Equipment Description

The functions managed by ADM–1 can be organized as follows:

- *traffic streams management;*
- *overhead management;*
- *synchronization management;*
- *protection management;*
- *equipment supervision.*

The following is an analysis of these functional groups, together with simplified block diagrams, which explain the flow of the involved signals.

A simplified block diagram of traffic stream flow is given in Fig. 1.2–1.

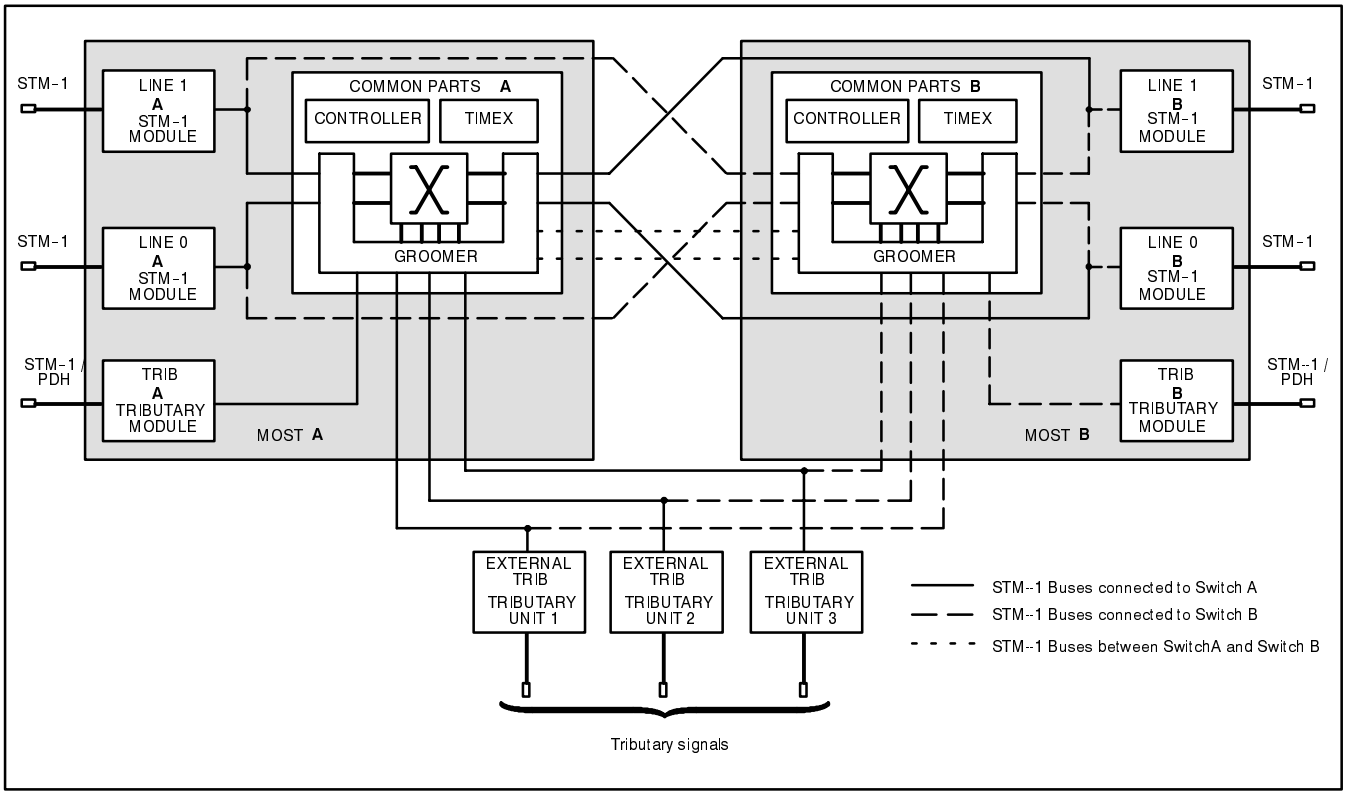

Fig. 1.2–1 *Simplified block diagram of traffic stream flow*

STM–1 Line Signal Interface

The ADM–1 interfaces up to four STM–1 optical or electrical line signals (two on East and two on West side).

These interface functions are performed by the STM–1 line sub–unit either optical or electrical STM–1 respectively for optical STM–1 or electrical STM–1 signals treatment.

On each side, East and West, the matrix can manage two STM–1 equivalent streams; therefore the two STM–1 sub–units can form either a pair for managing the MSP 1 + 1 or can work independently carrying two different STM–1 payloads.

