Recommendation T/CS 54-12 (Montpellier 1984)

TRAFFIC MEASUREMENTS

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

— that digital local and transit exchanges are increasingly used in CEPT-countries;

— that it could be advantageous to conceive a set of traffic measurement types suitable for several exchange systems now being planned or introduced for the telephone networks either analog or digital;

— that administrations have the responsibility for the measurements during the whole time the equipment concerned is in service;

— that it is desirable to harmonise functions for traffic measurements in CEPT-countries,

recommends

that the members of the CEPT use for traffic measurement the structure and measurement types set out below."

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GENERAL

The present Recommendation deals with the definition of the various traffic measurement types for circuit switched telephony service. This Recommendation applies to digital local and transit exchanges whether these exchanges are located in a fully digital network (switching and transmission) or in a mixed analogue/digital network.

The measurement types are to be considered as a set of minimum requirements for the exchange.

Traffic analysis funtions performed by further processing of the result of the recommended measurment types, are not considered in the present recommendation.

The traffic measurement model used in this recommendation is defined by CCITT, see the methodology Recommendation Z.332.

All information contained in this recommendation doesn't imply any specific implementation.

1. OBJECTIVES OF THE MEASUREMENTS

In the following the main objectives of the traffic measurements in the exchanges are presented from the user (administration) point of view.

1.1. Exchange dimensioning and planning

Dimensioning of the equipment of an exchange must be based on studies on the evolution and growth of traffic.

For the recognition of possible bottlenecks or overdimensioning and the proper dimensioning of extensions or new circuit groups it is desired that e.g. the following information could be derived:

— busy hour traffic on the exchange consisting of the total amount of originating traffic, incoming traffic, internal subscriber traffic, transit traffic, terminating traffic and outgoing traffic.

It is also necessary to measure the traffic carried by the control equipment, i.e. processors, by the switching stages, by the auxiliary units, etc.

1.2. Network dimensioning and planning

For the proper dimensioning of the routes in the telephone network it is necessary to get information of the destination traffic flows in the network and perform studies on the evolution and growth of the traffic.

For the recognition of possible bottlenecks or overdimensioning and the proper dimensioning of new circuit groups it is desired that e.g. the busy hour traffic intensity could be derived on each circuit group.

In the case of bothway circuits the different categories of traffic must be treated separately.

1.3. Exchange performance monitoring

In order to maintain the network technical performances, i.e. the quality of service at the required standard levels, it is important to monitor the traffic in the exchanges continuously and undertake correct ive actions in the case of degradation. For example traffic load balancing may be related to this monitoring.

Switching systems should provide automatic measurements of traffic and grade-of-service indicators. Traffic measurements data should be divided into two categories:

— data provided in real-time, for on-line survey of the grade-of-service;
— data recorded, for further analysis of the grade-of-service and engineering purposes.

1.4. Network (trafficability) performance monitoring

Traffic analysis need information of the traffic flows in the network, in order to verify trafficability performance (grade of service) in the telephone network.

1.5. Support to maintenance

The observation of real traffic in the exchanges provides information which can be used for the location of faults, e.g. by

— providing information about the distribution of holding times and indicating devices on which the average holding time is abnormally low or high due to an eventual fault;
— indicating devices that are constantly busy or free due to a possible fault.

1.6. Accounting tariffs and marketing

Traffic data may be needed for the division of revenues between different companies or and also for optimizing the tariff policy.

Observation of subscriber behaviour yields information for the marketing departments.

It is desired to study the characteristics of the traffic of various socio-professional subscriber categories, and to calculate short or medium term traffic forecasts by subscriber category or geographical area. Also the behaviour of the users in relation to the network should be characterized.

1.7. Network management in real-time

Network management requires real-time monitoring and measurement of the status and performance of the network, and the ability to take prompt action to control the flow of traffic when necessary, as specified in the E.410 series of CCITT Recommendations, see also Recommendations Q.506 and Q.516. Experience has shown that it is difficult to perform network management functions unless exchanges are provided with the necessary facilities to support these functions.

Traffic data are required to identify and quantify difficulties as they occur in the network to alert network managers and/or management systems that some action may be required, to measure the effect of any network management action taken, and to indicate when a network management action should be modified or removed. Accordingly, traffic data must be collected and processed in real time and it should be based on a system of measurement, which is either continuous, or of a high sampling rate to quickly measure traffic changes and allow a rapid network management response.

In the case of unexpected failure in the network it is the purpose of network management operations to prevent the propagation of congestion. The continuous supervision of the traffic situation should provide the network manager and/or systems sufficient indicators for taking appropriate actions which may be either protective (e.g. unidirecting or blocking of routes) or expansive (e.g. rerouting).

It is desired that e.g. the completion ratio of each circuit group and destination code could be derived at sufficiently small intervals.

1.8. Subscriber monitoring

This class of objective should help to settle problems which may occur between the subscriber and the administration; subscriber complaints may refer to billing, quality of service, etc.

