ANNEX A
(to Recommendation M.30)

Examples of network elements

A.1 A network element (NE) is the grouping of telecommunication and other equipment that can communicate operations and administrative messages via a telecommunication management network (TMN) over one or more standard interfaces for the purpose of being monitored and/or controlled.

Network elements are not part of a TMN if they contain only maintenance entities (ME) and/or support entities (SE), as defined in Recommendation M.20. Network elements with mediation functions are partly within a TMN, as described in § 5.5.

The various parts of NEs and their interfaces are shown in a) of Figure A-1/M.30 for ME, in b) of Figure A-1/M.30 for SE, and in c) of Figure A-1/M.30 for QA. Using these units, Figure A-2/M.30 shows an example of NE-configurations. As illustrated, one NE may contain a number of MEs and SEs connected to a Q-adapter.

The following interfaces are used:

a) T telecommunications interface, which carries the information flow to be managed by TMN;

b) Q Q_1, Q_2 and Q_3 TMN-interfaces as described in this Recommendation;

c) M non-standardized maintenance interface as described in this Recommendation;

d) TS telecommunication support interface, which is related to the function of the support element or used for connection of monitors/work stations.

A.2 Relations between NE, ME, SE and QA for maintenance are illustrated in Figures A-3/M.30 to A-10/M.30 using a number of examples.

The abbreviations used in the figures are:

CFS Common frequency supply

CTE Channel translation equipment

DCC Digital cross connect

DIG MUX Digital multiplexer

GTE Group translation equipment

LT Line terminal

M (non-standardized) Maintenance interface

ME Maintenance entity

MTE Mastergroup translation equipment

NE Network element

Q Q_1, Q_2, Q_3 interfaces

QA Q-adapter

SE Support entity

SMTE	Supermastergroup translation equipment
STE	Supergroup translation equipment
SUR	Supervision unit, dependent repeater
SUT	Supervision unit, line terminal
T	Telecommunications interface
TS	Telecommunications support interface

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Figure A-1/M.30, (N), p. 1

Figure A-2/M.30, (N), p. 2

Figure A-3/M.30, (N), p. 3

Figure A-4/M.30, (N), p. 4

Figure A-5/M.30, (N), p. 5

Figure A-6/M.30, (N), p. 6

Figure A-7/M.30, (N), p. 7

Figure A-8/M.30, (N), p. 8

Figure A-9/M.30, (N), p. 9

Figure A-10/M.30, (N), p. 10

ANNEX B
(to Recommendation M.30)

TMN application functions

B.1 *Introduction*

The TMN application functions are classified in the five categories specified in § 3.2.

The functional list has been classified according to the OSI management categories as an aid in selecting the protocol and the application language for the TMN interfaces.

The list of functions, its terminology and classification is preliminary and is expected to be refined as the study proceeds.

The application functions are not intended as requirements for any NE or TMN. Each function in the list is included because it may be necessary for some implementation of a related application. Some functions will be appropriate for a certain implementation of an interface application, but unnecessary or inconvenient for others.

B.2 *Index of list of application functions described in § B.3*

B.3.2.3.1.2 Monitor and talk

B.3.2.3.1.3 Measurement

B.3.2.3.1.4 Signalling and supervision

B.3.2.3.2 Digital data circuit test

B.3.2.3.2.1 Test access

B.3 *List of application functions*

B.3.1 *Performance management*

B.3.1.1 *Performance monitoring (PM)*

1) *Request PM data* — TMN requests the NE to send current PM data;

2) *PM data report* — NE sends performance data to the TMN. It may be generated routinely by the NE, sent upon demand by the TMN or by exception when a parameter threshold has been exceeded;

3) *Schedule PM data report* — TMN directs NE to establish a schedule for the reporting of PM data;

4) *Request PM data report schedule* — TMN directs NE to send the current PM data reporting schedule. NE responds with the schedule;

5) *Start/stop PM data* — TMN directs the NE to start or stop the collection of PM data;

6) *Initialize PM data* — TMN directs NE to reset storage registers for PM data;

7) *Set PM attributes* — TMN directs NE to assign designated values to PM attributes;

8) *Request PM attributes* — TMN requests NE to send current PM attributes;

9) *PM attributes report* — NE sends the currently assigned PM attributes to TMN;

10) *Request protocol conversion data* — TMN requests NE to transmit the data concerning the protocol conversion performance, such as the types and their number of protocol conversions;

11) *Protocol conversion data report* — NE sends data concerning protocol conversion performance.