STM–1 (VC–12) Tributary Signal Interface

The ADM–1 interfaces up to five 155Mbit/s STM–1 electrical or optical tributary signals with management up to VC–12 level.

These interface functions are performed by the STM–1 Optical/Mux Units and the STM–1 G.703 Electrical/Mux Units and STM–1 El. Line Sub–units.

Three units and two sub–units of this type are included in the full configuration, and each of these manages one STM–1 stream on the receive and transmit side.

Each of these units can work independently from the others or the MSP 1 + 1 can be set forming up to two pairs.

140Mbit/s Plesiochronous Tributary Signal Interface

The ADM–1 interfaces up to five 140Mbit/s CMI coded tributary signals.

These interface functions are performed by the 140Mbit/s Tributary Units or sub–units.

Three units and two sub–units of this type are included in the full configuration, and each of these manages one 140Mbit/s streams on the receive and transmit side. The 140Mbit/s signal is inserted and extracted into/from VC–4.

34 and 45Mbit/s Plesiochronous Tributary Signal Interface

The ADM–1 interfaces up to eight 34 or 45Mbit/s tributary signals.

These interface functions are performed respectively by the 3x34Mbit/s Tributary Units for the European 34Mbit/s standard and 3x45Mbit/s Tributary Unit for the American 45Mbit/s standard. On the MOST Unit the 1x34Mbit/s G.703 Tributary Sub–unit can be fitted.

Two units and two sub–units of this type are included in the full configuration, and each of these manages three (the unit) or one (the sub–unit) 34/45Mbit/s streams on the receive and transmit side. The 34 and 45Mbit/s signals are inserted and extracted into/from VC–3.

The 1 + 1 unit protection can be set for this kind of interfaces.

1.5/2Mbit/s Plesiochronous Tributary Signal Interface

The equipment interfaces 2Mbit/s HDB3 coded or 1.5Mbit/s AMI or B8ZS coded tributary signals.

Interface functions are performed by the 63x1.5/2Mbit/s G.703 Tributary Unit, the 16x1.5/2Mbit/s Tributary Sub–unit and the 32x1.5/2Mbit/s Tributary Sub–unit. One unit and two sub–units of this type are included in the full configuration, and each of these manages respectively sixty–three, thirty–two or sixteen 1.5/2Mbit/s streams on the receive and transmit sides.

The incoming plesiochronous signals are coded from either HDB3, AMI or B8ZS into NRZ, then assigned (with the appropriate justifications) to synchronous containers of the same bit rate, to which path information (POH) and a reference pointer are added to obtain a TU–12.

Identical functions in reverse order are performed on the transmit signal.

The 1 : N or 1+1 unit protection can be set for this kind of interfaces adding an extra 63x1.5/2Mbit/s G.703 Tributary Unit in the protection slot.

STM–1 Signal Processing and Routing of the Single TU

The STM–1 Optical or Electrical /Mux Unit or Sub–unit extracts from main signal, section information (SOH) and path information (POH) and reads the AU pointers, which serve to locate the virtual containers inside the STM–1 module.
For regenerator equipment only the RSOH bytes are extracted.

After rejustification, which follows the pointer extraction, the data for each TU are sent to the MOST Unit (in a 4–bit parallel format at a bit rate of 38.88Mbit/s).

The data obtained from each TU are sent to the MOST Unit (for regenerator equipment these data are sent directly to the other line interface, without passing through the MOST Unit).

The tributary units insert low level path information (POH) and TU pointers in the justified tributary signal.

The data relative to each TU obtained is sent to the MOST Unit.

In the MOST Unit these signals are concentrated and routed, as per the configuration required, in one of the possible directions on both the receive and the transmit paths.

The overhead bytes management is distributed on several units.

A simplified block diagram of overhead byte distribution on the different units, is given in Fig. 1.2–2.

