit/s external output signals (EXT1 can be either 2MHz or 2Mbit/s while EXT2 is 2MHz) and the MOST Unit Type 3 is provided with two PLL circuits generating two different 2MHz and 2Mbit/s external output signals (EXT1 and EXT2 can be either 2MHz or 2Mbit/s). When the 2Mbit/s is selected the SSM can be managed.

These outputs can be synchronized by the following sources:

- *electrical/optical STM–1 streams;*
- *electrical 2Mbit/s streams;*
- *locked to SEC.*

The synchronisation outputs are squelched for the following reasons:

- *loss of synchronisation source;*
- *quality of the synchronisation source lower than a predetermined threshold.*

For test purposes the squelch of 2MHz/2Mbit/s outputs can be disabled.

Protection

The ADM–1 has been designed to guarantee a high level of availability. Therefore it supports several protection schemes, on both equipment and traffic side.

Equipment Protection

Equipment protection means any redundancy thought to protect the functions performed by some units, even in case of their failure.

The equipment redundancy can be structured in:

- *common part redundancy;*
- *traffic interface redundancy.*

Common part protection is based on:

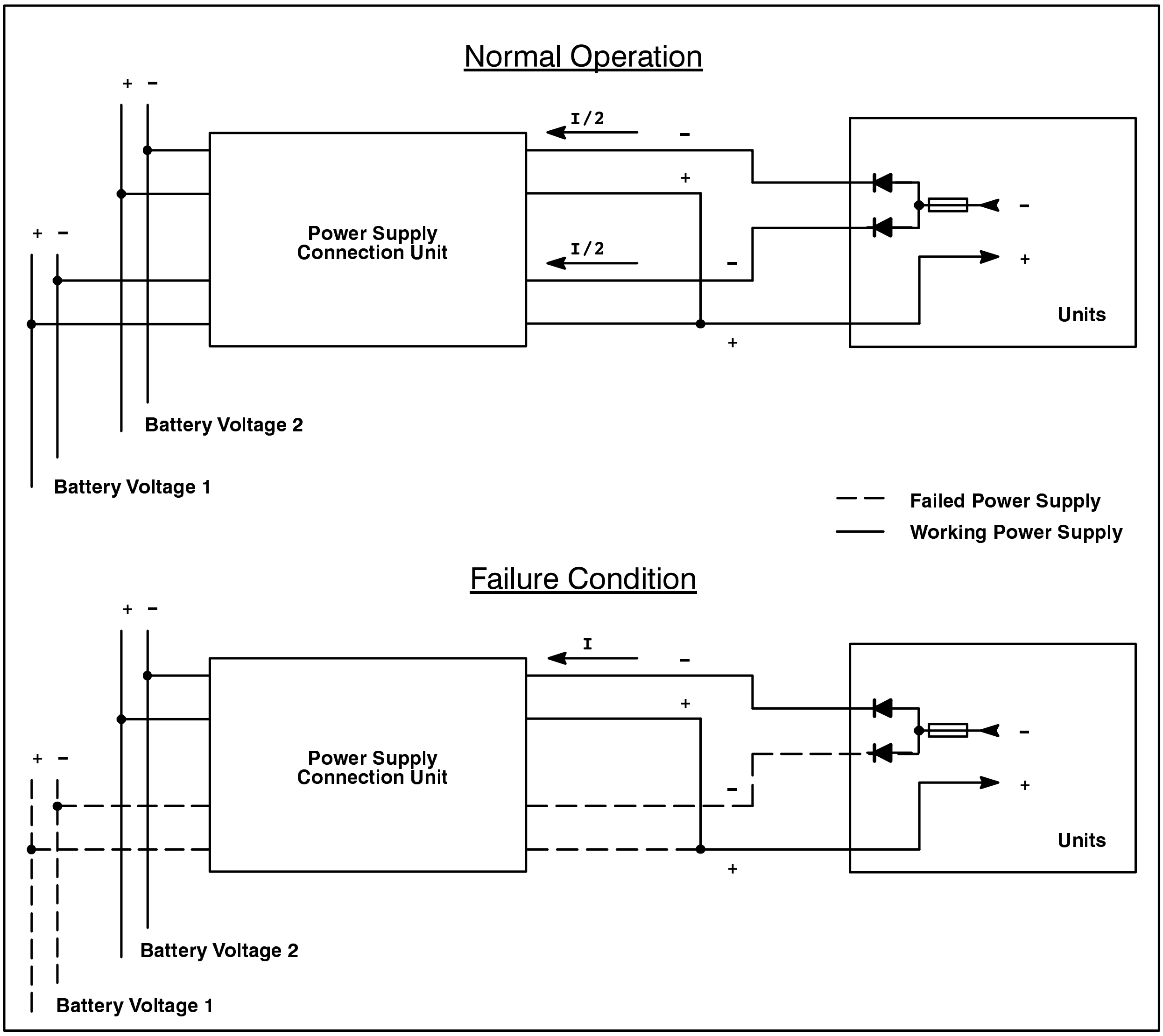
- *power supply protection by means of a redundant battery system and of distributed DC/DC converters;*
- *1+1 protection of MOST Unit common parts.*

Traffic interface redundancy allows the following 1:N protection schemes:

- *1:2 protection of 1.5/2Mbit/s MOST A and B Tributary Modules;*
- *1+1 protection of 1.5/2Mbit/s MOST A Tributary Module;*
- *1+1 protection of 63x1.5/2Mbit/s Tributary Unit;*
- *1+1 protection of the electrical units (STM1, 140, 45, 34Mbit/s).*

Power Supply Protection

The equipment is fed by two power supply lines which provide in parallel the voltage to all units. During normal operation the load is shared between the lines. In case of failure of one line the other will power all the load.



Each unit has its own DC/DC converter, so that a failure on one of them, does not force a failure in the whole equipment.

A failure on a DC/DC converter does not affect the whole equipment and can be treated as a failure on a single unit.

MOST Unit

The MOST Unit functionalities are the following:

- *alarms and events monitoring of the equipment during the normal operation;*
- *control of the whole equipment, through the CONTROL_BUS;*
- *management of cross connections;*
- *management of equipment timing;*
- *modification of the equipment configuration and provisioning via Local Controller or Network Management Centre;*
- *storage of the equipment database in a proper memory.*

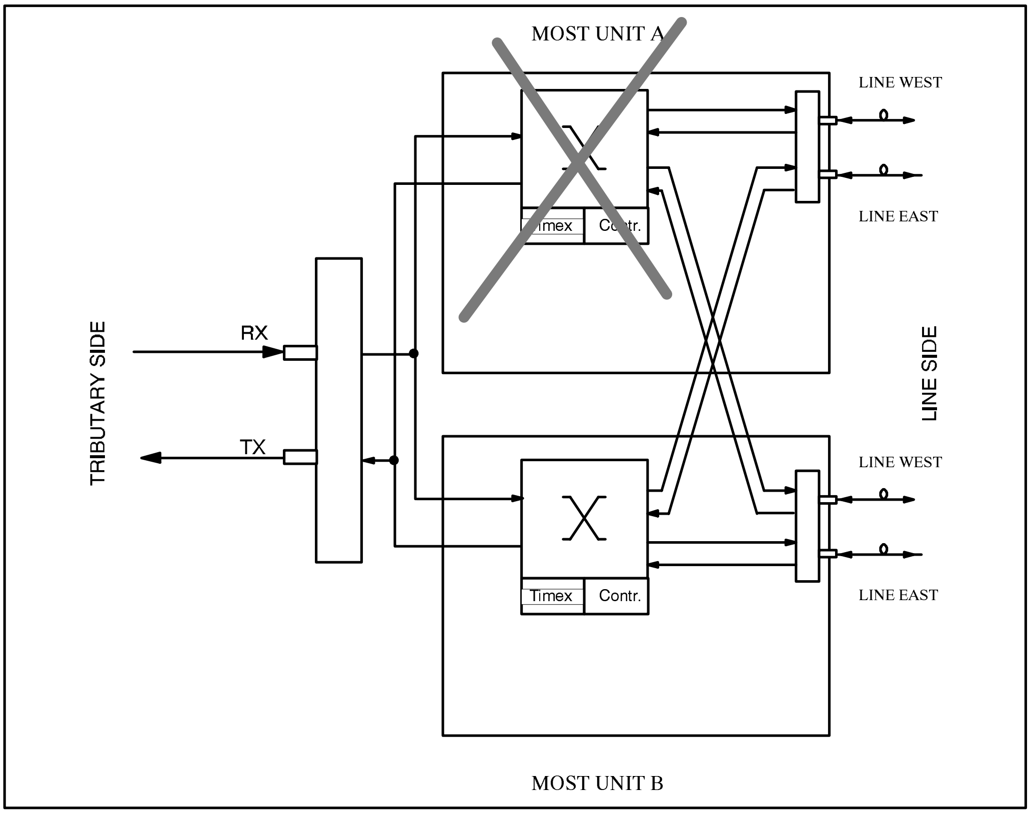


Fig. 1.1–16 *MOST Unit protection*

In case of MOST Unit failure, if a second MOST Unit is present, it detects the failure and switches to a full operative condition.
All the functions of the failed MOST Unit are now managed by the second MOST.

The possible MOST Controller States are:

- ***MASTER** status: the MOST Controller communicates with the other units in the shelf. In this case the MOST Unit has the full control of timing and management of the equipment;*
- ***SLAVE** status: the MOST Controller does not communicate with the other units in the shelf (except the other MOST Controller). In this case the MOST Controller is in a Stand–by condition.*

When two MOST Units are present, only one MOST Controller is active and the Matrix in use is the one on the Master MOST Unit.

There are no constraints on the use of Line and Tributary Modules. The modules on the Slave and Master MOST Unit can be used.

In case of a failure on the common parts of the worker MOST, the stand–by one detects this event through the X–MOST bus and change its status to Master. The incoming signals are sent in parallel to both switches, but only the Master MOST Unit will process them.

This protection is not automatically revertive. However, it is possible to force the switch by means of the Local Controller or the Network Management Centre.

The two MOST Units use the X–MOST BUS for all their communications.

1.5/2Mbit/s MOST Tributary Module 1:2 and 1+1

The MOST tributary modules can be protected in 1:2 mode by a 63x1.5/2Mbit/s G.703 Tributary Unit installed in the protection slot. The operations of each tributary module are controlled by the MOST Controller.
The 2Mbit/s streams are sent in parallel to the MOST Tributary Module and to the Tributary Protection Unit
If there is a failure, the tributary streams connected to the failed unit are switched on the protection unit. (Fig. 1.1–17).
This kind of protection is optional and must be configured by means of the local controller or NMC.

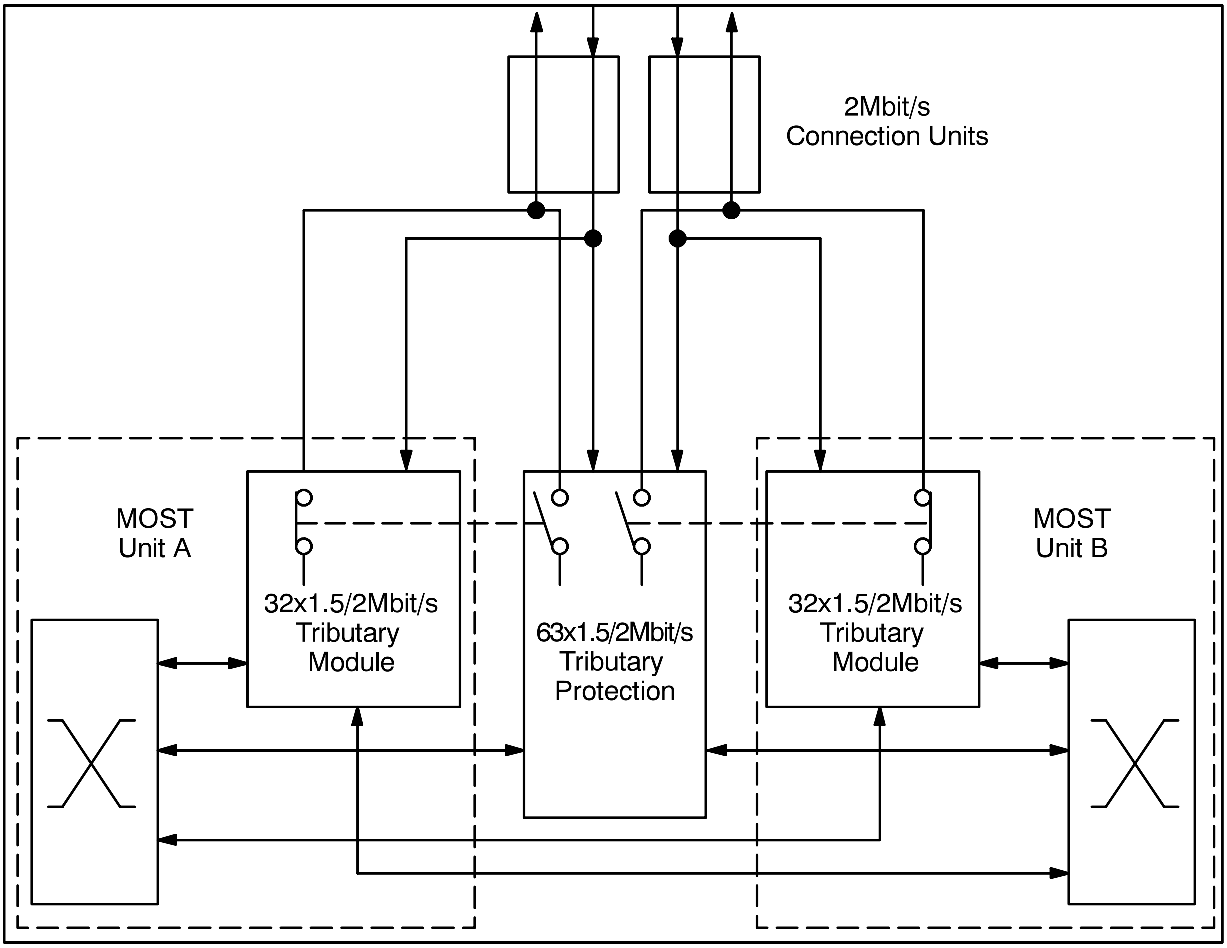


Fig. 1.1–17 *MOST A and MOST B Tributary Module 1:2 protection logical scheme*

Another protection scheme can be realised for protecting the 1.5/2Mbit/s Tributary Module of the MOST A (this protection can be realized even if MOST B is present and it is MASTER.