B.3.1.2 *Traffic management and network management (NM)*

1) *Set traffic data attributes* — TMN directs NE to set parameters to collect traffic data;

2) *Request traffic data attributes* — TMN requests NE to report the current traffic data attributes;

3) *Request traffic data* — TMN requests NE to transmit traffic data to TMN;

4) *Traffic data report* — NE sends specified traffic data to TMN;

5) *Request clock sync* — TMN requests NE to transmit its current clock time to TMN;

6) *Clock sync report* — NE sends the current clock time;

7) *Set error analysis* — TMN directs NE to assign designated values to error analyses parameters. These are used by NE to recognize that a given unit is faulty based on the detection of errors and intermittent troubles;

8) *Request error analysis data* — TMN requests NE to report the current error analysis parameters or resulting data;

9) *Error analyses report* — NE sends error analyses data to TMN;

10) *Set NM data attributes* — TMN directs NE to set parameters to generate required NM measurement data;

11) *Request NM data attributes* — TMN requests NE to report the current NM data attributes;

12) *Request NM data* — TMN requests NE to send the NM data to TMN. This includes periodic measurement data and status and alerting discrete information;

13) *NM data report* — NE sends required NM data to TMN;

14) *Sent NM control* — TMN directs the NE to perform specified real-time NM controls;

15) *Control report* — NE sends NM control status information to the TMN;

16) *Set NM thresholds* — TMN directs the NE to set or change the congestion thresholds used by the NE to perform automatic NM control;

17) *Request NM threshold* — TMN requests the NE to send the current congestion thresholds to the TMN;

18) *NM threshold report* — NE sends current congestion thresholds to TMN.

B.3.1.3 *Quality of service (QOS) observations*

1) *Schedule QOS data report* — TMN directs NE to establish a schedule for the report of QOS data;

2) *Request QOS data report schedule* — TMN directs NE to send the current QOS data reporting schedule;

3) *QOS report* — NE reports to TMN the value of an observed QOS parameter. It may be sent on demand by TMN or on a scheduled basis;

4) *Set QOS threshold* — TMN directs NE to set or change the QOS parameter threshold;

5) *Request QOS threshold* — TMN directs NE to send the current QOS threshold;

6) *Exceptional QOS report* — NE reports to TMN the value of an observed parameter when a parameter threshold has been exceeded;

7) *Initialize QOS data* — TMN directs NE to reset storage registers for QOS data;

8) *Start/stop QOS data* — TMN directs NE to start or stop the collection of QOS data;

9) *Schedule QOS test calls* — TMN directs NE to establish a schedule for the execution of QOS test calls;

10) *Request QOS test call schedule* — TMN directs NE to send the current QOS test call schedule;

11) *QOS test call report* — NE reports to TMN the result of QOS test calls. It may be sent on demand by TMN or on a scheduled basis;

12) *Set QOS test call attributes* — TMN directs NE to set or change the attributes of QOS test calls;

13) *Start/stop QOS test calls* — TMN directs NE to start or stop sending test calls;

14) *Initialize QOS test calls* — TMN directs NE to reset the storage registers for test calls;

15) *Request QOS test call attributes* — TMN directs NE to send the current QOS test call attributes;

16) *Schedule (semi) automatic observations* — TMN directs NE to establish a schedule for the execution of (semi) automatic observations;

17) *Request (semi) automatic observation schedule* — TMN directs NE to send the current (semi) automatic observation schedule;

18) *Automatic observation report* — NE reports to TMN the result of automatic observations. It may be sent on demand by TMN or on a scheduled basis;

19) *Set (semi) automatic observation attributes* — TMN directs NE to set or change the attributes of (semi) automatic observations;

20) *Start/stop (semi) automatic observations* — TMN directs NE to start or stop the (semi) automatic observations;

21) *Initialize automatic observations* — TMN directs NE to reset the storage registers for automatic observations;

22) *Request (semi) automatic observation attributes* — TMN directs the NE to send the current (semi) automatic observation attributes.