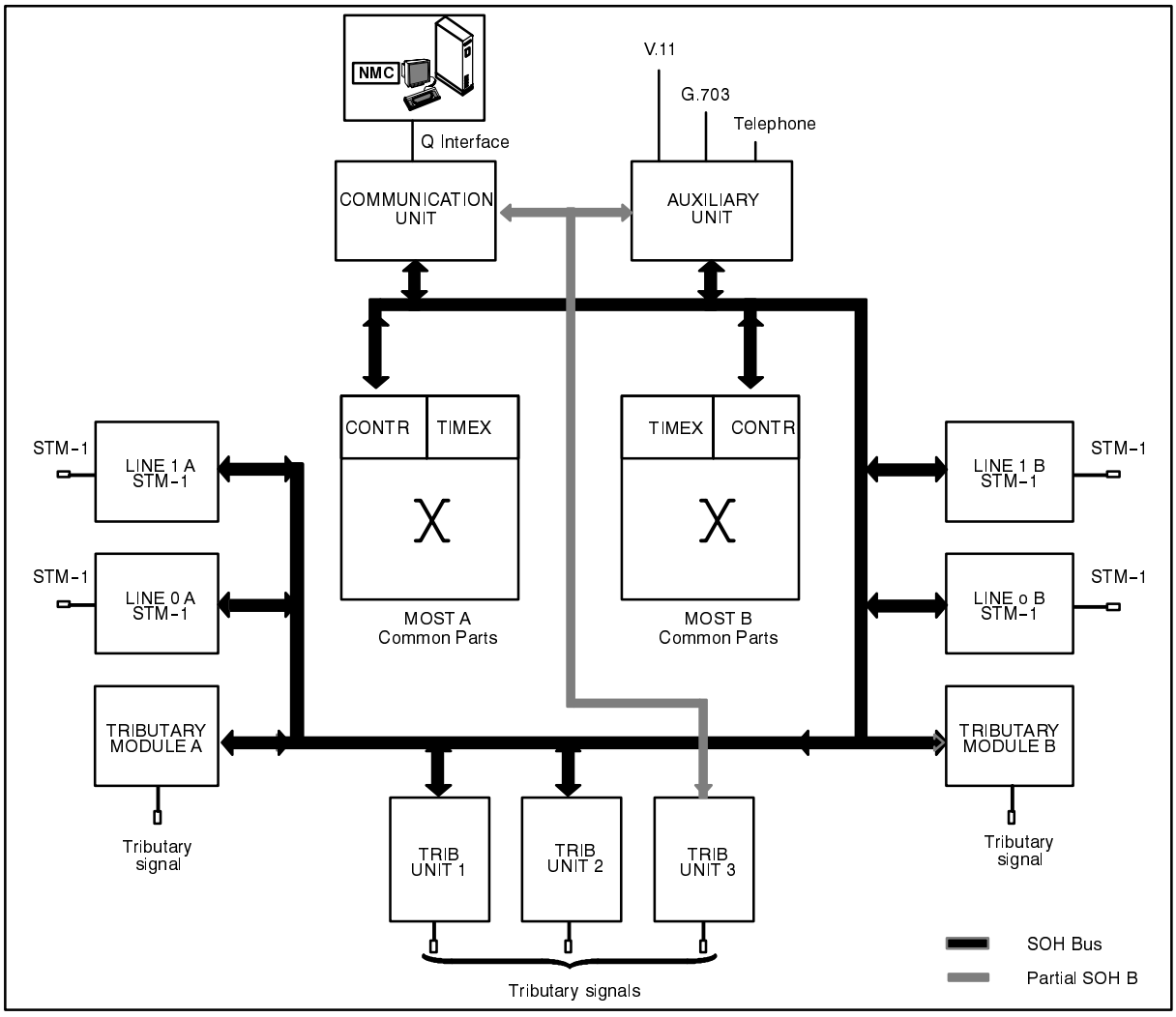

Fig. 1.2-2 *Simplified block diagram of overhead bytes distribution*

Overhead Extraction

The line and tributary interfaces are responsible for the extraction of both SOH and higher order POH bytes (the PDH tributaries are only responsible for POH extraction).

The first bytes to be processed are the bytes for frame alignment (A1 and A2 of RSOH) and the bytes for error monitoring (bytes B1 of RSOH, B2 of MSOH and B3 of POH).

The line interfaces processes also the bytes with information about the path trace identifier (bytes J0 of RSOH and J1 of POH) and about the type of payload carried by the STM-1 signal (byte C2 of POH).

The analysis of these bytes can force the emission of an alarm indication (i.e. Excessive Bit Error Rate, Signal Label Mismatch, etc.)

7The remaining bytes are inserted in the OH bus (with the exception of K1, K2 and S1 which are inserted into the internal STM–1 streams and sent towards the MOST Unit).

All the units are connected in parallel to the same OH bus and normally their outputs are in a high–impedance state. Only one unit at a time can enable its output in order to insert data in one or more OH bytes.

Identical functions are performed, in the reverse order, on the transmit side signal.

DCC Processing

The DCCr for the Regenerator Section (bytes D1 to D3 of RSOH) and the DCCm for the Multiplex Section (bytes D4 to D12 of MSOH) form, respectively, a 192kbit/s and a 576kbit/s data channels, used for the communication (for management and monitoring purposes) between Network Elements and NMC.