The Tributary Module can be protected in 1+1 mode by a 32x1.56/2Mbit/s G.703 Tributary Unit installed in the protection slot. The protection scheme is similar to the 1+1 above described.

Fig. 1.1–18 shows the logical connection among the circuits.

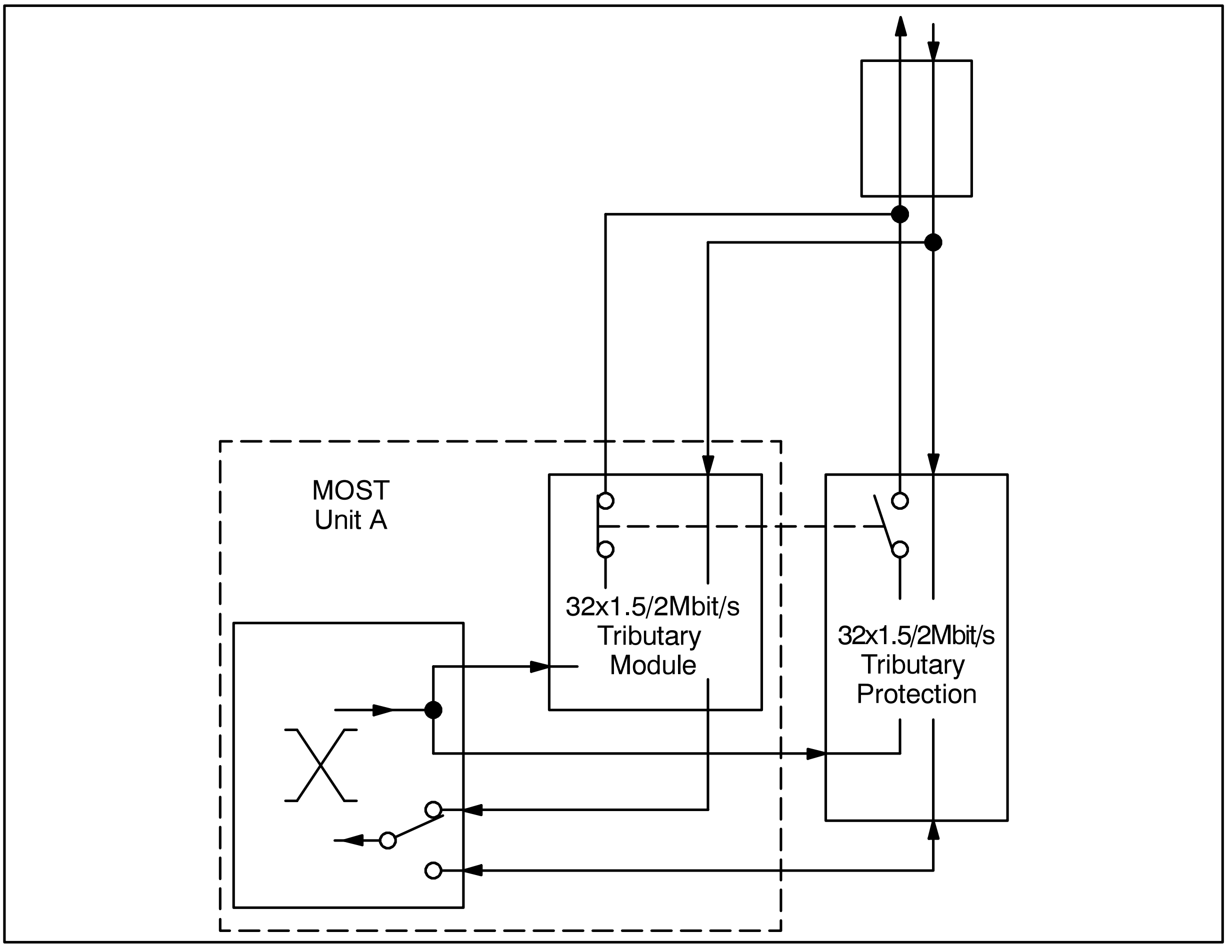


Fig. 1.1–18 *MOST A / MOST B Tributary Module 1+1 protection logical scheme*

63x1.5/2Mbit/s G.703 Tributary Unit 1+1 Protection

The 63x1.5/2Mbit/s G.703 Tributary Unit, in tributary position 2, can be protected in 1+1 mode by a 63x1.5/2Mbit/s G.703 Tributary Unit installed in the protection slot. The operations of each tributary unit is controlled by the MOST Controller.
The 2Mbit/s streams are sent in parallel to the 63x1.5/2Mbit/s G.703 Tributary Unit and to the Tributary Protection Unit
If there is a failure, the tributary streams connected to the failed unit are switched on the protection unit. (Fig. 1.1–19).
This protection kind is optional and must be configured by means of the local controller or NMC.

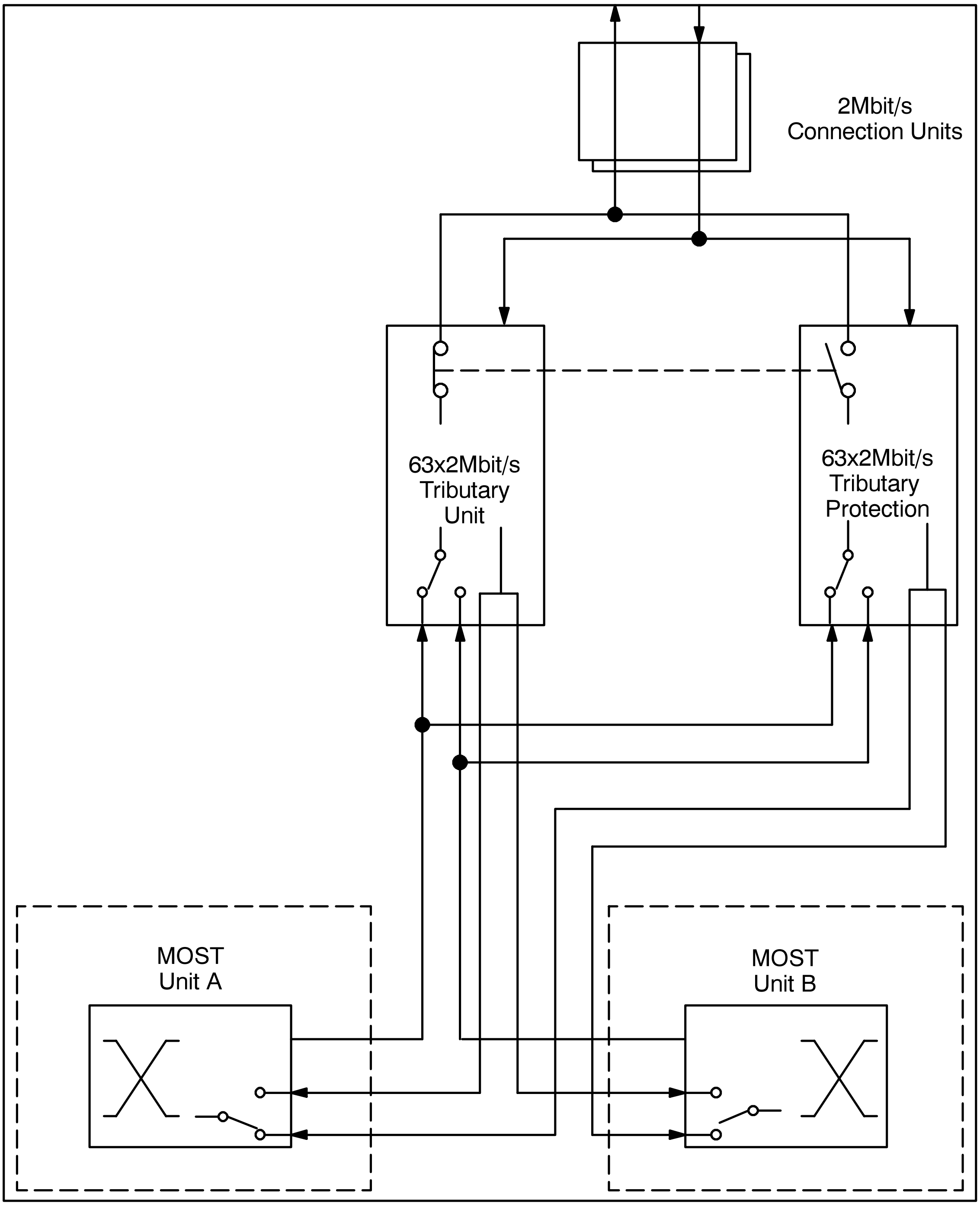


Fig. 1.1–19 *External Tributary Unit 1+1 protection logical scheme*

Electrical Tributary 1+1

The 34 – 45 – 140 and 155 Mbit/s electrical tributary (unit or MOST module) can be protected in 1+1 mode by a unit of the same type.
The operation of each tributary unit is controlled by the MOST Controller.
The incoming streams are sent in parallel to the Tributary and to the Protection Unit.
If there is a failure, the outgoing tributary streams connected to the failed unit are switched to the protection unit.

The connection unit includes a bridge on the line reception side and a selector on the line transmission side, in order to send the incoming signal both to the working unit and to the protection one.
The MOST Controller selects the unit from which the signal has to be extracted.

This protection kind is optional and must be configured by means of the local controller or NMC.

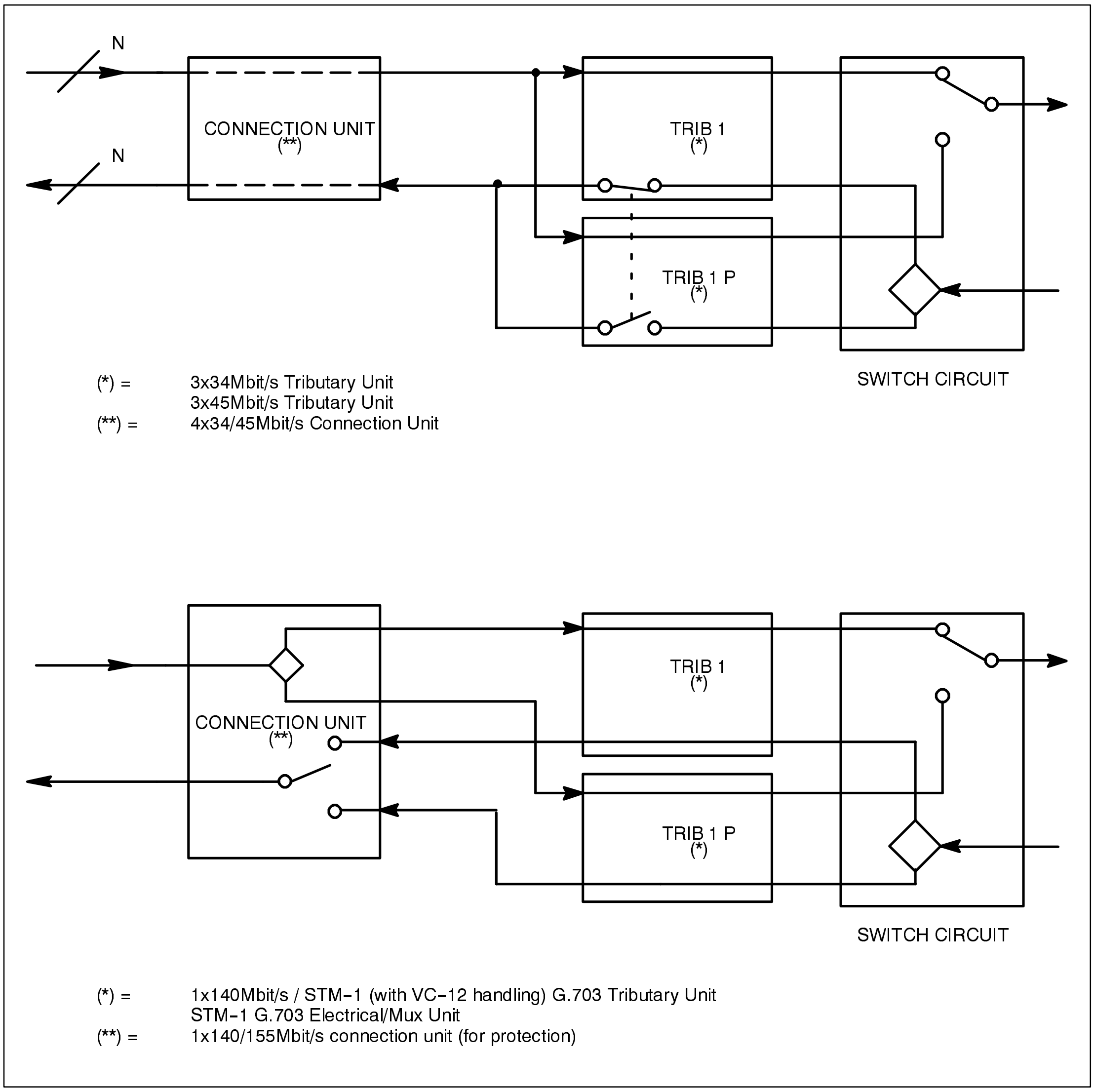


Fig. 1.1-20 *Electrical Tributary Protection 1+1*

For the 140Mbit/s/STM–1 Electrical Tributary Unit the following protection configurations can be selected:

- *tributary position 3 used as protection of MOST B Tributary Module;*
- *tributary position 2 used as protection of Tributary position 1.*

The first and the third configurations are alternative.