B.3.2 *Fault (or maintenance) management*

B.3.2.1 *Alarm surveillance*

1) *Request alarm information* — TMN requests NE to send current alarm information;

2) *Alarm information report* — NE notifies TMN of alarm information. It may be sent automatically on occurrence, or on demand by TMN;

3) *Schedule alarm report* — TMN directs NE to establish a schedule for the reporting of alarms;

4) *Request alarm report schedule* — TMN directs NE to send the current schedule for alarm reporting. NE responds with the schedule;

5) *Condition alarm* — TMN directs NE to assign alarm attributes, modes and thresholds;

6) *Request condition* — TMN requests NE to report the current assignment of alarm attributes, modes and thresholds; NE responds with the assignments;

7) *Route alarm* — TMN directs NE to send alarms to designated locations;

8) *Request alarm route* — TMN requests NE to send the current assignment of alarm routes for a specified set of alarms; NE responds with the routes;

9) *Allow/inhibit alarms* — TMN directs NE to allow/inhibit either local audible/visual alarms or remote alarms;

10) *Alarm cut-off* — TMN directs NE to reset designated audible alarms.

B.3.2.2 *Fault localization*

1) *Request diagnostic data* — TMN requests NE to send the results of a diagnostic sequence;

2) *Stop diagnostic in progress* — TMN directs the NE to stop a particular diagnostic procedure in progress;

3) *Diagnostic report* — NE reports the results of a diagnostic sequence to the TMN. It may be used in conjunction with the request and stop functions and has applications where it may be necessary or desirable to repeat diagnostic tests for a period of time to ‘‘catch’’ a failure;

4) *Schedule diagnostic* — TMN directs NE to establish a routine schedule for the initiation of a diagnostic;

5) *Request diagnostic schedule* — TMN requests NE to report the current schedule of diagnostics;

6) *Diagnostic schedule report* — NE sends the current schedule of diagnostics;

7) *Request exercise report* — TMN requests NE to send the results of a particular exercise;

8) *Exercise report* — NE sends the results of an exercise to TMN;

9) *Stop exercise* — TMN directs NE to stop a particular exercise in progress;

10) *Schedule exercise* — TMN directs NE to establish a routine schedule for the initiation of an exercise;

11) *Request exercise report schedule* — TMN directs NE to send the current schedule of an exercise. NE responds with the schedule;

12) *Operate/release loopback* — TMN directs NE to establish or release a specific loopback. It may be activated either remotely by TMN or locally by craft action;

13) *Test internal access path* — TMN directs NE to connect a termination on NE to another termination by a specified path within NE, then test the path;

14) *Hold network path* — TMN directs NE to hold a particular network path;

15) *Start/stop program traps* — TMN directs NE to start or stop a specific program trap;

16) *Program trap report* — NE automatically reports to TMN the occurrence of a program trap;

17) *Start/stop program trace* — TMN directs NE to start or stop a specific trace;

18) *Program trace report* — NE automatically reports to TMN the results of a trace;

19) *Start/stop audit* — TMN directs NE to start or stop an audit;

20) *Audit report* — NE automatically reports to TMN the results of an audit;

21) *Schedule audit* — TMN directs NE to establish a specified schedule for a given audit;

22) *Request audit schedule* — TMN requests NE to send the current audit schedule. NE responds with the test schedule;

23) *Start/stop loop insulation test* — TMN directs NE to start or stop a loop insulation test;

24) *Schedule loop insulation test* — TMN directs NE to schedule a loop insulation test;

25) *Request loop insulation test schedule* — TMN requests NE to send current loop insulation test schedule. NE responds with the schedule.