These overhead bytes are processed by the MOST Unit which extracts them from the OH bus. This unit extracts the data packets from the DCC channels and performs a routing operation, in order to select the interface these packets has to be sent to (line or tributary interfaces). For the management of the Q interface the Communication Unit.

When the system is used as a regenerator, the DCCm channel is not accessible, therefore the D4 to D12 bytes are put in the pass–through mode (the ones received from one line interface are sent to the line interface on the other side).

Auxiliary Services Processing

The auxiliary services include the order wire telephone channel and point–to–point data channels. The engineering order wire allows the audio connection among all the Network Elements connected by STM–1 signals (using the E1 byte of RSOH and the E2 byte of MSOH), while the auxiliary channels consist of 64kbit/s and/or V11 nx64kbit/s data streams, reserved for customer use (these data streams are obtained by means of the not used bytes of SOH).

These services are managed by the Auxiliary Unit which extracts the relevant bytes from the OH bus, elaborates the information relevant to the current Network Element and re–routes the data in which it is not directly involved.
When the system is configured as a regenerator some of the auxiliary bytes are not accessible (i.e. the E2 byte which is reserved for EOW on Multiplex Section), therefore they are sent to the other line interface in pass–through mode.

MS Switching

The MOST Unit on the MOST Unit is responsible for the management of MSP, both on line and tributary side. The K1 and K2 bytes of SOH are sent from the input interfaces towards the MOST Unit, on the internal STM–1 streams.

These bytes are extracted from the internal STM–1 streams and analyzed according to the protocol defined in ITU–T Rec. G.783 and G.841.

In the MSP K1 byte is used for request of a channel switch action (bits 1–4 carry the type of switch requested, bits 5–8 carry the number of channel on which the switch has to be performed), while K2 byte is used to indicate the current status of the protection channel (bits 1–4 carry the number of the channel which is protected, bit 5 carry an information about the type of MSP).

Once a protection switch request is detected on an incoming internal STM–1 stream, the MOST Unit re–routes the traffic of this channel on the protection one (the change–over takes place after an exchange of messages on K1 and K2 bytes, between the local and the remote Network Elements).

The synchronization sources management is concentrated on the MOST Unit, where all the clock reference signals are conveyed from line and tributary interfaces.

A simplified block diagram of synchronization management is given in NO TAG and NO TAG.