For the 34 – 45 Mbit/s Tributary Unit the following protection configurations can be selected:

- *1+1 protection between tributary in position 1 and 2;*
- *1+1 protection between tributary in position 2 and 3;*
- *1+1 protection between tributary module on MOST A and on MOST B;*

Network Protection

The equipment offers protection options in order to fulfill the requirements of different network configurations:

In point to point connections the following protection scheme can be managed:

- *Multiplex Section 1 + 1 Protection (MSP) on STM–1 lines and tributary interfaces.*

In ring and more complex topology networks, the following protection scheme can also be managed:

- *Sub–Network Connection Protection (Path Protection).*

From the point of view of management the path protection scheme is the simplest because the switching is performed by each node on the basis of a local decision and does not require exchange of messages between nodes.

Multiplex Section (1+1) Protection (MSP)

The working principle for STM–1 line protection (Unidirectional and Bidirectional) are illustrated in the diagram on Fig. 1.1–21 and Fig. 1.1–22.

In the unidirectional protection only the failed direction is switched. After the change–over the transmission stream uses the protection line while the reception stream keeps on using the main line.
In the bidirectional protection both directions are switched. For this reason, after the change–over, both transmission and reception streams use the protection lines.

At the transmit end, the tributary signal is sent to both the STM–1 Optical (Electrical) MOST Modules in order to be transmitted on the main and the protection line.

At the receive end, the transmission path is selected via the switches located on the active MOST Unit. The switches are controlled by the MOST Controller and are operated simultaneously on all tributary units.

The Master MOST Unit continuously monitors the two lines.

The automatic protection switching protocol (bytes K1 and K2), used for bidirectional protection, is specified in ITU–T G.783 Rec.

The following alarms detected by the lines are used as switching criteria:

- *LOS (Loss of Signal);*
- *LOF (Loss of Frame alignment);*
- *MS–AIS (Multiplex Section – Alarm Indication Signal);*
- *MS–EXC (Excessive Bit Error Ratio* $\geq 10^{-3}$ *on B2 byte, former EBER);*
- *MS–DEG (Signal Degrade exceeding a preset threshold in the range of* 10^{-5} *to* 10^{-9} *on B2 byte).*

The protection switches can also be manually operated from the LC (Local Controller) or the NMC (Network Management Centre).

Two working modes for MSP are available:

- *revertive;*
- *not revertive.*

After a protection switch, different actions take place, depending on the selected working mode.

In revertive mode, once the main line gets available again, it is automatically restored as the working one (this restoration is performed after the complete expiration of the wait to restore time). In not revertive mode, even if the main line gets available, the system still uses the protection line as the working one.

It is also possible to perform the 1+1 MSP protection on the tributary side using STM–1 units.

An example of STM–1 line protection is illustrated in Fig. 1.1–23.

On the tributary side the working principle is the same as the STM–1 line protection described above.

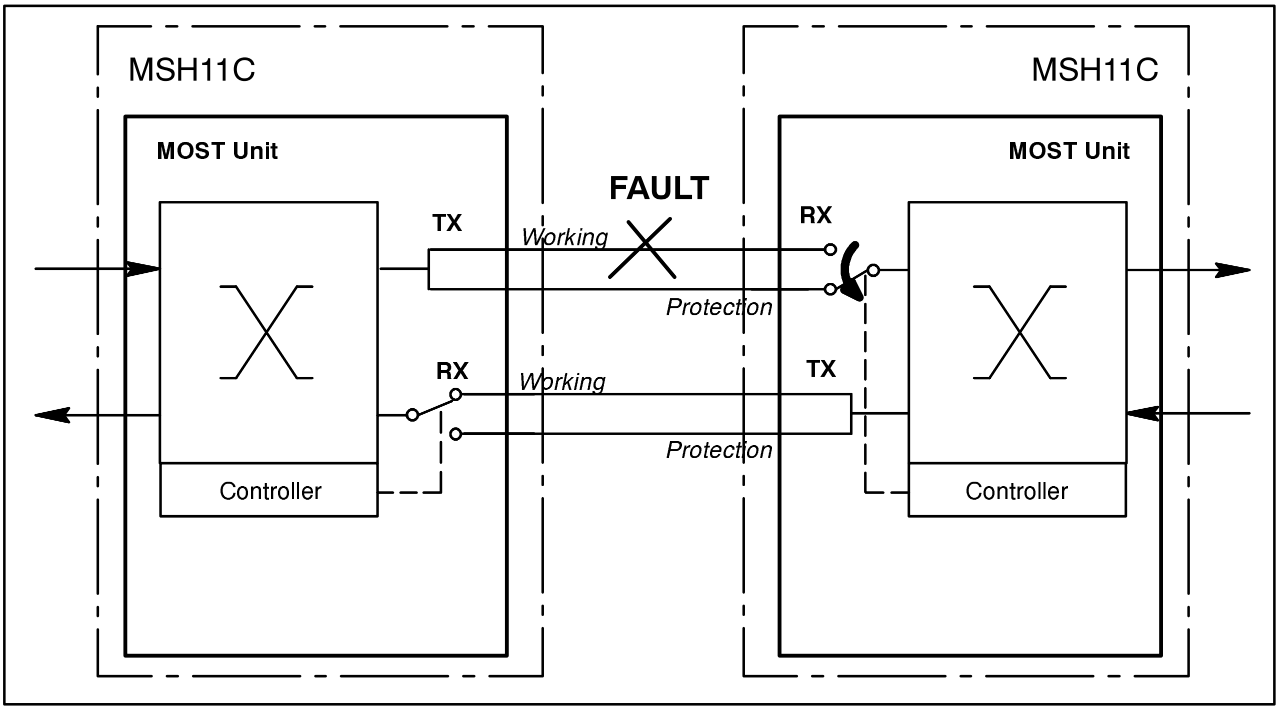


Fig. 1.1–21 *Unidirectional STM–1 Line Protection working principle*

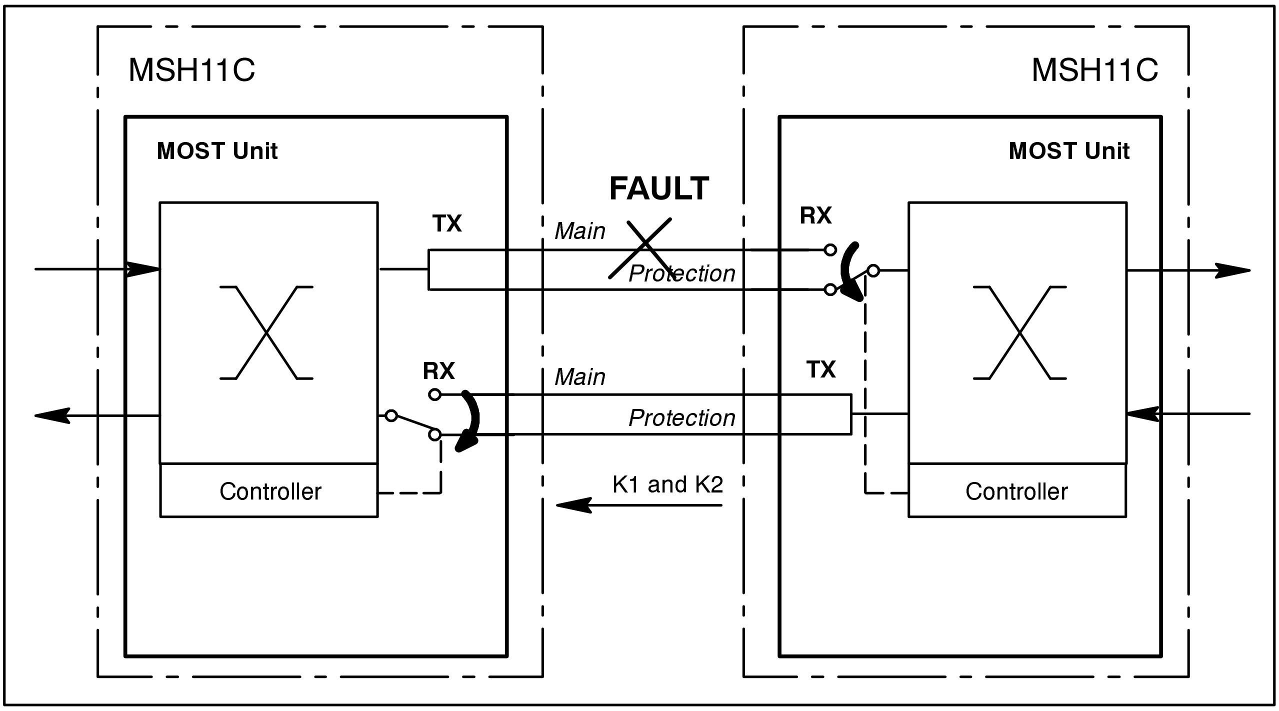


Fig. 1.1–22 *Bidirectional STM–1 Line Protection working principle*

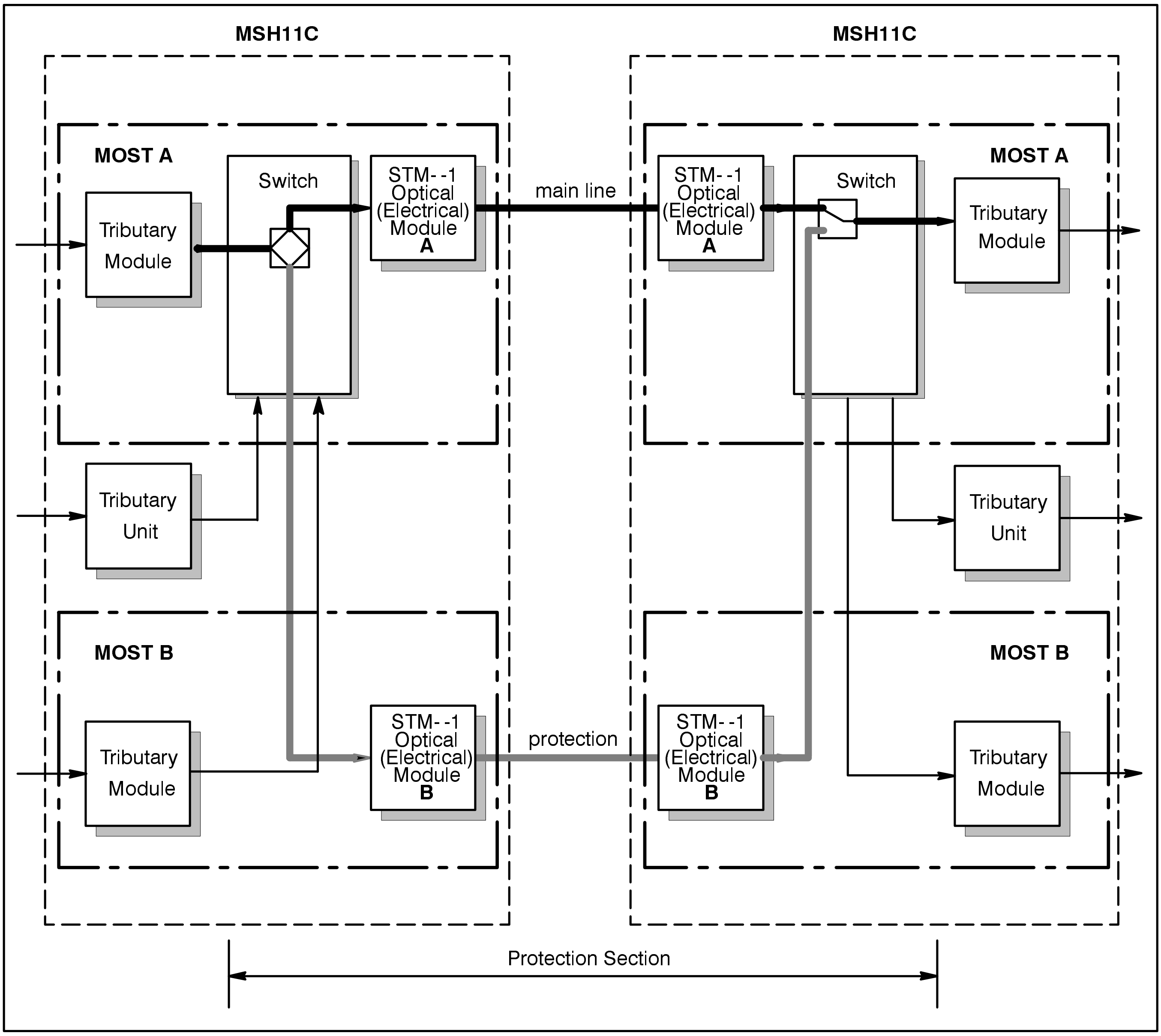


Fig. 1.1–23 *Multiplex Section (1+1) Protection (MSP) on line side*

Subnetwork Connection and Path Protection

This protection scheme finds its application in ring networks.

The working principle is illustrated in the Fig. 1.1–24.