The subscriber's monitoring is based on the results of subscriber's observation*) which are presented by the exchange. These results are summaries of each call related to the observed subscriber and containing information such as: If the call is effective or not, various time intervals including conversation time, number or metering pulses, etc.

2. TRAFFIC TYPES, OBJECT TYPES AND ENTITIES

2.1 Traffic types

From the traffic measurements point of view the following traffic types (Figure 1) are identified.

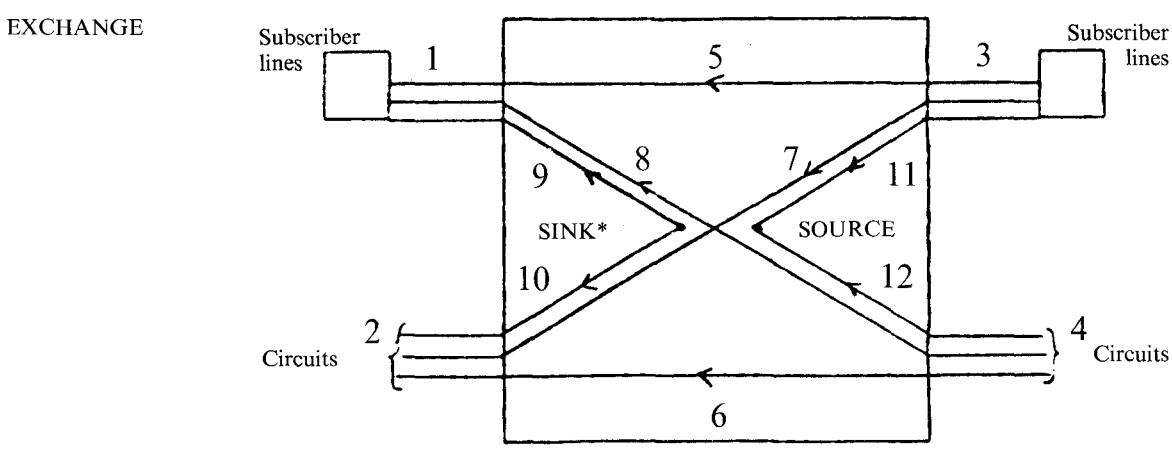


Figure 1 (T/CS 54-12). Traffic flow types in a generalized digital exchange.

1 Originating traffic.
2 Incoming traffic.
3 Terminating traffic.
4 Outgoing traffic.
5 Internal traffic.
6 Transit traffic.
7 Incoming terminating traffic.
8 Originating outgoing traffic.

*) *Note:* Observation does not imply recording of the actual conversations.

The following traffic types are also identified but to be studied further and are therefore not yet taken into account for the rest of this recommendation such as the call event diagrams (see 3.5.) and the recommended set of measurement types

9 Originating are system-terminating traffic.
10 Incoming are system-terminating traffic.
11 System-originating are terminating traffic.
12 System-originating are outgoing traffic.

*) The source and sink are defined with respect to traffic flows and they do not imply specific implementations for supplementary services or auxiliary units.

Further study is required on how operator traffic should be defined in this model.

2.2. Object types

Individual items on which the measurement is performed are considered as *objects*.

The following object types have been identified:

(a) circuits, circuit groups
  — incoming
  — outgoing
  — both way;
(b) destinations;
(c) subscriber lines, subscriber line groups
  — single subscriber line
  — PABX-groups
  — groups of operator lines;
(d) auxiliary units;
(e) common control units;
(f) signalling units.

2.3. Entities

The quantities for which data collection must be performed in a certain measurement are called entities. Examples of entities are

(a) call based entities
  — no. of bids
  — no. of call attempts
  — no. of seizures
  — no. of successful call attempts;
(b) object status based entities
  — traffic intensity
  — number of circuits in service.

3. AN OVERVIEW OF DATA COLLECTION PROCESS AND MEASUREMENT ENTITIES FOR EACH OBJECT TYPE AND EACH TRAFFIC TYPE

This chapter presents an overview of the necessary basic data for traffic measurement. This data is classified in the following in to four categories (see 3.1. to 3.4.).

The list of entries of the measurement matrix provides an overview and should lead to the identification of the minimum set of entities for each object type.

The object is from the MML point of view actually a delimiter which is used to control the measurement process. Thus from the traffic measurement process point of view they are not "true objects". of the measurement. In many cases the entities of a measurement can be common to several objects of different type or even object independent (traffic type dependent).

3.1. Data collection

Data from traffic measurements are stored in the exchange in counters. There are two basic types of counters:

— counters belonging to a certain object;
— counters belonging to a certain traffic type. These counters can be common to several objects of the same object type or different object types.

The latter ones are sometimes called "exchange counts"

The object status data which is needed for the switching programs (circuit idle, subscriber busy, etc.) is also used for traffic measurement purposes.

Three distinct methods of data collection can be distinguished

(a) Data collection on cumulative counters, where data related to a particular event are summed (= event registration). Examples of event are: a bid, a seizure, internal congestion, etc.

(b) Data collection by regular inspection of status (circuit busy/free states, memory allocation indicators, etc.) indicators (up/down counters). Statistical information such as traffic intensity and equipment load can be derived with the help of this data.