B.3.2.3 *Testing*

B.3.2.3.1 *Voiceband and voiceband data circuits test*

B.3.2.3.1.1 *Access and control*

1) *Connect test access* — TMN directs NE to provide a monitor connection to the transmission pairs of the accessed circuits;

2) *Disconnect test access* — TMN directs NE to drop access to the circuit under test and return the circuit to its normal state;

3) *Request test result* — TMN requests NE to report intermediate or final results from a measurement;

4) *Test result report* — NE sends the results of a test to TMN;

5) *Change terminate and leave (T&L)* — TMN directs NE to change T&L state of the circuit under test and report the resulting T&L state to TMN;

6) *Request to terminate and leave* — TMN directs NE to report the T&L status of the circuit under test;

7) *Terminate and leave report* — NE reports the T&L status of the circuit under test;

8) *Change pairs* — TMN directs NE to execute reversals of specified transmission pairs for 4- and 6-wire metallic circuits on either the equipment or facility side of the test port;

9) *Change leads* — TMN directs NE to execute reversal of tip and ring leads of metallic transmission pairs on the circuit under test;

10) *Change port restore* — TMN directs NE to clear all test conditions and restore the circuit to a monitor state;

11) *Request facility test status* — TMN directs NE to send the status of the facility carrying the circuit under test;

12) *Facility test status report* — NE sends the status of the facility carrying a specified circuit.

B.3.2.3.1.2 *Monitor and talk*

1) *Connect talk and split* — TMN directs NE to establish talk and listen paths between the circuit under test and the monitor/talk line;

2) *Connect monitor listen* — TMN listens selectively to the circuit under test and monitors any transmission pair in either direction;

3) *Change monitor level* — the TMN directs NE to change the level of the monitor connection;

4) *Change monitor filter* — TMN directs NE to remove or insert the single frequency notch filter placed in the monitor connection;

5) *Disconnect monitor* — TMN directs NE to remove any monitor or talk conditions established on the circuit under test.

B.3.2.3.1.3 *Measurement*

1) *Measure circuit characteristic* — TMN directs NE to measure a circuit characteristic including, but not restricted to, voltage, current, tip-ring-ground capacitance and resistance, noise, tone and outpulsing signals;

2) *Apply test signals* — TMN directs NE to send a test signal on the circuit. Examples are outpulsing and ringing signals;

3) *Remove test signal* — TMN directs NE to remove the test signal sent by the apply function;

4) *Stop measurement* — TMN directs NE to terminate continuous or repeating type measurements.

B.3.2.3.1.4 *Signalling and supervision*

1) *Change split and supervision* — TMN directs NE to set up metallic test access splitting of the circuit and supervise in both directions for both a.c. and d.c. supervision;

2) *Request supervision status* — TMN requests NE to send in an analysis of the current signalling state of the circuit under test;

3) *Supervision status report* — TMN reports the current signalling state of a circuit under test to TMN.

B.3.2.3.2 *Digital data circuit test*

B.3.2.3.2.1 *Test access*

1) *Connect test access digital* — TMN directs NE to provide test access to a digital data circuit;

2) *Monitor digital signals* — TMN establishes digital data monitor test access and determines the presence of network control codes or customer data;

3) *Change digital test access to split* — TMN directs NE to provide split test access to the digital circuit under test;

4) *Test digital loopback* — TMN directs NE to provide a loopback on the circuit under test and perform a loopback test;

5) *Change latching loopback* — TMN splits the circuit under test and changes the operate and release functions of digital network element latching loopback devices;

6) *Change multipoint junction unit functions* — TMN directs NE to perform various control functions such as block, select, unselect, and release, on the multipoint junction unit (MJU) in the circuit;

7) *Test multipoint junction unit* — TMN directs NE to split the circuit under test and performs primary and secondary channel tests on the multipoint junction unit (MJU);

8) *Test straightaway* — TMN directs NE to split the circuit under test and connect the required test modules to perform a straightaway test;

9) *Establish loop around access* — TMN directs NE to establish a test access to a metallic circuit by selecting a test access path (TAP) and providing a looparound on the selected TAP;

10) *Connect monitor state* — TMN directs NE to establish a monitor state without the need to re-access the circuit under test. This function will remove or reset any previous state or condition except the terminate and leave state;