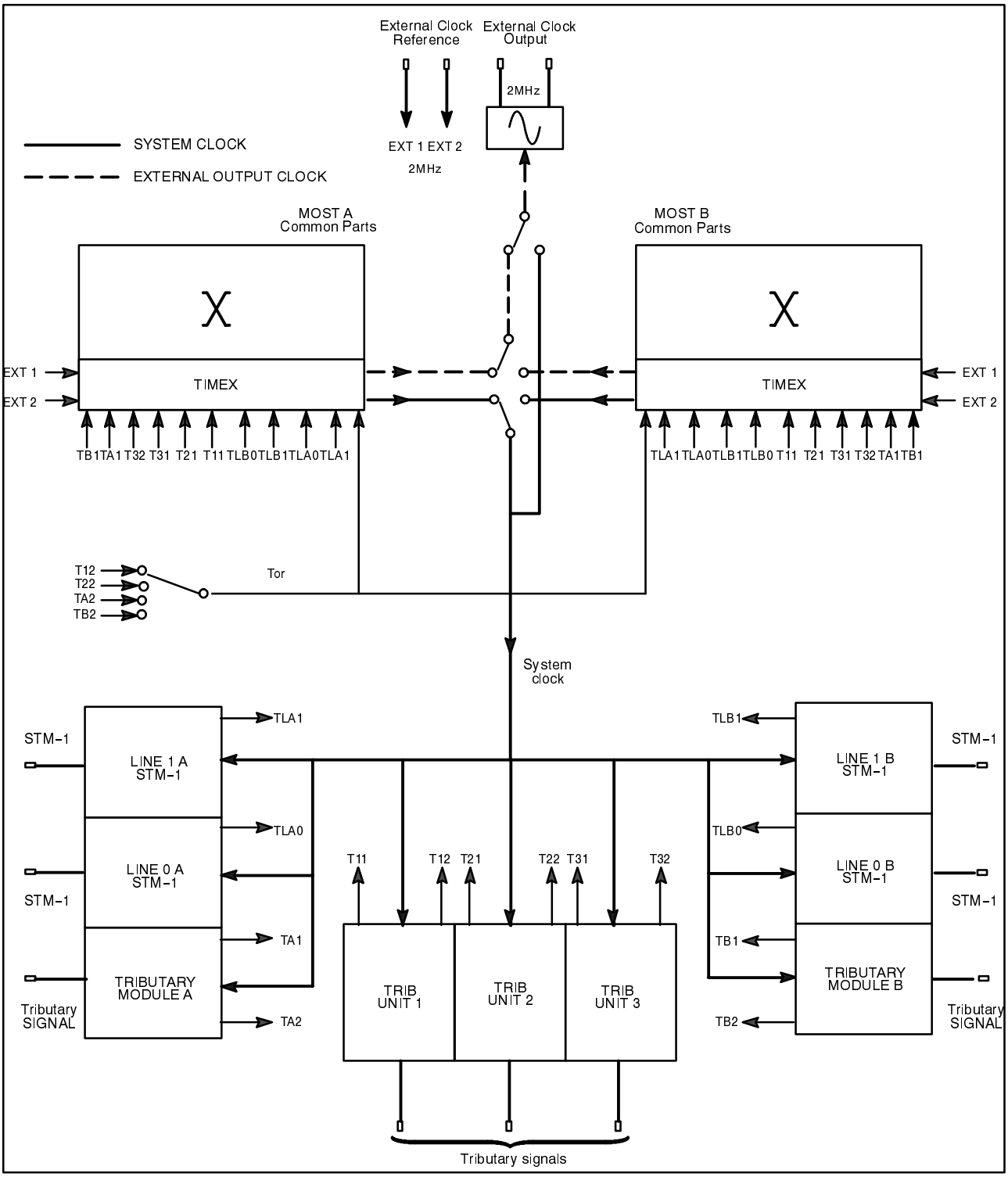

Fig. 1.2-3 *Simplified block diagram of synchronization management for MOST Unit Type 2*