For each node the VCs to be protected are sent in both directions of the ring.

At the receiving node each VC to be dropped is received from the two directions.

The line units monitor both signals and, if a failure is detected on the selected one, the switch is operated and the other signal is selected.

The main difference between path and MS Protection is that paths are protected individually on the basis of local information only. Therefore, Path Protection does not need an APS (Automatic Protection Switching) protocol (between local and remote ends).

Using the LC (Local Controller) or the NMC (Network Management Centre) it is possible to enable or disable the protection for each VC.

The available path protection are the SNCP/N (Not Intrusive), the SNCP/I (Inherent) and the Path Protection. The used switching criteria are:

SNCP/I at AU–4 level

- *AU LOP (Administrative Unit Loss Of Pointer);*
- *AU AIS (Administrative Unit Alarm Indication Signal).*

SNCP/N at AU–4/VC–4 level

- *AU LOP (Administrative Unit Loss Of Pointer);*
- *AU AIS (Administrative Unit Alarm Indication Signal);*
- *HO EXC (High Order Excessive errors) (B3 BIP–8 information);*
- *HO DEG (High Order Degradation) (B3 BIP–8 information);*
- *HO UNEQ (High Order Unequipped signal) (C2 information);*
- *HO TIM (High Order or Low Order Trace identifier mismatch) (J1 information).*

Path Protection at VC–12/VC–2/VC–3 level

- *TU LOP (Tributary Unit Loss Of Pointer);*
- *TU AIS (Tributary Unit Alarm Indication Signal);*
- *LO EXC (Low Order Excessive errors) (B3 BIP–8 and V5 BIP–2 information);*
- *LO DEG (Low Order Degradation) (B3 BIP–8 and V5 BIP–2 information).*

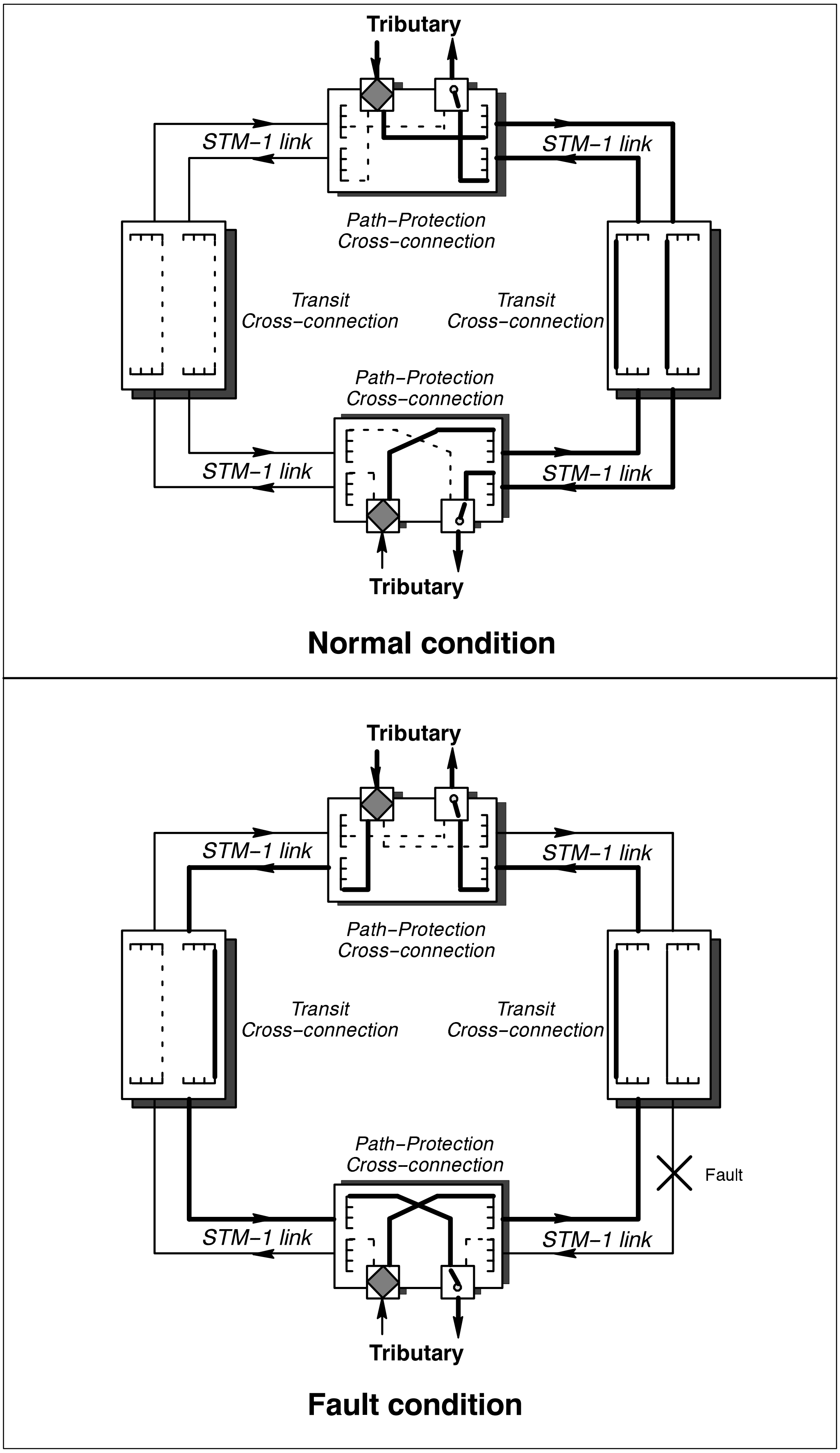


Fig. 1.1–24 *Sub–Network Connection Protection*

Services

The system supports several services, for both maintenance and supervision purposes.
The overhead bytes of line and tributary streams, are used for connecting remote Network Elements, via DCC channels, EOW or user defined channels.

Overheads (OH)

Line Section Overheads

The Section Overhead (SOH) bytes are used for frame alignment, error monitoring, control functions or as auxiliary data channels.

The first three rows form the Regenerator Section Overhead (RSOH) and are accessible in both line multiplexes and regenerators. Rows from 5 to 9 form the Multiplex Section Overhead (MSOH) and are accessible only in the line multiplexes.

Some of the SOH bytes are processed directly by the MOST Units, the others can be accessed through the Auxiliary Unit (Service Telephone and Auxiliary Channels) and can be used as data channels. The Data Communication Channels (DCC) are generally processed by the MOST Unit.
If a Communication Unit is present the DCC are managed by this unit.

Section Overhead Bytes Distribution

All the units are connected in parallel to the same busses and normally their outputs are in the high–impedance state (only the Tributary in position 3 is not connected to the MOST Units). Only one unit at a time can enable its output in order to insert data in one or more SOH bytes. The output is enabled only in the time–slots of interested bytes in order to let other units insert data in other bytes of the same bus.

In ADM configurations, the bytes that are not locally dropped/inserted are put in the pass–through mode (the ones received from one side are transmitted to the other side).

In Regenerator configurations the bytes relevant to MSOH are not processed and they are sent in the pass–through mode.

A block diagram showing the busses used for the SOH bytes distribution within the system is given in Fig. 1.1–25.

Data Communication Channels (DCC)

The DCC_R for the Regenerator Section (bytes D1–D3) and DCC_M for the Multiplex Section (bytes D4–D12) are respectively a 192kbit/s and a 576kbit/s data channels used for the remote control and monitoring of each equipment of an optical link. They are processed by the MOST or by the Communication Unit when present.
The ADM–1 Equipment can manage up to four DCC, when the only MOST Unit is present. If the DCC are managed by the Communication Unit (that is when this unit is fitted), the maximum number of managed DCC is eight and the DCC on MOST are disabled.

The MOST Units accept eight DCC inputs (four from the lines, three from external STM–1 tributaries and one from the tributary module on the MOST itself) but are able to manage only four DCC. On the other way, the Communication Unit accepts all nine DCC (four from the lines and five from STM–1 tributaries) but it is able to manage only eight.

In the ADM configurations also the DCC, as the other SOH bytes, are put in the pass–through mode when not locally inserted.

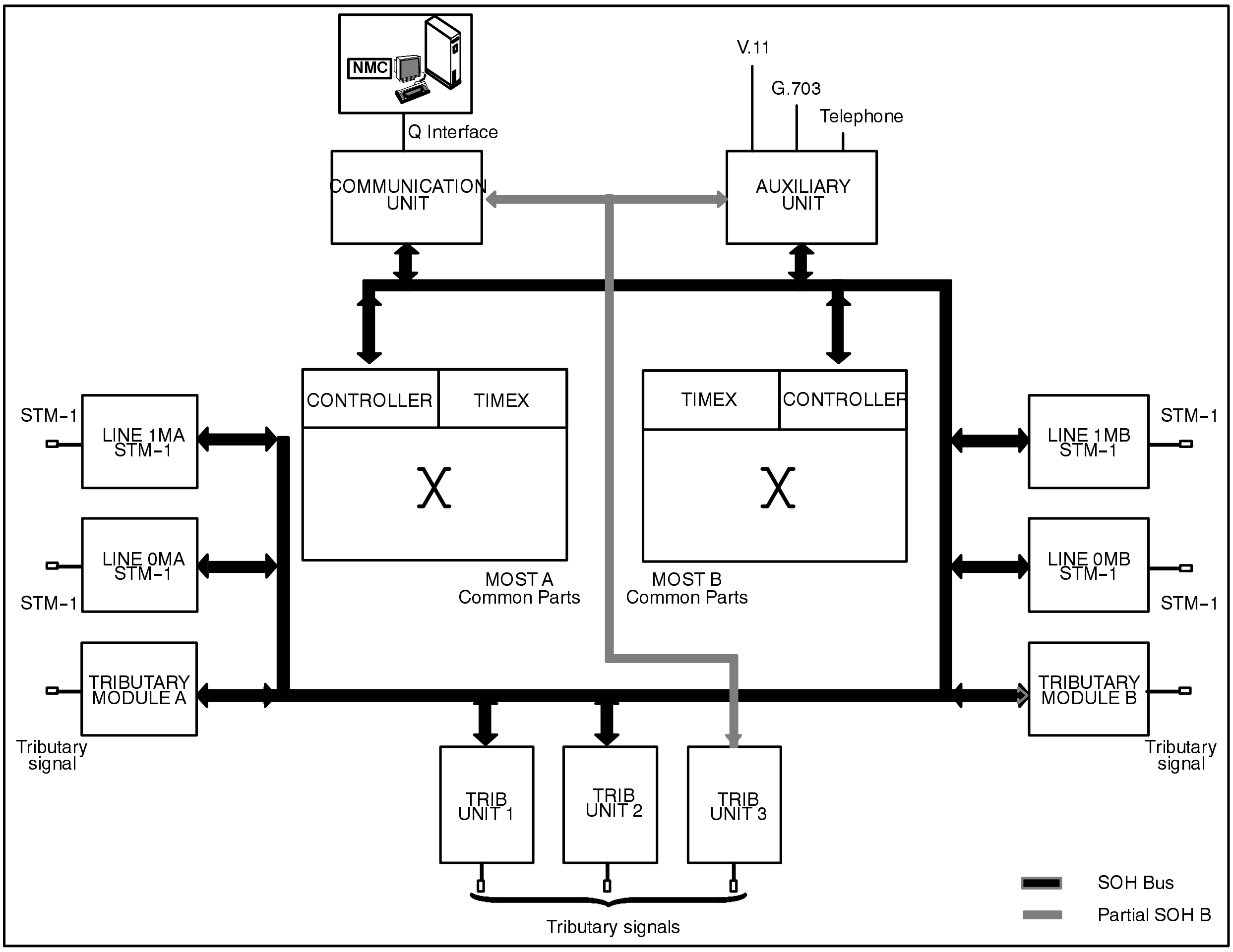


Fig. 1.1–25 *SOH bytes distribution*

Higher Order Path Overhead Monitoring – HPOM

HPOM is a function defined in Recc. ITU–T G.783. Parts of the POH bytes of the incoming HO–VC (VC–4) are recovered and monitored, while the HO–VC is forwarded unchanged through this function. The bytes monitored are:

- *Path trace (J1), path status information (G1), path signal label (C2)*
- *BIP–8 (B3) on the HO–VC. The computed BIP–8 for the current frame is compared with the recovered B3 from the following frame*

Supervisory Unequipped Mode

Higher Order Unequipped Generator is a function defined in Recc. ITU–T G.783.

If an outgoing VC–4 is completely free (no VC is connected), the HUG generates a high order VC with undefined payload and fully valid POH. This operation consists of:

- *Generation of a container C–4 with undefined payload information*
- *Generation of a frame offset*
- *Setting of the path signal label C2 to ”unequipped”*
- *Insertion of the path trace (J1) and path status information (G1) in the POH*
- *Computation of BIP–8 over all bits of the VC–4 and insertion in the B3 byte position of the following frame*

If a VC–4 with a signal label not equal to unequipped is received by the HUG, it is passed to the successive functions without modification.

Order wire channels

According to ITU–T Recommendations, E1 and E2 bytes can be used as order wire telephone channels. The first, which is allocated in the RSOH, is dedicated to telephone calls over regenerator sections; the second is allocated in the MSOH and is dedicated to calls over multiplex sections.

Tributary Section Overheads (SOH)

The section Overhead bytes of the STM–1 tributary signals have the same functions and allocation of the SOH bytes of the line signals.

Path Overheads (POH)

The High Order Path Overhead bytes are allocated in the first column of the Virtual Container (VC–4 or VC–3) and contain path–specific information. Their main functions are : path identification, error monitoring, path status monitoring and payload–type identification.