(c) Call oriented data collection, where data related to a particular call are captured (= call reporting). A number of details of every nth call or calls fulfilling a preselected selection criterion is recorded.

The third data collection method applies a call-driven concept, whereas the first two methods apply a scan-driven concept to derive statistical data.

Any equipment withdrawn from service (not-serviceable or backward blocked) is excluded from traffic measurements, but the quantities of such equipment during the periods of the measurement has to be determined.

3.2. Counters and status indicators belonging to a certain object

For each individual object (subscriber, circuit, route, destination, etc.) there is a number of counters and each of them is assigned to a certain entity (e.g. number of seizures, number of successful calls, number of unsuccessful calls). All the objects of an object type have the same number of counters.

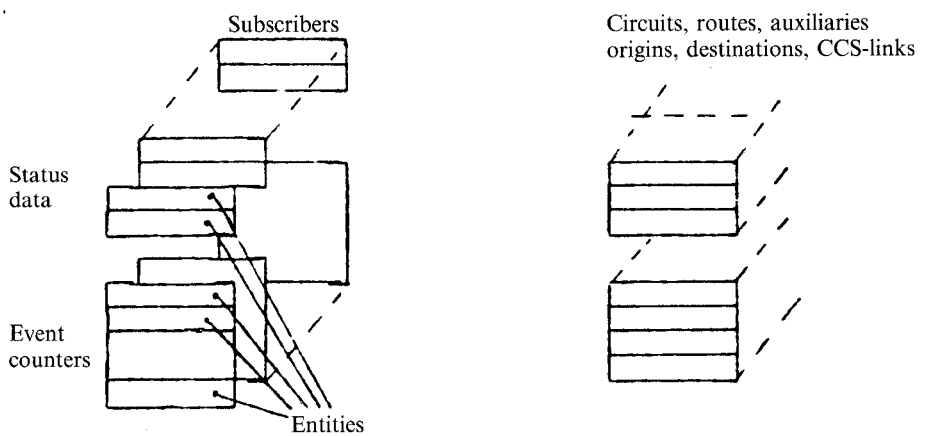


Figure 2 (T/CS 54-12). Object dependent counters.

The number of counters per object for each type and the entities which are cumulating these counters have to be studied and should be chosen according to the object type and the needs of traffic measurements. It has to be studied if the use of some or all of these counters is depending on whether the object is in the object list of an activated measurement.

3.3. Call record

Call records contain data relevant to the call set up phase, the conversation phase and the clear-down phase. The call record contains information about the objects which are related to the call (A-subscriber, B-subscriber, incoming circuit, outgoing circuit, etc.) and entities which are traffic type dependent (see Figure 3).

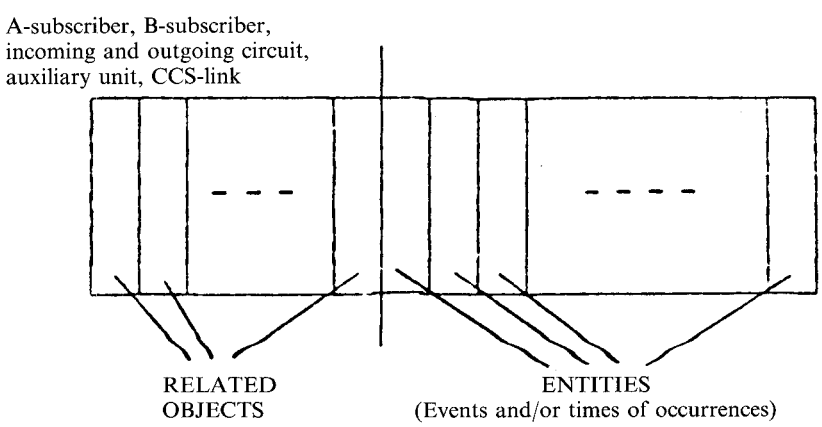


Figure 3 (T/CS 54-12). Call record.

Information related to call records, whether assembled or not, should be made available immediately or deferred for further processing.

If the contents of a call record or a part of it is stored on a mass memory it has to be studied if the objects related to the call will be used to limit the output on the mass memory. Anyhow the required traffic measurement results or other results are obtained by post processing the contents of the mass memory.

3.4. Exchange counts (counters belonging to a traffic type)

If the contents of a call record are to be stored to exchange counts (see Figure 4) the objects (any of them or several of them) can be used in defining the sets of counters which are to be cumulated according to the entities stored in the call record.

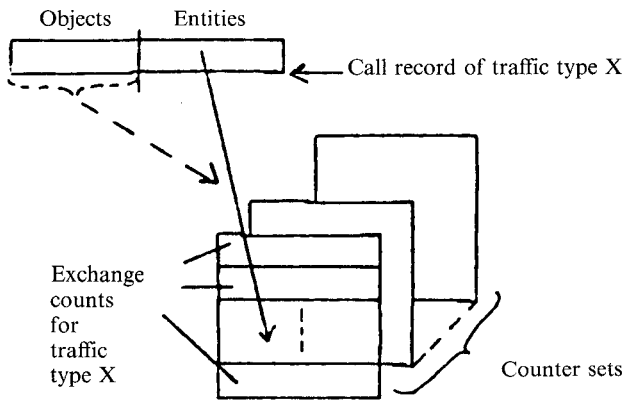


Figure 4 (T/CS 54-12). Exchange counts.