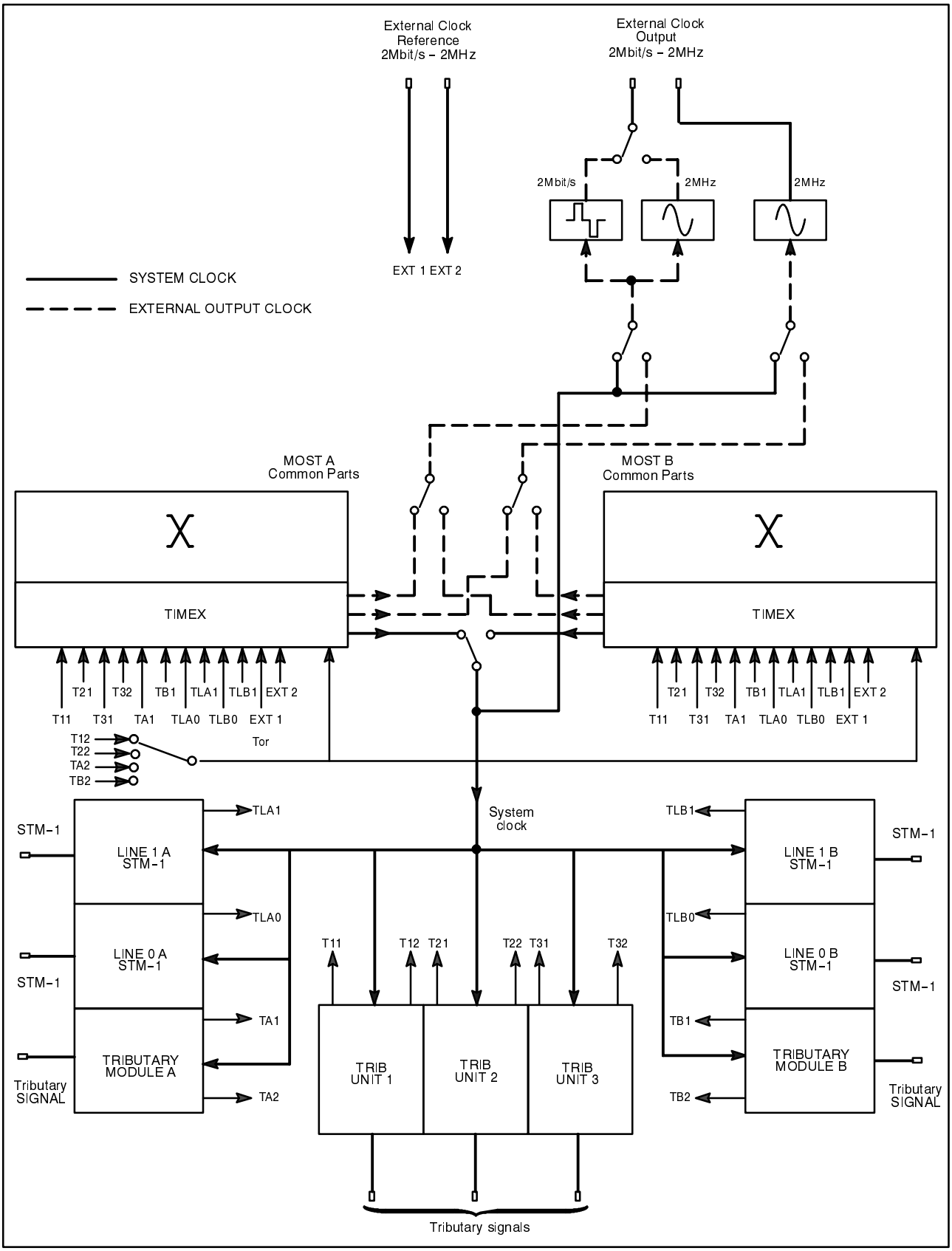

Fig. 1.2-4 *Simplified block diagram of synchronization management for MOST Unit Type 2S*

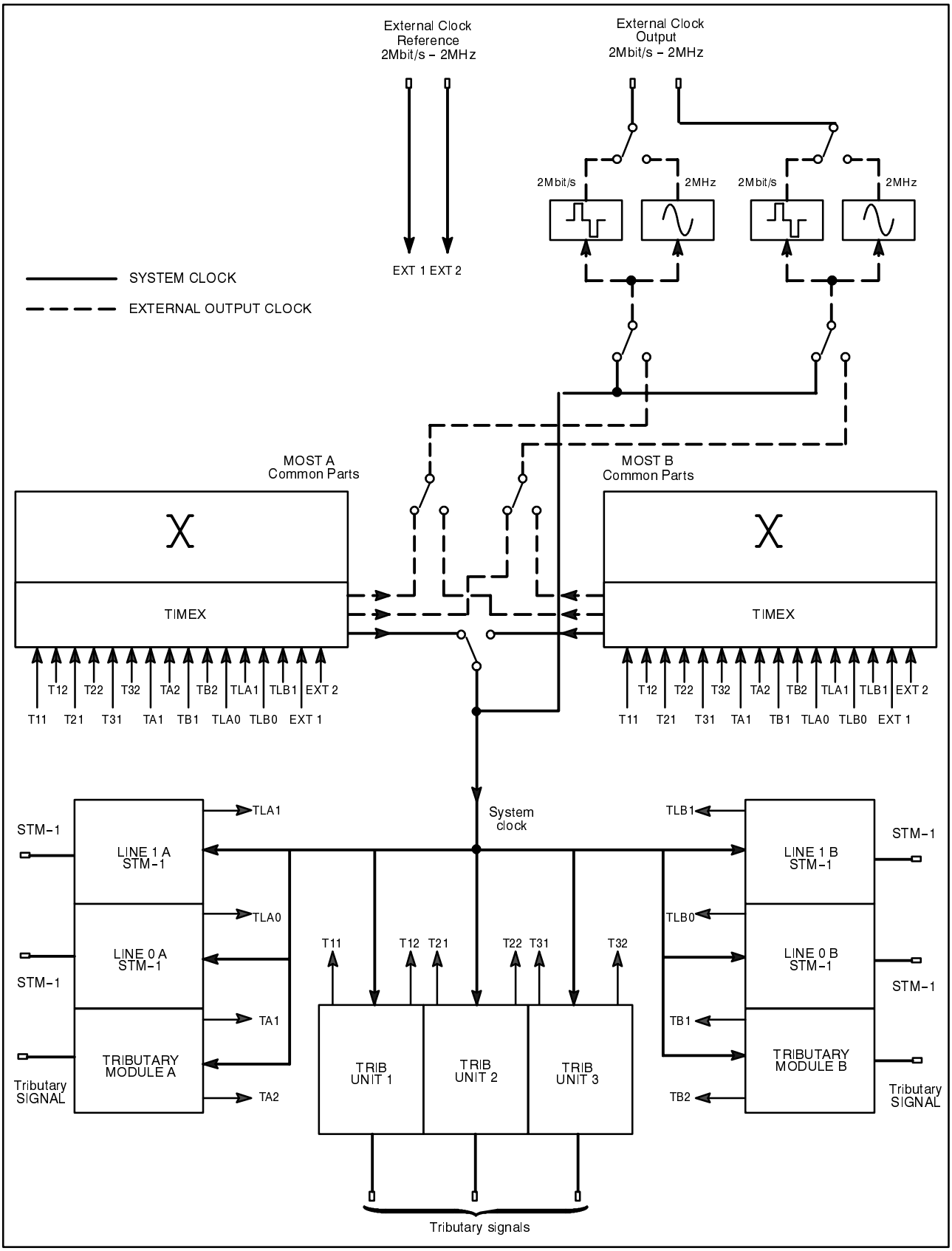

Fig. 1.2-5 *Simplified block diagram of synchronization management for MOST Unit Type 3*