11) *Change split metallic/digital* — TMN directs NE to split the specified pair or pairs at the metallic or digital access point of the circuit under test, and connect it to the TAP. Both the facility (F) and equipment (E) sides of the split circuit are connected to the TAP, in agreement with the lead-pair assignment and configuration code;

12) *Change terminate and leave metallic/digital* — TMN directs NE to change the terminate and leave state of the circuit under test;

13) *Silence repeater* — TMN directs NE to shut down a repeater;

14) *Request TAPs status* — TMN requests the status of all TAPs serving NE;

15) *TAPs status report* — NE reports the status of all TAPs to TMN;

16) *Reset TAPs* — TMN directs NE to release all existing test access connections in the NE. It also restores all TAPs involved to an idle state;

17) *Diagnose TAP* — TMN directs NE to carry out a looparound of the TAPs from the test system for purposes of diagnosis.

B.3.3 *Configuration management*

B.3.3.1 *Provisioning*

B.3.3.1.1 *NE configuration*

1) *Request configuration* — TMN requests that the NE report the current configuration of each entity;

2) *Configuration report* — For each entity, NE reports status, capacity of the entity, optional parameters, type of entity (in sufficient detail for TMN identification) and the version and revision of the version;

3) *Grow* — TMN notifies NE of the presence of a newly installed entity;

4) *Prune* — TMN notifies NE of the disconnection of an entity;

5) *Restore* — TMN notifies NE to begin monitoring the newly installed entity;

6) *Assign* — TMN notifies NE that a previously unequipped entity is now equipped;

7) *Delete* — TMN notifies NE that a previously unequipped entity is no longer equipped;

8) *Set service state* — TMN directs NE to place the specified entity in one of the following states: in service (available for use), out of service (unavailable for use), standby (not faulty but not performing normal function), reserved;

9) *Request assignments* — TMN requests that NE report the identity of each assigned entity. The request may be for a specified entity or for all equipped entities;

10) *Assignment reports* — NE reports the identity of each assigned channel for each equipped entity or for a specified entity;

11) *Set parameters* — TMN directs NE to set parameters associated with a specified entity;

12) *Set service thresholds* — TMN directs NE to set performance thresholds for the specified channel;

13) *Add/drop* — TMN directs NE to insert or remove a channel from the complement of through-channels;

14) *Cross-connect* — TMN directs NE to interconnect two specified channels operating at the same rate;

15) *Disconnect* — TMN directs NE to remove the interconnection between two specified channels;

16) *Start transmission test* — TMN directs NE to begin a transmission test on a given circuit;

17) *Balance* — TMN directs NE to perform a balance test/adjustment;

18) *Start transponder test* — TMN directs NE to look for a transponder signal on the given circuit;

19) *Set report periods* — The TMN directs NE to set or change report periods;

20) *Request report periods* — The TMN requests NE to send the current periods to the TMN.

B.3.3.1.2 *Administrative functions*

1) *Set clock* — TMN directs NE to set NE system clock to current calendar, date and time;

2) *Backup copy* — TMN directs NE to make a backup copy of the designated NE data base file for purposes of archiving for future restoral;

3) *Terminate procedure* — TMN directs the NE to terminate a process between a TMN and a NE;

4) *Route messages* — TMN directs NE to route automatic messages generated by NE to one or multiple communications channels;

5) *Set service controls* — TMN directs NE to assign user access and functional capability.

B.3.3.1.3 *Data base management*

1) *Initialize* — TMN configures a new data base which is related to an NE. This may or may not be downloaded to the NE. This may also include loading a new program related to the NE;

2) *Reinitialize* — TMN reconfigures the data base within an NE while it is in service;

3) *Update* — TMN adds, changes or deletes one or more records in the data base of an NE. This can be done in a delayed activation mode or upon command entry. It may also be able to enter data base updates on a test basis prior to permanent entry;

4) *Query* — TMN reads NE for all or part of its data base contents;

5) *Backup* — TMN keeps a copy of all or part of the data base of an NE. In case of memory failure in the NE, the TMN downloads the backup copy to the NE.