3.5. Event reference diagrams

An overall event reference diagram is presented in Figure 5 (T/CS 54-12) (This figure is identical to Figure 3/Q.515). This diagram covers all the traffic types presented in Figures 6 to 13.

Event reference diagrams for system-terminating traffic and system-originating traffic will be defined at a further stage.

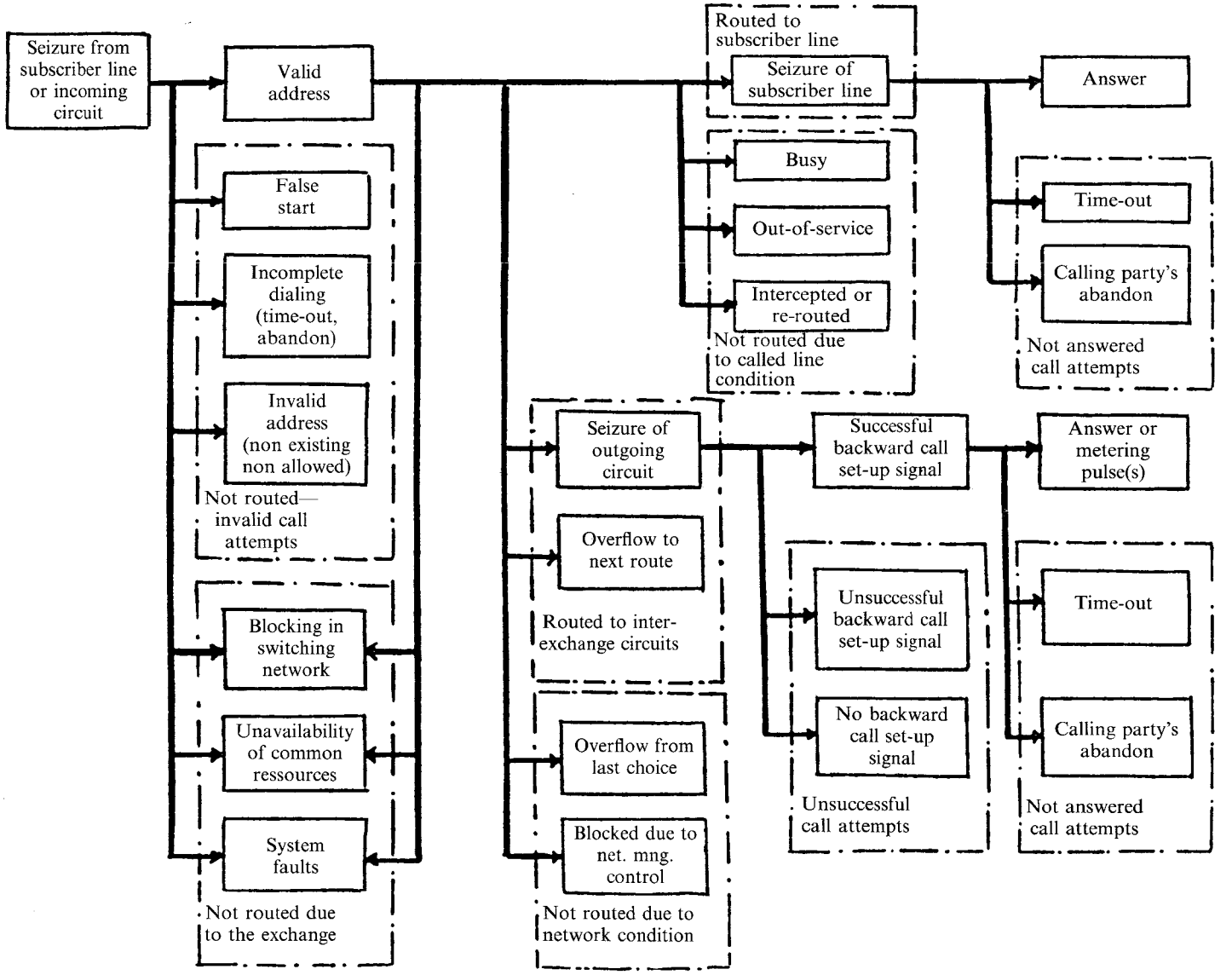


Figure 5 (T/CS 54-12). Overall event reference diagram.