Communication channels for auxiliary and service functions are provided using STM–1 OverHead bytes.

Engineering Order Wire (EOW)

This service allows the audio connection among all the equipment connected by STM–1 signals, by means of a standard telephone with DTMF signalling. The EOW channel uses the E1 or E2 bytes.

Two types of call are possible:

- *a collective call which is received simultaneously in all equipment;*
- *a selective call that initiates ringing in the selected equipment only.*

In Ring networks the EOW channel provides an automatic restoration procedure in case of failure.

The interface for the EOW is a standard 2 wires analog interface, with DC current feed, hook status detection and DTMF signalling. Moreover a 4 wire both analog and digital interface is available to extend the EOW channel.

A block diagram showing the structure of the Engineer Orderwire is given in Fig. 1.1–26.

The EOW channel is managed on both line (East A and B and West A and B) and tributary side, with an overall number of 7 channels.

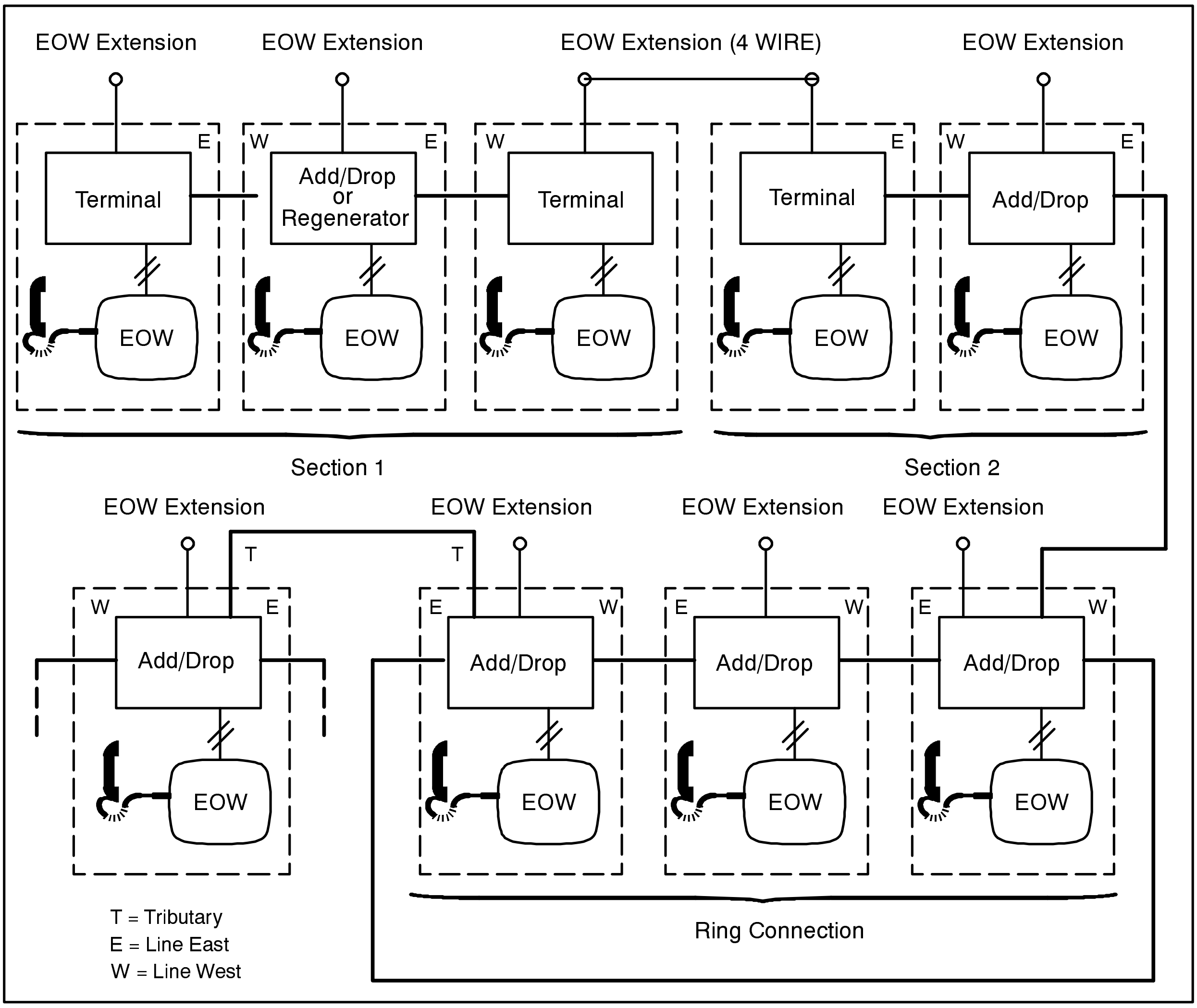


Fig. 1.1–26 *Structure of the Engineer Order Wire*

Data Channels

These services allow a point–to–point data connection between the two network elements that terminate the relevant accessible overhead bytes.

The available interfaces are:

- *two 64kbit/s G.703 codirectional interfaces;*
- *two N X 64kbit/s V.11 contradirectional interfaces (where n is 1, 3 or 9).*

The SOH transport bytes can be selected by means of Local Controller or Network Management Centre.

Equipment Management

General

ADM–1 can be managed by means of a Local Operator or of the Network Management Centre.

The allowed functions are:

- *Configuration management*
  - *inventory data collection*
  - *provisioning*
  - *circuit building*
  - *protection enabling and switching*
  - *software download*
- *Maintenance management*
  - *alarm collection*
  - *testing*
- *Performance management*
  - *performance data collection*
  - *performance data reporting*
- *Security and access management*

The communication between ADM–1 and the administration Centre is compliant with the ITU–T / ETSI standard information model.

From the physical point of view, the communication model for the ADM–1 is based on the partition of the transmission line into multiplex sections according to Fig. 1.1–27. This displays the control arrangements and the interfaces of the ADM–1 equipment for operation and Network Management. Data communication channels DCCR (bytes D1 to D3) or DCCM (bytes D4 to D12), can be selected using the Local Controller and used on a bit–transparent basis for Network Management.

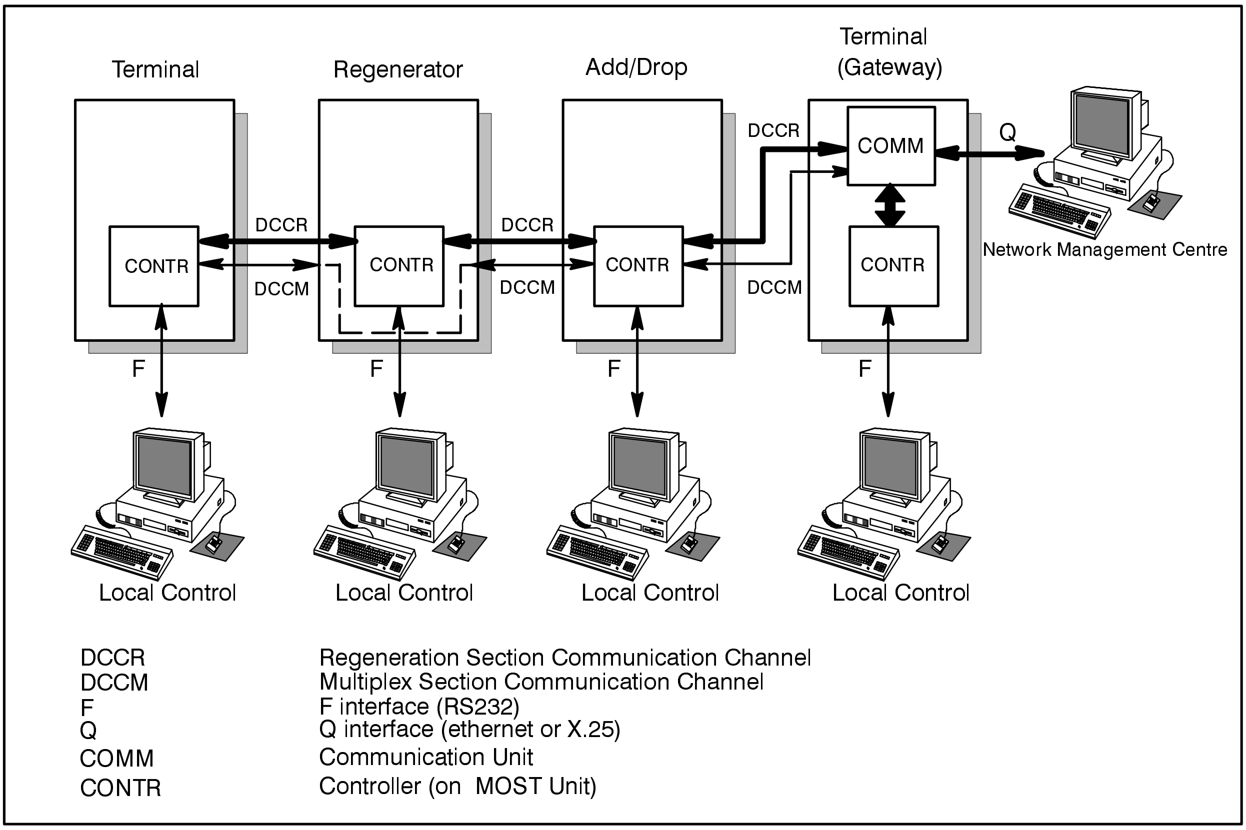


Fig. 1.1–27 *Monitoring Equipments and Interfaces for the ADM–1 network management*

Several multiplex sections can be connected, through specific DCC Link Interfaces, to form a network area which can be managed in terms of configuration, device monitoring and fault location.

All the equipments of a network area can be directly accessed by a Local Control Terminal (LC) via RS232 F Interface.

The equipment provides proprietary functions that allow the LC to perform a remote login on other similar systems belonging to the same network.

The equipment does not require the continuous connection of a Local Control Terminal. The terminal is only necessary when setting the equipment during operation for line configuration, diagnosing and faults or abnormal working location.

To include an ADM–1 equipment in a Telecommunication Management Network (TMN), provision is made for the insertion of a Q Interface according to Recommendation Q.811 & Q.812 and Qecc (from line or tributary SDH interface) as defined by ITU–T Recommendation G.784.

Network Management Centre Connection

The control and alarm functions relevant to all the equipments of the network can be handled by a single management Centre (Fig. 1.1–28).
This communicates, via a data interface (Q interface), with a Gateway equipment.

The Gateway allows the management Centre to monitor all the equipments belonging to its same sub–network, by using the Data Communication Channel (DCC) in the signal stream.

The Q interface can be connected to an Ethernet line via 802.3 10BASE5 interfaces.

The Network Management Centre (NMC) consists of a HP workstation with dedicated software.

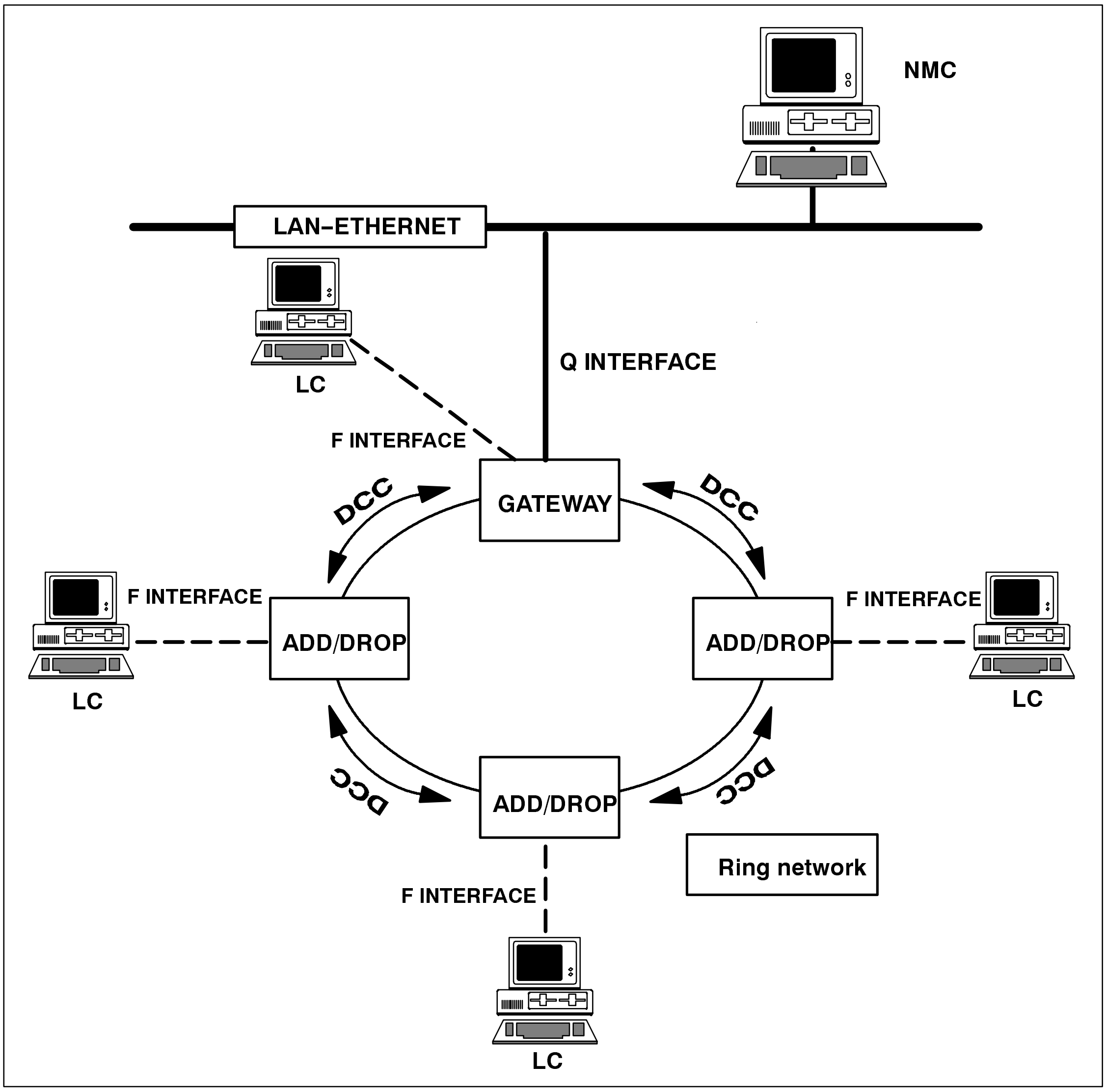


Fig. 1.1–28 *Example of ring Network Management*

Local Controller Connection

Control and alarm functions can be locally performed on each equipment. Configuration changes are only possible if the access has been enabled by the Network Management Centre (Fig. 1.1–28).