B.3.3.2 *Status and control*

1) *Request status* — TMN requests NE to send current status information;

2) *Status report* — NE reports to TMN the value of a monitored parameter. It may be sent on demand by TMN or on a scheduled basis;

3) *Schedule status report* — TMN directs NE to establish a schedule for the reporting of status information;

4) *Request status report schedule* — TMN directs NE to send the current schedule of status reporting. NE responds with the schedule;

5) *Allow/inhibit automatic restoration* — TMN directs NE to allow or inhibit automatic restoration in an M+N or duplex system;

6) *Operator/release automatic restoration* — TMN directs NE to switch a specified line or equipment to the redundant unit or release it from the redundant unit. For an M+N system, service is placed on the redundant unit and taken off of the working unit. For a duplex system the main unit becomes standby and the standby unit becomes the main unit.

B.3.3.2.1 *Message handling systems network*

1) *Request message storage status data* — TMN requests NE to transmit the message storage status data of store and forward communication to TMN;

2) *Message storage status data report* — NE sends the status data to TMN.

B.3.3.2.2 *Leased circuit network*

1) *Request status of dynamic provisioning of leased circuit network* — TMN requests NE to transmit the status of dynamic provisioning to TMN;

2) *Status report of dynamic provisioning of leased circuit networks* — NE sends the current status to TMN.

B.3.3.2.3 *Transmission network*

1) *Request status of automatic transmission restoration* — TMN requests NE to transmit the switching activities and current status of automatic transmission restoration;

2) *Status report of automatic transmission restoration* — NE sends the current status of the switching operations to TMN.

B.3.3.3 *Installation*

A detailed list of installation functions for an SPC-exchange is provided in Recommendation Z.331 [1], § 3.3.

B.3.4 *Accounting management*

This term and the subject is for further study.

B.3.5 *Security management*

1) *Change channel class* — TMN directs NE to change the security user class of an operations channel;

2) *Change terminal class* — TMN directs NE to change the security class of NE terminal;

3) *Dial capability* — TMN directs NE to initiate a secure dial-out/dial-back capability to TMN;

4) *Log in* — TMN sends the appropriate password and identification of an NE communications channel;

5) *Log off* — TMN directs NE to terminate communication on a channel;

6) *Change* — TMN directs NE to change the log-in code assigned to NE;

7) *Change dial number* — TMN directs NE to change the auto-dial-back number that NE uses to call back the calling party upon receipt of a dial-out call.

B.4 *Glossary*

B.4.1 **alarm**

An alerting indication to a condition that may have immediate or potential negative impact on the state of the monitored NE.

B.4.2 **alarm attribute**

A collective reference to delaying, stretching and severity of alarm indications.

B.4.3 **alarm route**

A path between an NE and a TMN for the transmission of alarm information.

B.4.4 **audit**

A test of the validity of data and/or generic programs in the NE.

B.4.5 **control**

A modifier of the state of an NE.

B.4.6 **delaying**

Withholding the report of alarm information until the condition has persisted for a predetermined amount of time.

B.4.7 **diagnostic**

A routine in the NE which performs detailed tests to isolate troubles.

B.4.8 **exercise**

Sequential operations which test the overall functioning of an NE or sub-system.

B.4.9 **initialization**

Setting a process to a specified state. This may be a restart state or intermediate levels.

B.4.10 **loopback**

A procedure used in fault location whereby a signal is returned to its source along the same path on which it was received.

B.4.11 **mode**

The alarm characteristic of being either continuous or self-retiring.

B.4.12 **performance monitoring (PM)**

The monitoring of various parameters of an NE on an in-service basis to measure the quality of performance.

B.4.13 **performance monitoring attributes**

Characteristics of PM parameters including thresholds and pattern recognition criteria.

B.4.14 **severity**

An alarm attribute indicating the magnitude of the related failure. Some measures of severity include major, minor, service affecting and non-service affecting.

B.4.15 **supervisory signal**

A signal indicating the state or change of state of a circuit.