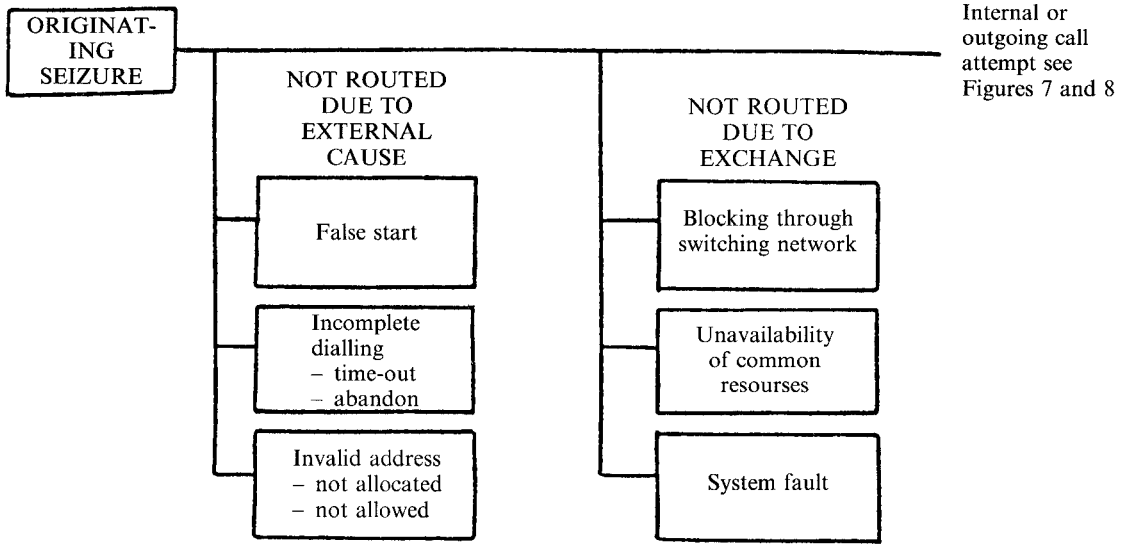
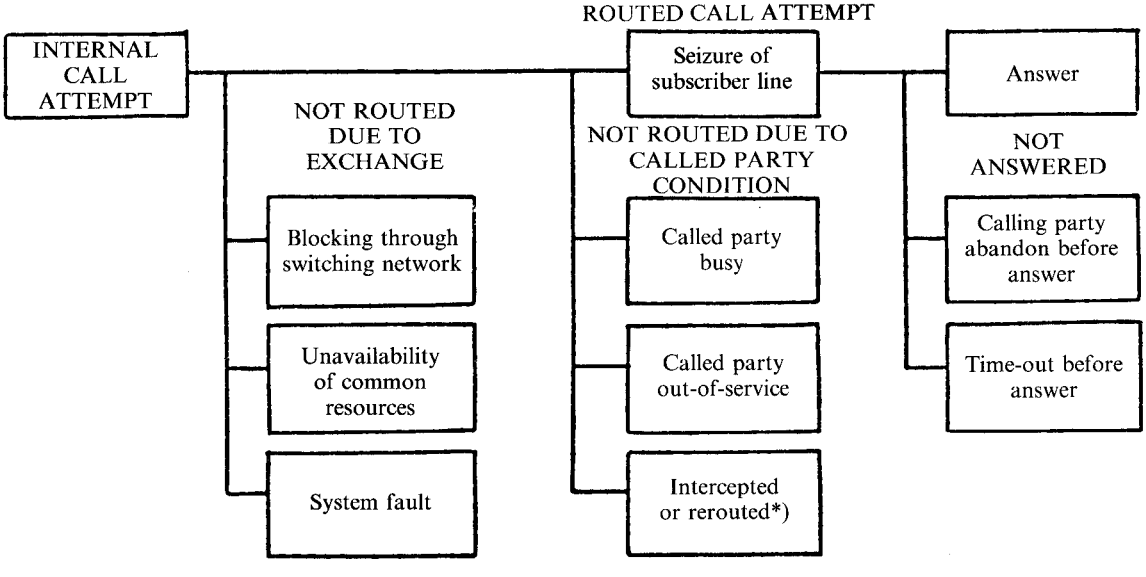


Figure 6 (T/CS 54-12). Originating traffic.



*) *Note:* This box globally represents the cases of internal call attempts that are not routed to a physical subscriber line (e.g. set-up of an abbreviated dialling, follow-me service, etc.).

Figure 7 (T/CS 54-12). Internal traffic.