The Local Control of the equipment is performed via a serial interface (F interface) (Fig. 1.1–29) by means of a Personal Computer associated to an INTEL 80486 (or higher) microprocessor with dedicated software.

By means of the SDH Data Communication Channels (DCC's) or of the ethernet line, the Remote Login option is available on ADM–1 (Fig. 1.1–29). This option allows the remote management using pass–through functionality of connected NEs.

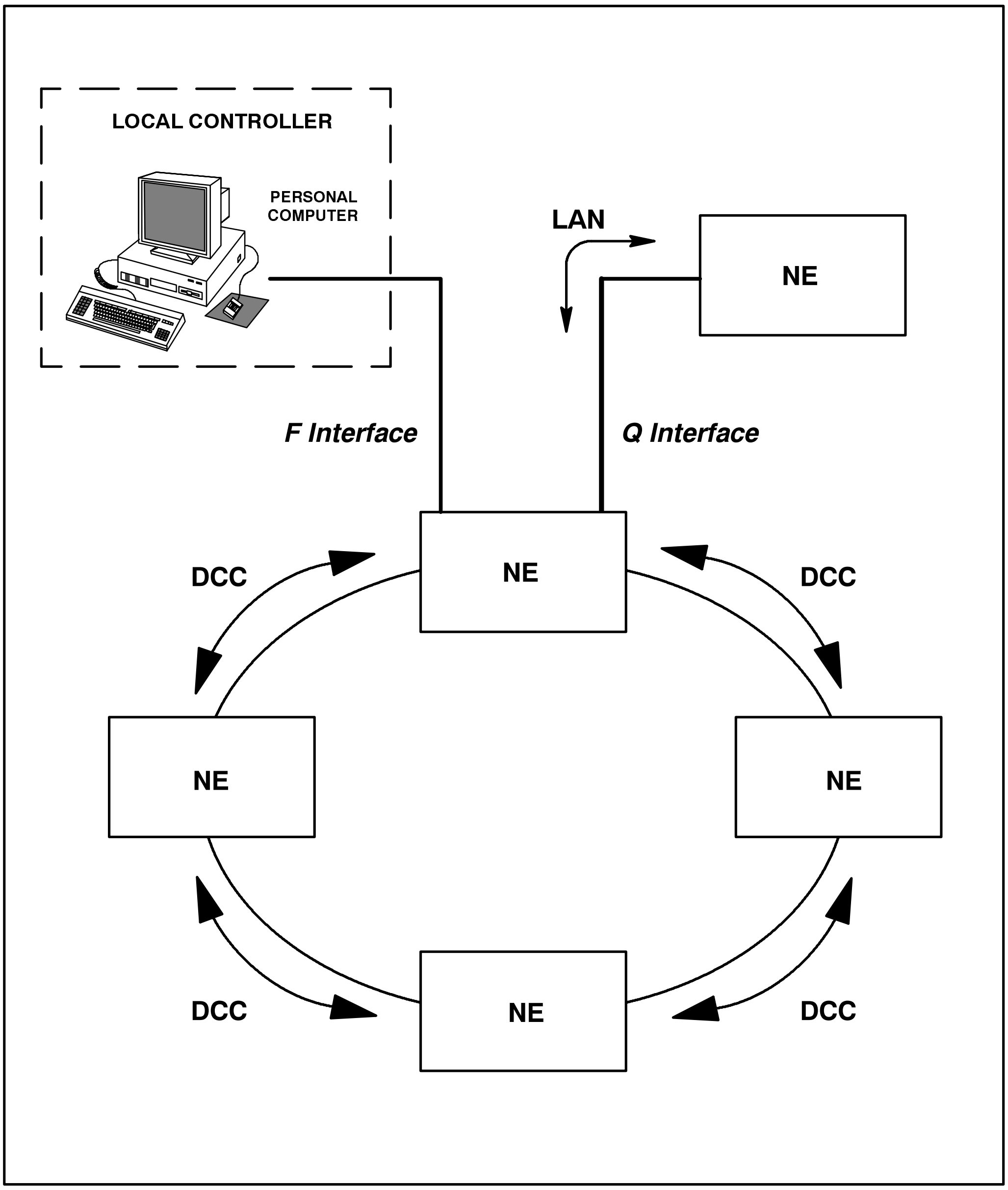


Fig. 1.1–29 Control of ADM–1 using the LC (Ring Network example)

Configuration Management

The configuration of each system within a network can be modified by means of LC or NMC.

The functions and utilities available on LC and NMC include the capability of modifying the configuration of the units within a system (i.e. the change of traffic parameters or the equipping of a new unit).

By means of the LC, point–to–point traffic connections can be created, while the NMC is also allowed to create traffic connections on complex circuits.

To ensure a high availability of these traffic connections, by means of both the NMC and the LC, different kind of protection schemes can be enabled, either at unit or network level (i.e MSP, SNCP, 1:N tributary unit protection, etc.)

Each unit is also provided with an electronic inventory data, stored on a non–volatile memory, on which are recorded the following information:

- *unit type;*
- *unit serial number;*
- *software version installed on the unit;*
- *active memory bank.*

All these information can be accessed both remotely and locally and a search based on this data can be performed by the administration Centre.

Since the system application software can change, for the introduction of new functionalities, each unit is fitted with flash memories, on which the software can be downloaded.

This operation can be performed either by the NMC or the LC, without affecting the traffic on the involved systems.

Another important aspect of configuration management is the configuration of the Management Network.
This configuration includes the addressing of each Network Element (i.e. NSAP address, LAPD side, etc.) and the communication parameters (i.e. packet sizes, protocol timers, etc.).

Once the Management Network has been configured, each change must be strictly verified, in order to avoid the loss of connection with the NMC.

Maintenance

Maintenance on ADM–1 is meant as a location of faults on the units, followed by a recovery procedure, generally based on the replacement of faulty units.

Each unit is provided with built–in diagnostic facilities which allow to identify a faulty unit.
Whenever these internal diagnostic facilities are not sufficient to locate a fault, more sophisticated diagnostic tools can be accessed, by means of NMC or LC.

ADM–1 is capable of transferring the output data relevant to a diagnostic facility, to a remote NMC as soon as a failure is detected and of associating the alarm status report to the diagnostic results.

Alarms

The ADM–1 equipment has a comprehensive alarms detection and processing system which takes appropriate actions in the event of failure and/or malfunction.

The alarms on each unit are detected by the controller on the Master MOST Unit, by monitoring the Control Bus.

Alarm Report

Alarms are reported by:

- *the lighting up of optical indicators (LEDs) on units where an alarm is active (internal alarms);*
- *the lighting up of optical indicators (LEDs) on the MOST Unit;*
- *transmission of ground contacts to the cabinet Alarm Unit;*
- *transmission of ground contacts to the tele–signals connector;*
- *display of alarms on the Local Control Personal Computer that communicates with the Controller on the MOST Unit, via a data interface (F interface);*
- *display of alarms by Network Management Centre that transmits commands and receives information from the Equipment Communication Unit, via a data interface (Q interface);*
- *transmission of alarm status to the far–end equipment.*

Unit LEDs

Each unit is provided with LEDs, used to indicate its correct operation. These LEDs give a first indication of the unit status.

On each unit the *internal* alarms are grouped (OR) to indicate when a internal fault occurs with the lighting–on of a red LED (△) on the unit front panel.

A green LED is present on the front panel of the traffic units to indicate:

- *the unit is active and in service;*
- *unit working, when a unit is duplicated for protection.*

On the Communication Unit there are also the following three LEDs:

- *green LED indicating that the unit is transmitting on the Q interface;*
- *green LED indicating that the unit is receiving from the Q interface;*
- *yellow LED indicating a collision detected on the Q interface.*

A yellow LED on the Optical/Mux Unit is lit to indicate that the ALS is disabled.

MOST LEDs

The MOST unit allows to display the alarms active on the card and the alarms summary for each equipment and is fitted with ten LEDs and three push buttons. The LEDs are:

- △ ***red LED:*** *lights on when an internal fault is detected on the MOST;*
- ***CONF green LED:*** *lights on when the unit is configured;*
- ***VS green LED:*** *lights on to indicate the presence of a service voltage;*
- ***URG red LED:*** *lights on when an* urgent *alarm is detected;*
- ***NURG red LED:*** *lights on when a* not–urgent *alarm is detected;*
- ***INT red LED:*** *lights on when an* internal *alarm is detected;*
- ***EXT red LED:*** *lights on when an* external *alarm is detected;*
- ***IND yellow LED:*** *lights on when an* indication *alarm is detected;*
- ***ABN yellow LED:*** *lights on when an* abnormal *operation is detected;*
- ***MEM yellow LED:*** *lights on after an alarm acknowledgement operation (pushing the MEM button on the front panel the yellow one lights–on).*

The **ABN** (Abnormal) LED lights–on when:

- *the optical protection device is disabled;*
- *an internal loopback for test is activated;*
- *a lockout or a forced switch on MSP is activated.*

The MEM push button on the unit front panel allows to *memorize* (acknowledge) all the summary alarms (the yellow LED *MEM* lights on).

Rack Alarm Unit LEDs

A Rack Alarm Unit, fitted with two or three LEDs, is located on the top of the cabinet to give summary alarm indication for all the equipment fitted in the rack.

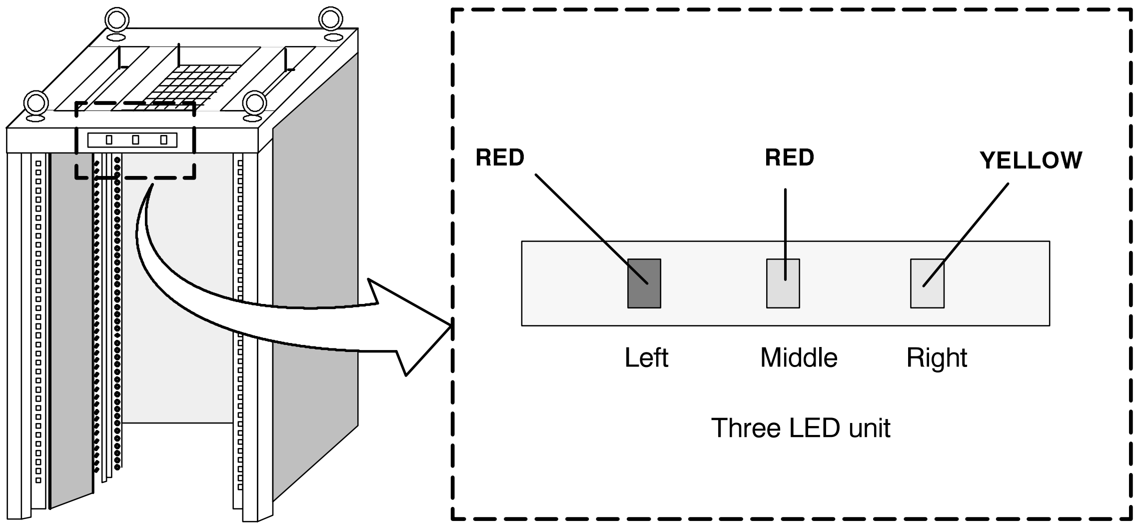


Fig. 1.1–30 *Rack Alarm Unit. Position and types*

The three LED unit can be set according to one of the following configurations:

CONFIGU-RATION	LEFT LED		MIDDLE LED		RIGHT LED	
	LED colour	Meaning	LED colour	Meaning	LED colour	Meaning
A	Red	Urgent	Red	Not Urgent	Yellow	(*)
B	Red	Any active alarm	Red	EOW call received	Yellow	(*)
C	Red	Urgent or Not Urgent	Red	Indicative	Yellow	(*)

NOTE (*) ***This LED lights on:***

- ***after an alarm acknowledgement operation (pushing the button on the front panel of the End Of Shelf Unit);***
- ***when any abnormal condition is detected.***

Tele–signals

Different operation are handled on the tele–signals:

- *transmission of ground contacts to the tele–signals connector;*
- *management of ground contacts incoming from the tele–signals connector.*

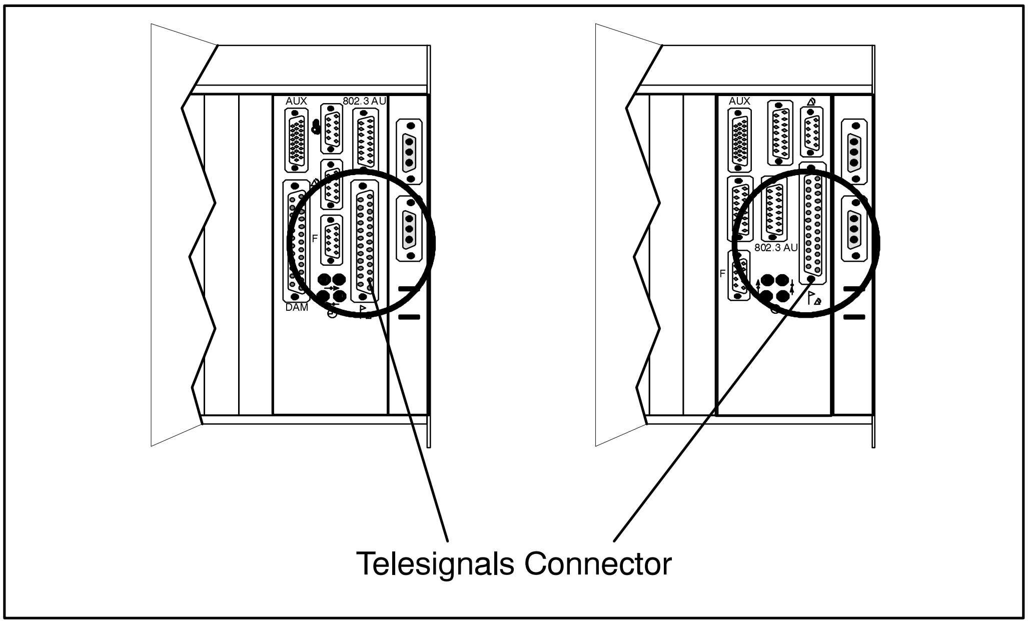


Fig. 1.1–31 *Tele signal connector position*

Tele–signal management

Two different kinds of tele–signal management can be selected, by changing some soldering pads on the MOST Unit Type 2 and MOST Unit Type 2S. Both kinds are available on MOST Unit Type 3.