B.4.16 **scheduling**

Can include the assignment of time intervals to the execution of one or more functions by the NE. It can also include inhibition or allowance of execution of the function without affecting prior scheduling.

B.4.17 **status**

Information on the current state of an NE.

B.4.18 **stretching**

Holding the indication of an alarm condition for a predetermined amount of time, even after the condition resolves to increase the chance that the TMN has scanned the indication.

B.4.19 **terminate and leave (T&L)**

Terminating one or both direction of transmission on an outgoing transmission path.

B.4.20 **test access point (TAP)**

A virtual or physical testing path between a test system and the circuit under test in the NE.

B.4.21 **thresholding**

Assignment of a specified value of a monitored parameter such that trouble indication is generated only when this value is exceeded.

B.4.22 **trace**

A report of the execution flow of a specified event.

B.4.23 **trap**

An automatic report of a specified event which would otherwise not be reported.

ANNEX C

(to Recommendation M.30)

Tables of function attribute ranges

The TMN should be designed such that it has the capability to interface with several types of communications paths, to ensure that a framework is provided which is flexible enough to allow for the most efficient communications between the NE and the TMN, workstations and the TMN, between elements within the TMN or between TMNs. In this case the term efficiency relates to the cost, reliability and quantity of the data transported.

Costs are impacted by two aspects. The first is the actual cost to transport data across the network between the TMN and the NE. To minimize this cost various network architectures are considered, e.g., star, multipoint, loop, tree. The communications required must also be considered, e.g. leased circuits, circuit switched or packet-switched networks. In making this choice, network availability and cross-network delays must be evaluated as attributes to be used in the decision-making process.

The second aspect is the design of the interface including the selection of the appropriate communications protocol. In this case there are several attributes associated with functions performed within the NE that would help to govern this choice. These attributes include: reliability, frequency, quantity and the requirement for priority.

This Annex provides tables of ranges for each of the function attributes that should be taken into consideration when planning the design of the data communications channels and selecting the appropriate protocol to be used to interface between a TMN and NE, TMN and workstation, or between elements within a TMN. Table C-1/M.30 shows the basic function attributes. Table C-2/M.30 shows examples of TMN attributes to support the OSs requiring real-time operations, and Table C-3/M.30 shows examples of the same attributes for a non real-time OS.

H.T. [T1.30]

TABLE C-1/M.30

Basic table of function attributes

	Attributes	Requirements	Nature of attributes
{	Delay (speed) Reliability (accuracy) Availability	Short Medium Long High Medium Low High Medium Low	
{	Quantity Non- periodic High Medium Low	{ Often Medium Seldom Often Medium Seldom {	Periodic Priority

Tableau C-1/M.30 [T1.30], p.

H.T. [T2.30]

TABLE C-2/M.30

Example of function attributes for real-time operation

| ua), b)

	Attributes	Requirements	Attribute ranges
(P)	Delay (speed)	Short Medium Long	{
	Reliability (accuracy)	High Medium Low	{
	Availability	High Medium Low	{
(C)	Quantity	{	{
Priority	{		

a) ‘‘Real-time’’ has a two-fold meaning:

i) on-line activities consistently carried out from time-to-time, such as sampling of system status (type A),

ii) activities that are not frequently done but require quick operation once they have been called for (type B).

b) Attributes can be considered for:

i) each command, each inquiry, the responses to them, and each spontaneous report,

ii) an operation which consists of the combination of the categories in i), e.g. a command and its response.

c) For example, file loading, system recovery, etc. (type B).

d) For example, system file saving, call data saving, etc.

TABLE C-3/M.30

non-real-time operation

	Attributes	Requirements	Attribute ranges
	Delay (speed)	Short Medium Long	{
(P)	Reliability (accuracy)	High Medium Low	{
	Availability	High Medium Low	{
	Quantity	{	

{

ranges	Attributes	Requirements	Attribute		
{	Delay	(speed)	Short	Medium	Long
(C) { (P)	Reliability	(accuracy)	High	Medium	Low
{	Availability	High		Medium	Low
{	Quantity				
{					

(C)