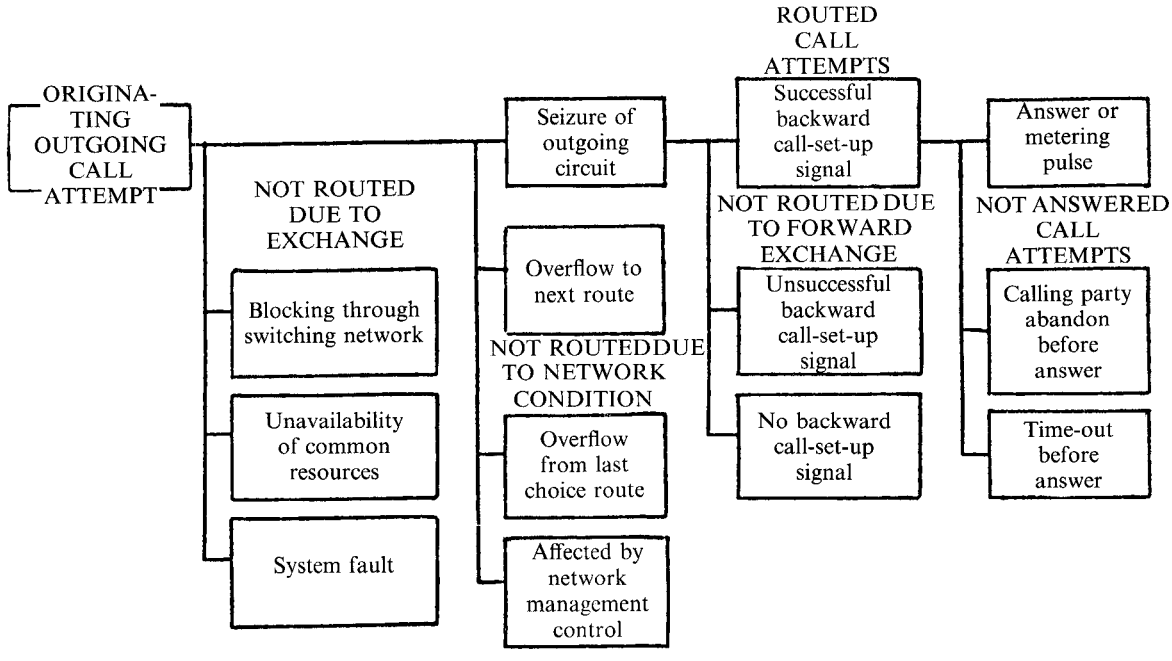


Figure 8 (T/CS 54-12). Originating outgoing traffic.

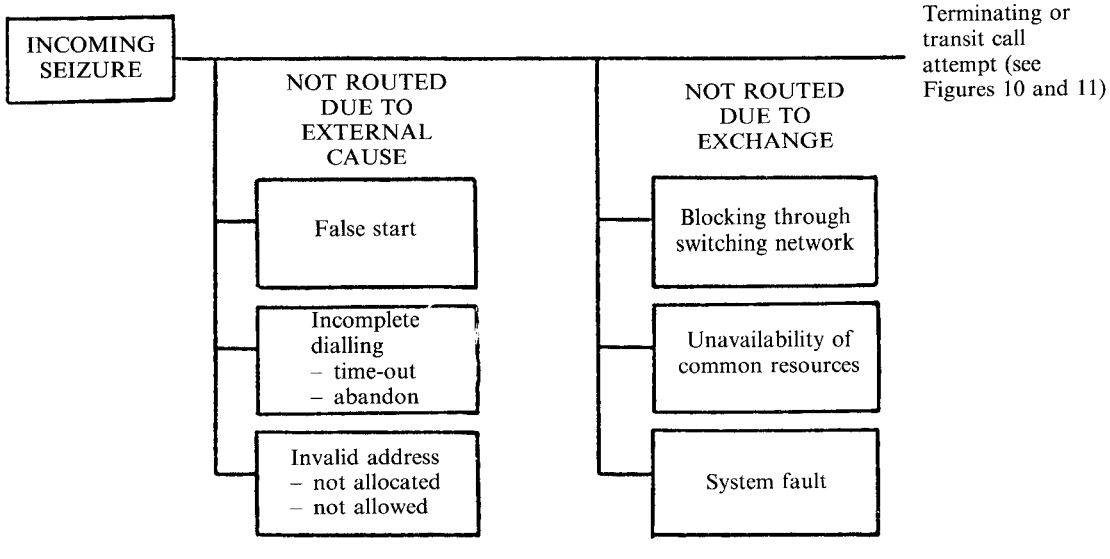
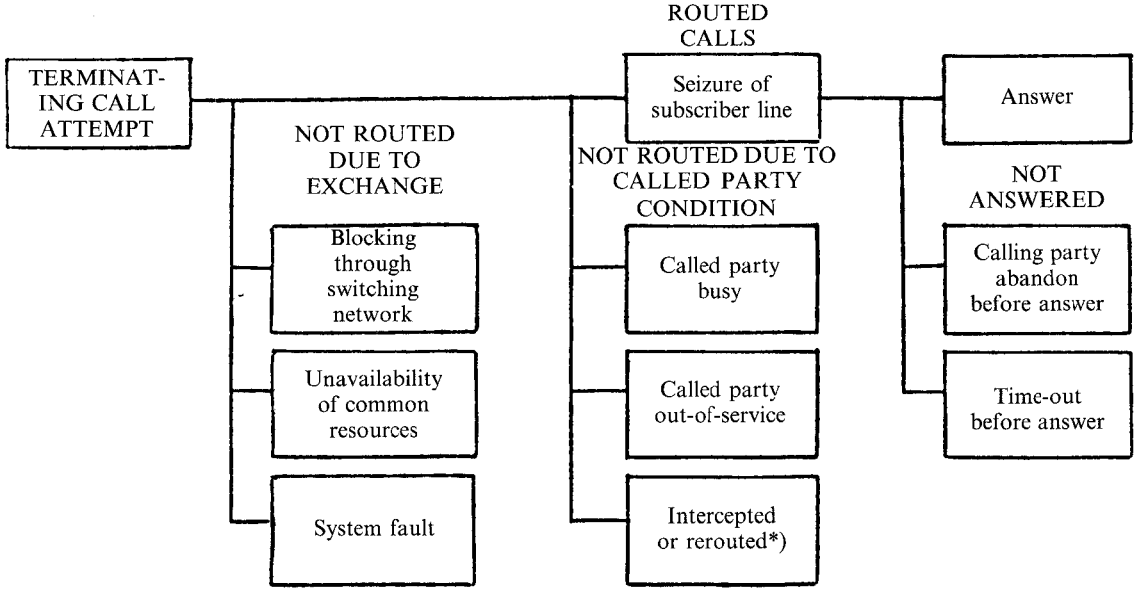