The first application allows to issue earth signals in case of alarm (single wire ground contact). When an alarm is detected the equipment transmits ground contacts to make available summary indication (usually terminated on exchange centralized panels).

The second application provides the connection between two pins in presence of alarm (two wire, signal and reference). When an alarm is detected the equipment connects together signal and reference pins, in order to close an external circuit.

For the single wire configuration eight output ground contacts are managed (the meaning of three of them can be defined by the user).

*The ground contacts electrical characteristic are defined in accordance with **B interface**.*

The double wire configuration allows to manage up to four double wire contacts.

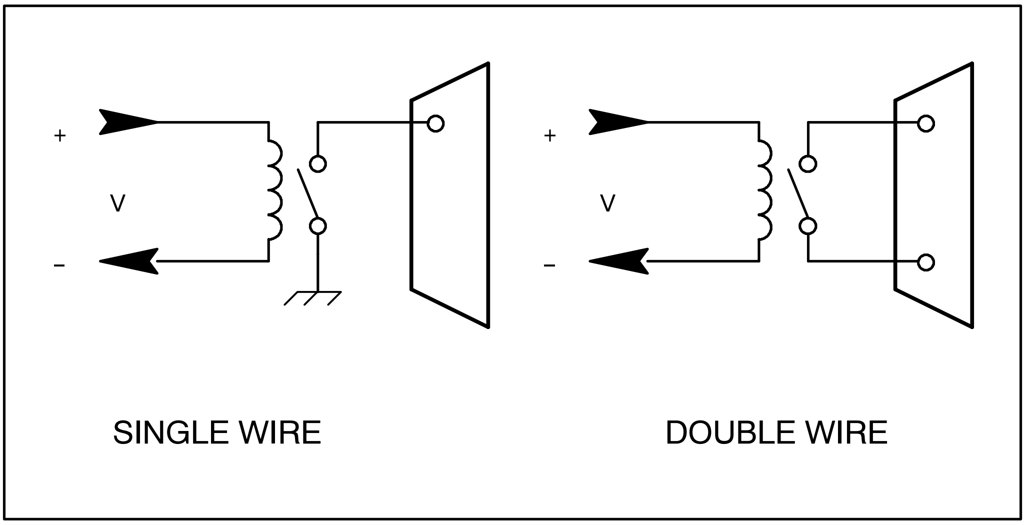


Fig. 1.1–32 *Single wire ground contacts*

Receiving Ground Contacts

ADM–1 manages up to 4 ground contacts incoming from the telealarm connector. The ground contacts electrical characteristic are defined in accordance with **B interface**. The ground contacts are detected by the MOST unit which converts them into alarm criteria and which manages them by means of Controller as any other alarm. On the telesignals connector the following pins are available to connect the external ground contacts.
For the electrical characteristics refer to chapter ”**Technical Specification”** at the end of this section.

PIN	SIGNAL NAME	EXPLANATION
28	A_EXT_IN4	Alarm Input 4
27	A_EXT_IN3	Alarm Input 3
26	A_EXT_IN2	Alarm Input 2
25	A_EXT_IN1	Alarm Input 1

Transmitted ground contacts

When an alarm is detected the equipment transmits ground criteria to make available summary indications (usually terminated on exchange centralized panels).

These telesignals, terminated on the  connector on the Common Part Connection Unit on the upper part of the subrack, are:

- ***URG*** transmitted when an ***Urgent*** alarm is detected (1)
- ***NURG*** transmitted when an ***Not Urgent*** alarm is detected (1)
- ***INT*** transmitted when an ***Internal*** alarm is detected (1)
- ***EXT*** transmitted when an ***External*** alarm is detected (1)

- ***IND*** transmitted when an ***Indication*** alarm is detected (1);
- ***SW 1*** transmitted when an abnormal condition is detected;
- ***SW 2*** transmitted when on a 2Mbit/s Tributary port a loss of signal or a dynamic overflow is detected (2);
- ***SW 3*** transmitted when a malfunction on the Q Interface is detected (2).

NOTE (1) ***The setting of these ground contacts is fixed.***

NOTE (2) ***This setting can be modified using the Local Controller***

Indication on LC and NMC

Using the Local Controller or the Network Management Centre the information for each alarm root can be displayed.
This information is:

- ***Alarm type*** (LOS, AIS etc.) identifies the alarm root
- ***Source*** (MOST Unit, 63x1.5/2Mbit/s G.703 Tributary Unit etc) identifies the alarm source
- ***Category*** (Urgent, internal,indication etc) identifies the alarm category
- ***Local State*** (Acknowledged, active) identifies the alarm status

For a complete list of all possible alarm types and alarm sources refer to Volume 2 **Local Operator's Handbook**.

Each alarm category is given with a default value which can be modified via software.
A different configuration will change all the criteria for the LEDs light–on and transmitted telesignals.

The Alarm **Local Status** can be:

- ***Inactive*** not active alarm;
- ***Active*** active alarm;
- ***Acknowledged*** alarm acknowledged pushing the button on the MOST Unit or via a software command.

For each equipment all the alarm information is also stored in a log file with an indication of date, time and raised/cleared event indication that can be displayed via the Local Controller or via the Network Management Centre.

Diagnostic

The ADM–1 offers two diagnostic tools, with the purpose of locating the fault on a specific part of the network.
These tools are:

- *loopbacks;*
- *diagnostic pattern insertion.*

Loopbacks

For maintenance purposes, special loopback connections are available.

By means of these loopbacks, after the detection of an alarm on a traffic unit, the source of the fault can be isolated.

In detail the possible locations of a fault are:

- *inside the unit;*
- *inside the system (but not on the unit which has detected the alarm);*
- *outside the system.*

Loopbacks must be used carefully, since they affect synchronization (SSM) and data channels (DCC).

Each traffic interface, on both line and tributary side, allows the management of two kinds of loopback, front–end loopback and back–end loopback.

Front–end Loopback

These loops can be either ’transparent’ or ’not–transparent’.
In the ’transparent’ loopback, the incoming signal is looped back and transmitted forward, towards the Switch Unit.

In the ’Not–transparent’ loopback, the incoming signal is looped back, but an AIS signal is sent towards the Switch Unit.

For this kind of loopback see Fig. 1.1–33.

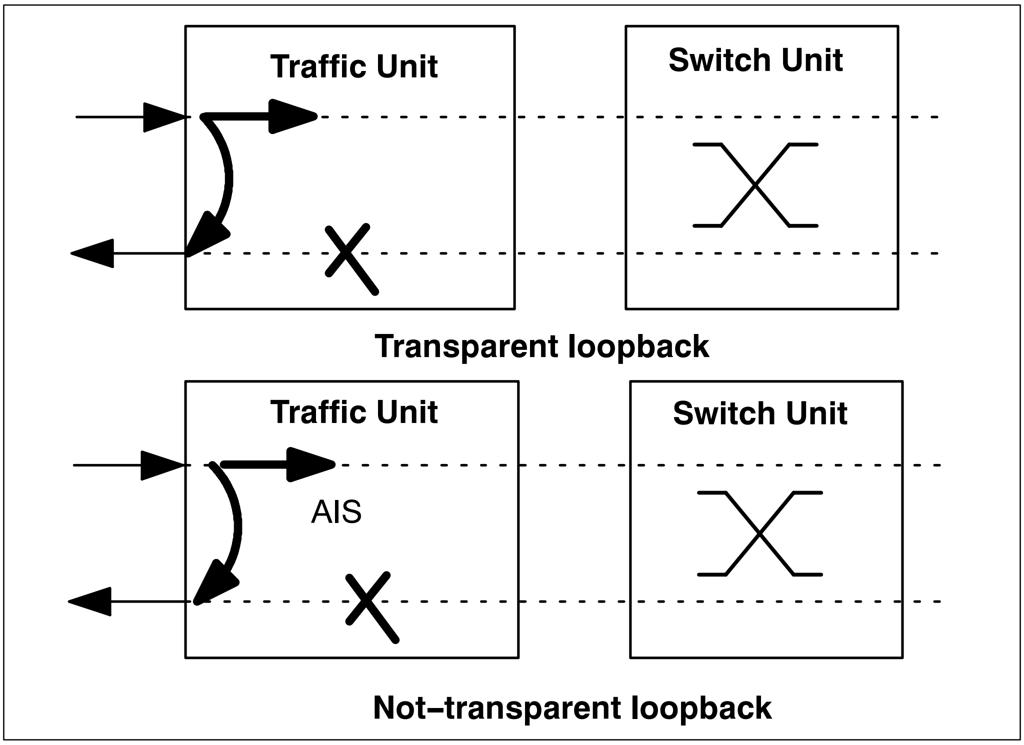


Fig. 1.1–33 *Front–end loopback*

Back–end Loopback

These loops can be either 'transparent' or 'not–transparent'.
In the 'transparent' loopback, the outgoing signal is looped back and transmitted forward, towards the output interfaces.

In the 'Not–transparent' loopback, the incoming signal is looped back, but an AIS signal is sent towards the output interfaces.

For this kind of loopback see Fig. 1.1–34.

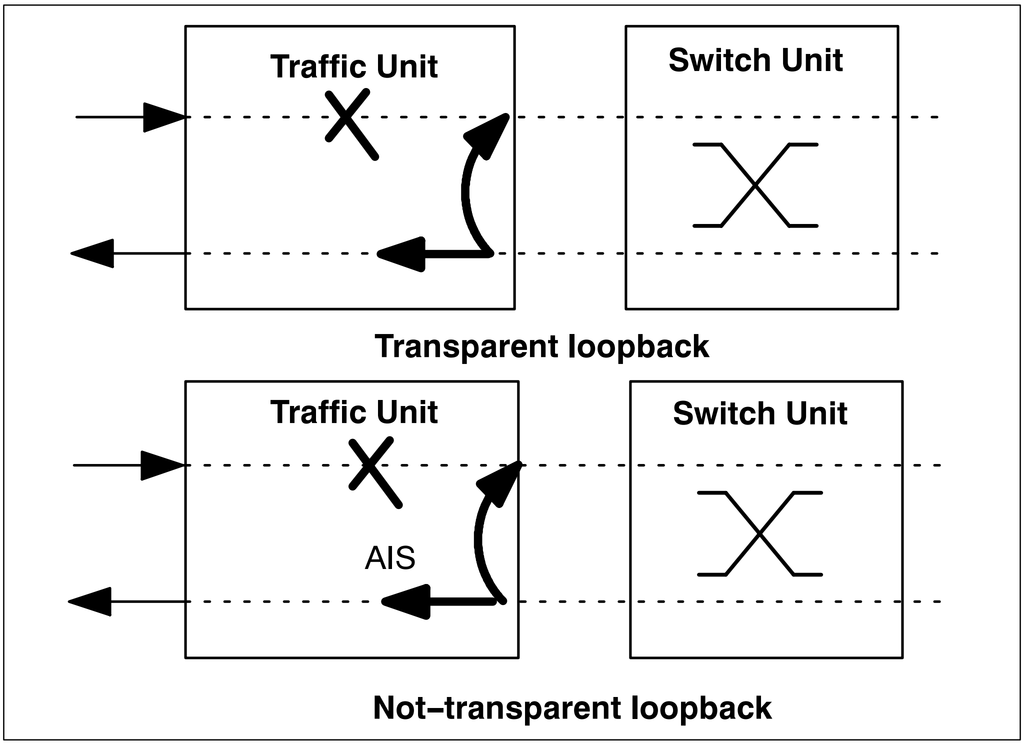


Fig. 1.1–34 *Back–end loopback*

Diagnostic Patterns Insertion

This function is used to test the quality of the transmission signals of tributary interfaces. The plesiochronous tributary units generate a $2^{15}-1$ (2Mbit/s) or $2^{23}-1$ (34 and 140Mbit/s) Pseudo Random Bit Sequence (PRBS) and send it towards the Matrix circuits. In the selected channel the payload is replaced by the PRBS.