Clock References Extraction

Both on line and tributary input interfaces, clock extraction circuits are available. These circuits are based on PLL oscillators, synchronized by the incoming line or tributary signal (SDH or PDH), which make available a 128KHz clock reference signal.

There are also two external clock references, available on the connection panels, based on 2Mbit/s or 2MHz signals.

All these clock references are sent in parallel to both MOST Units, in order to ensure the clock extraction even in case of failure of one of them.

Synchronization Signal Generation

Each MOST Unit is responsible for the selection of the in use clock reference, according to the priority and/or quality tables. If no clock references are available, this unit supplies a synchronization signal by means of its internal clock generator (working either in free running or in holdover mode).

The selected synchronization source is sent in parallel towards all the line and tributary interfaces (by means of a 38.88MHz signal).

The two external synchronization signals can use a priority and/or quality table different from the system one, because they are connected to a dedicated clock generator. Both external outputs are connected only to the working MOST Unit

When the system is used in a regenerator configuration, the synchronization scheme is simpler. Each line is provided with an independent clock generator in order to implement the through timing synchronization scheme. Therefore the clock reference extracted from an input line interface is used to synchronize the output line interface on the other side.

For what concern the protection schemes (except for the MSP described in a previous paragraph), their management is performed with a cooperation of different units.

MOST Unit Common Parts 1+1 Protection

The 1+1 protection involves the timing, supervision and switching functions.

Each line or tributary interface receives STM–1 internal streams from both MOST Units (from the matrix). By performing a check on some overhead bytes of these internal streams, it is possible to detect whether these streams are valid or not.

Whenever the internal STM–1 streams incoming from the working MOST Unit are detected as not valid, the streams from the other MOST Unit are selected.

Tributary 1:N and 1 + 1 Protection

The MOST Unit detects an alarm indication on a tributary interface and forces the matrix to perform the change–over to the internal streams handled by the protection unit.

To accomplish this change–over the MOST Unit is also responsible for driving the relevant switches on the connection panels (when present).

SNC Protection

Each line or tributary interface analyzes the incoming signals and, if a SNCP switching criterion is detected, an indication is sent towards the MOST Unit using the STM–1 internal streams.

It is up to the MOST Unit to substitute the failed channel with the protection one.

The equipment supervision is performed by the MOST Unit through the messages issued on the Control bus.

A simplified block diagram of equipment supervision is given in Fig. 1.2–6.