Figure 9 (T/CS 54-12). Incoming traffic.



*) *Note:* This box globally represents the cases of internal call attempts that are not routed to a physical subscriber line (e.g. set-up of an abbreviated dialling, follow-me service, etc.)

Figure 10 (T/CS 54-12). Terminating incoming traffic.

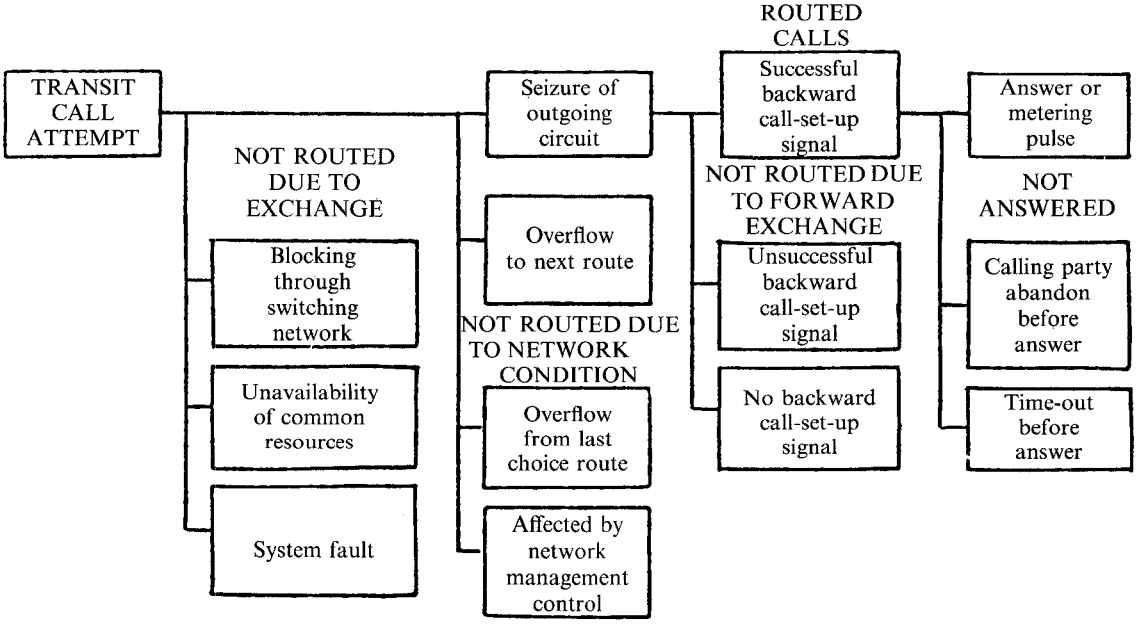
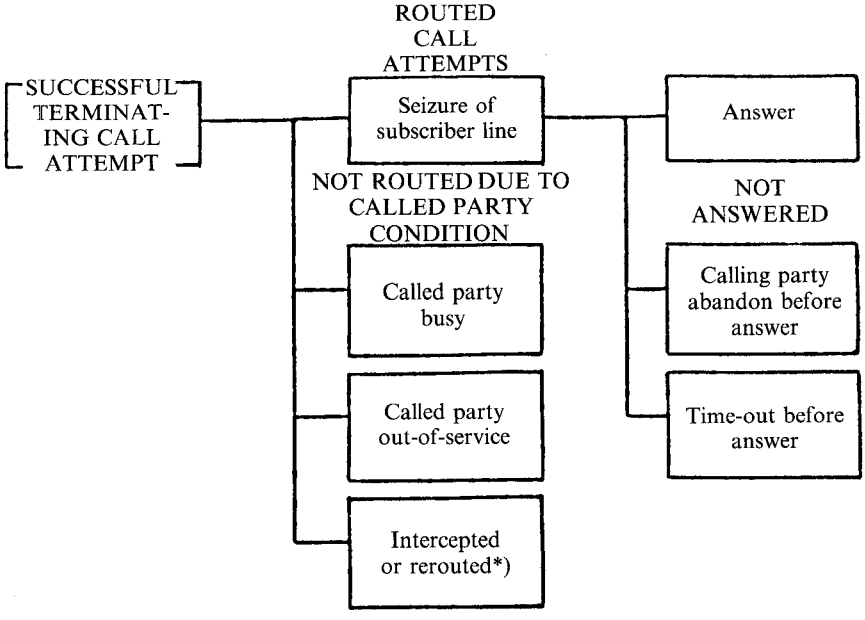


Figure 11 (T/CS 54-12). Transit traffic.