When used in conjunction with LC, the diagnostic pattern is looped back towards the tributary unit.
When this functionality is controlled by NMC, it can be used to check the quality of transmission through a STM–N line between two equipments both controlled by the NMC.
The Pseudo Random Bit Sequence is transmitted through the selected channel to the remote equipment where is monitored on the receive side.
The tests are only possible if the necessary cross connections have been created in advance.

These tests can be performed in two directions and on many channels at the same time.

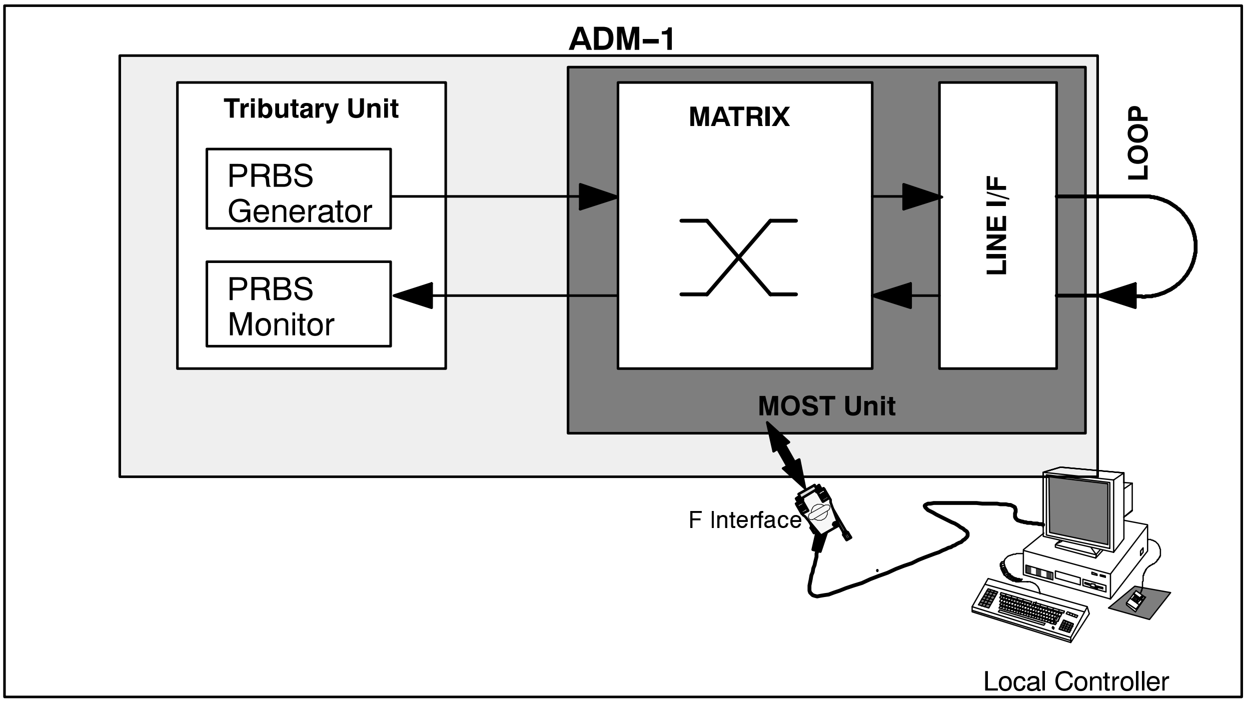


Fig. 1.1–35 *Insertion of diagnostic patterns by means of Local Controller*

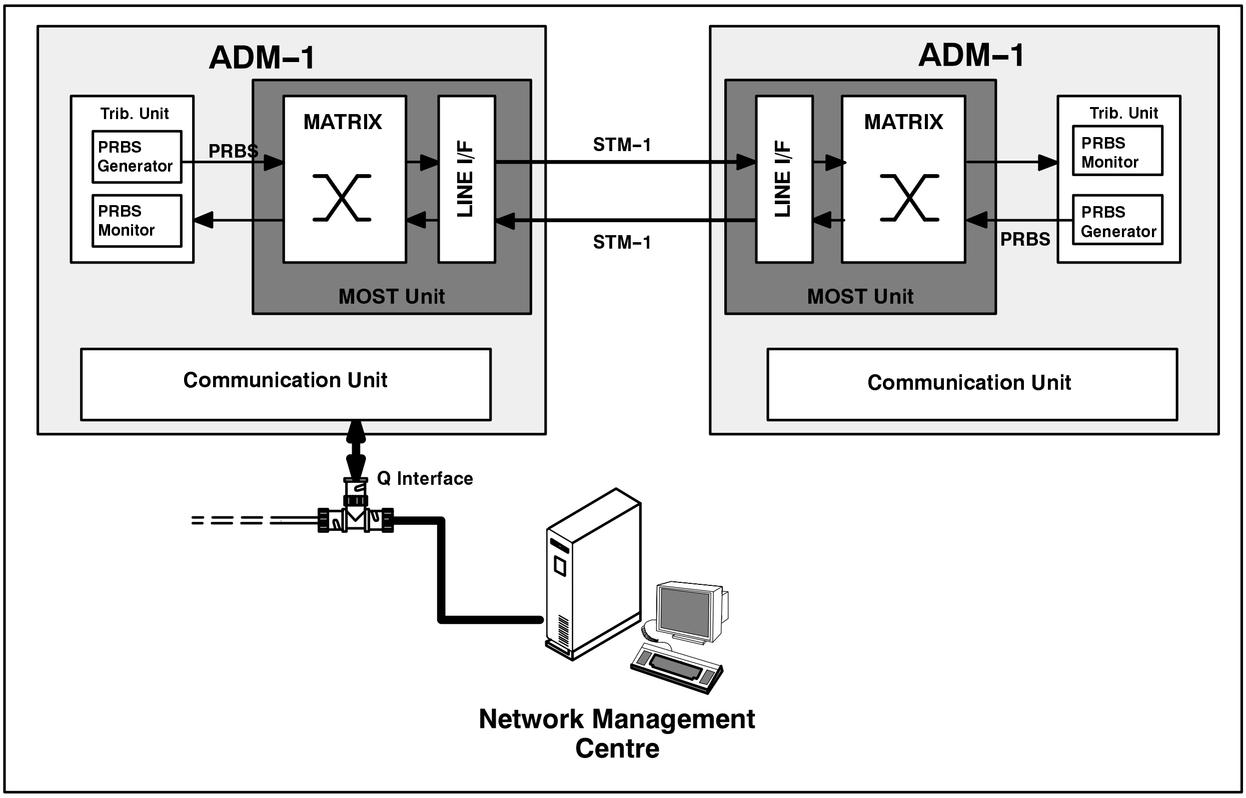


Fig. 1.1–36 *Insertion of diagnostic patterns by means of Network Management Centre*

Performance Monitoring

Performance monitoring refers to the monitoring of transmission quality on both SDH and PDH paths.

The monitoring of performances parameters is based on the evaluation of errored blocks (EB).
On the SDH signals the error check is performed using the overhead bytes devoted to Bit Interleaved Parity.
On the PDH signals are used the bits of Cyclic Redundancy Check.
The main parameters related to the performance monitoring are:

- *BBE (Background Block Error);*
- *ES (Errored Second);*
- *SES (Severely Errored Second);*
- *OFS (Out of Frame Second).*

There are also some additional parameters which can be optionally monitored:

- *PSC (Protection Switching Count);*
- *PSD (Protection Switching Duration);*
- *CSES (Consecutive SES);*
- *UAS (Unavailable Seconds);*
- *AU PJE (Negative/Positive Administrative Unit Pointer Justification Events).*

The performance parameters are evaluated on different entities, either local or remote. The entities on which ADM–1 monitors performance parameters are:

- *MS termination (Near End and Far End);*
- *RS termination (Near End);*
- *VC termination (Near End and Far End);*
- *VC monitor (Near End and Far End);*
- *AU–4 received;*
- *PDH termination.*

All the monitored parameters are evaluated and stored, in 15 minutes and 24 hours registers, as specified in ITU–T G–784 and G.826 Recommendations.

Security and Access Control

Within an SDH network the configuration of each system affects the overall performances of the network.
For this reason the access to the system configuration must only be allowed to authorized operators, in order to avoid any problem on the network (i.e. the deletion of a cross connection can cause a traffic interruption on a channel, the disconnection of DCC between two NEs can make one of them unreachable from the NMC, etc.).

Power Supply

The ADM–1 is provided with a decentralized power supply, i.e. each plug–in unit contains a power supply section which uses the battery voltage from the exchange (–48V±20% to –60V±20%) to generate the operating voltages required for the plug–in units.

For each system, the battery voltage B1 or B2 is fed to the Power Supply Connection Unit.

Located on the plug–in unit there is a fuse which, in the event of a fault (e.g. short–circuit), is designed to prevent further damage (e.g. circuit board tracks burning through, failure of further plug–in units).

The functions of the power supply section of the plug–in unit include:

- *converting the battery voltage to the required operating voltages of the system plug–in units and DC isolation between battery voltage and operating voltage;*
- *monitoring of operating voltages, the primary current and the output currents. The operating voltages generated on the plug–in unit in question can also be tested at the plug–in unit test jacks;*
- *signalling of disturbances via the plug–in unit's signalling slave–bus. Failure of an operating voltage is indicated by a red LED on the affected plug–in unit.*

An auxiliary D.C. voltage of –48V to –60V is also required to light the LEDs on the cabinet top.

The various voltages supplied are shown in the distribution diagram of Fig. 1.1–37.

The voltages generated by the on–board DC/DC converters on each unit and the fuse values are listed in the relevant table in the Chapter "Technical Specification".

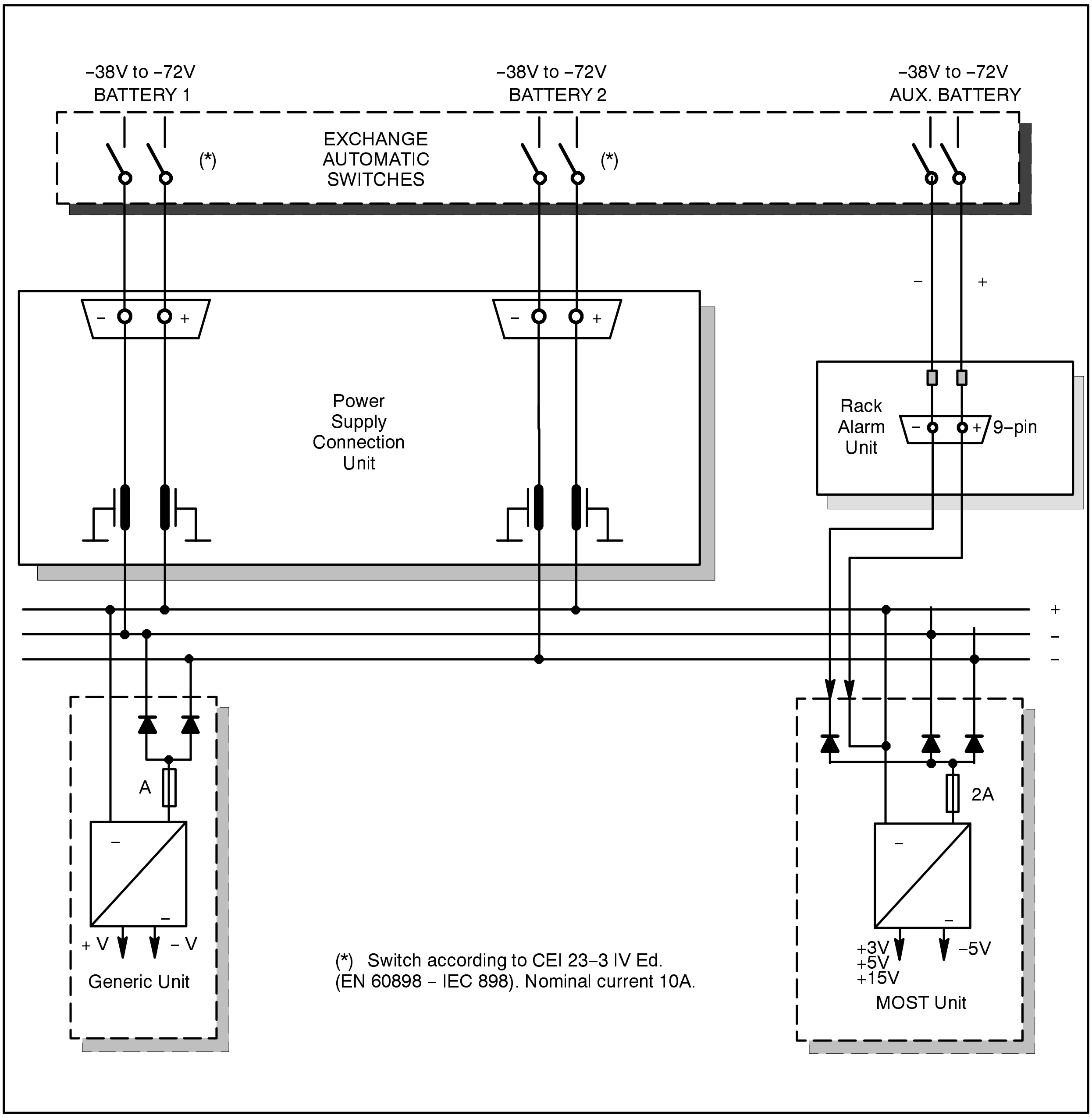


Fig. 1.1–37 Power supply distribution – Functional diagram