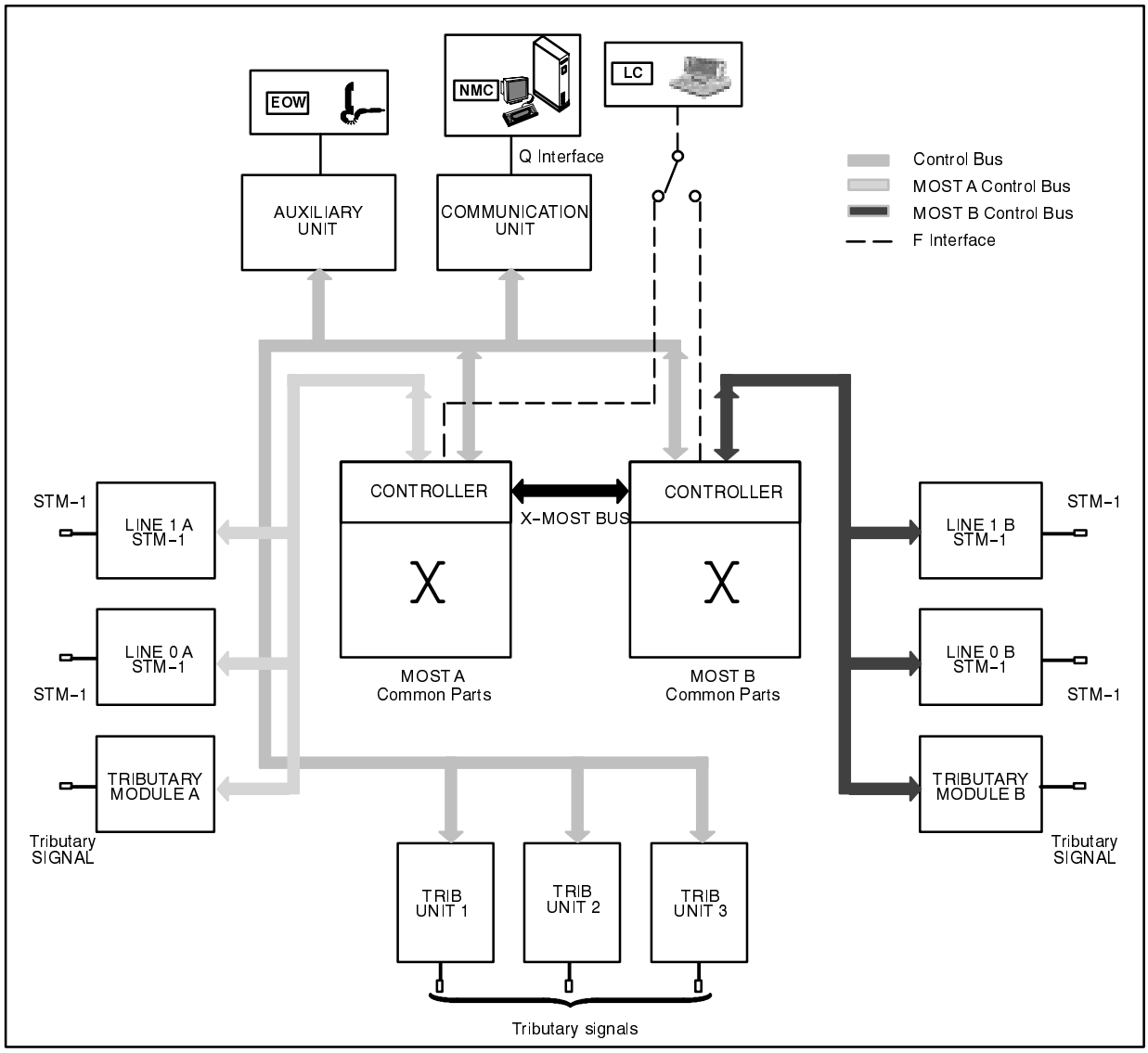

Fig. 1.2-6 *Simplified block diagram of equipment supervision*

Fault Detection

The fault detection is a function distributed on all the units.
The master MOST Unit performs the overall supervision of the equipment, in conjunction with the internal microprocessor of each unit.

The fault detection can be structured into:

- *internal checks on each unit;*
- *checks on traffic signals (on both tributary and line side);*
- *checks performed by* master MOST Unit *on each unit.*

Internal Checks

On each unit the microprocessor collects any internal failure (i.e. problem on DC/DC converters, malfunction on laser transmitters, etc.).

These internal alarms cause the light–on of a red LED on the unit front panel and are collected by the master MOST Unit.

Check on Traffic Signals

The line and tributary interfaces perform a check on the quality and content of SOH and POH bytes of the received signal.

From this analysis, alarm indications relevant to the traffic can be detected (i.e. LOS, AIS, RDI, etc.)

These alarm indications are collected by master MOST Unit and are also sent towards the MOST Unit, in order to allow any eventual protection switch.

Checks

The master MOST Unit collects the alarm and protection switch indications, from all the units.

It is also up to the master MOST Unit to monitor the status of each unit, by means of the CONTROL BUS.

All the collected data are used to drive the LEDs on the MOST Unit and to communicate the status of the equipment to LC or NMC.

Protection

For what concerns protection management, the protection scheme directly managed by the MOST Unit is the 1 + 1 protection for the 3x34Mbit/s Tributary Unit, 3x45Mbit/s Tributary Unit and 4x34Mbit/s Video Codec /ATM Tributary Unit .
In these schemes the change–over to the tributary stream managed by the protection unit is performed on the matrix, as soon as a fault on a Tributary Unit is detected and is driven by the controller circuits on the master MOST Unit. It is also up to this unit the control of the switches on the connection panels.

For all the other protection schemes (MSP, SNCP etc.) the change–over from main to protection is performed by the matrix or line and tributary interfaces, which communicates the completion of this switch operation to the controller components on the master MOST Unit.
It is up to this unit to make available to the NMC or the LC these information.

PAGE INTENTIONALLY LEFT BLANK