*) *Note:* This box globally presents the cases of internal call attempts that are not routed to a physical subscriber line (e.g. set-up of an abbreviated dialling, follow-me service, etc.).

Figure 12 (T/CS 54-12). Terminating traffic.

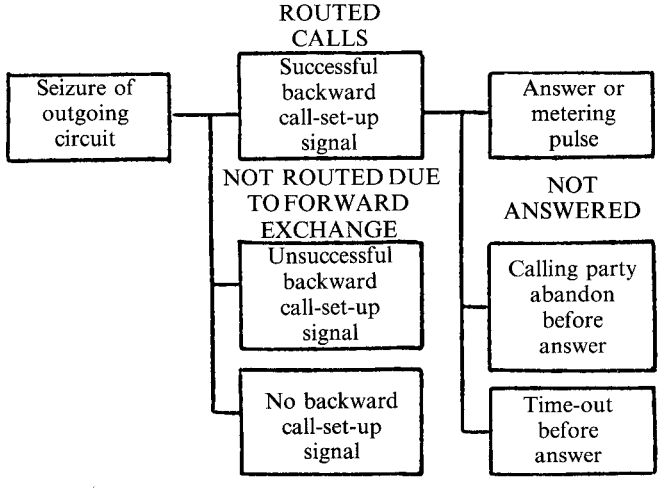


Figure 13 (T/CS 54-12). Outgoing traffic.

4. CLASSES OF MEASUREMENTS

4.1. List of measurement classes

The following classes of measurements have been taken into account:

(a) Overall traffic measurements in the exchange

These measurements involve the streams of traffic defined by the inlets-outlets of the exchange.

They express the traffic offered and the traffic carried (handled) by the exchange and the external network and are performed on the totality of subscriber lines or circuits in order to provide global data for each of said traffic streams.

Typical entities are: Number of seizures, number of successful/unsuccessful call attempts, etc.

(b) Measurements on circuit group

These measurements are performed on selectable circuits group(s) in order to assess the offered and carried traffic (in a more specific way than by overall measurements) and the influence of the exchange and the external network on the call progress.

Typical entities are: Number of seizures, traffic intensity, number of successful/unsuccessful call attempts, etc.

(c) Traffic measurements on destinations

The measurements on destinations are performed on selectable destination codes to evaluate the traffic from the exchange to various destinations in the network.

(d) Traffic measurements on subscriber line groups

These measurements are performed in order to gather infomation about the quantity of the subscriber traffic and the call handling performance.

Typical entities are: Global traffic intensity, global duration of originated and/or incoming conversations, etc.

(e) Traffic measurements on auxiliary units

These measurements are mainly performed to detect the capability of said units in carrying the traffic offered.

Typical entities are: Number of seizures, traffic intensity number of non-served calls, waiting traffic, etc.

(f) Measurements on the exchange control unit(s)

These measurements have the purpose to assess the real-time load of processor(s) and the utilization of dynamic memory areas.

Typical entities are: Number of times and percentage of the time a Reference load utilization threshold is exceeded, etc.

(g) Measurements on common channel signalling system

These measurements provide information about the telephone signalling traffic originating or terminating at the measured signalling points.

Typical entities are: Number of received/transmitted MSU's, utilization of the signalling buffer, etc.

(h) Call records

This class has been defined with the term "record" instead of "measurement" since the exchange does not process the raw data collected, not even by updating a counter as in many of the previously listed measurements.

Call records contain e.g.: Dialled digits, type of routing and identity of relevant choice, etc., and the time of occurrence of significant call events.

By further processing of the call records it is possible to determine the traffic matrix (per destination and/or per relation), measure or monitor the quality of service, etc.

4.2. Measurement classes versus objective classes

The various classes of traffic measurements listed above have been identified in the light of the intended uses listed in chapter 1 of this recommendation.

These relationships are summarized in Table 1 (T/CS 54-12).

Continuous measurements or recordings that have the purpose to collect billing or revenue accounting data have not been considered in Table 1 (T/CS 54-12). This subject is not covered in this recommendation.

Classes of objectives / Classes of measurements	Exchange dimensioning and planning	Network dimensioning and planning	Exchange performance monitoring	Network performance monitoring	Support to maintenance	Accounting, tariffs and marketing	Network management	Subscriber monitoring
Overall traffic measurements			×	×	×		(×)	
Measurements on circuit group	×	×	(×)	×	×		×	
Measurements on destinations		×		×		(×)	×	
Measurements on subscriber line groups	×		(×)					×
Measurements on auxiliary units	×		×		×			
Measurements on exchange control units	×		×		×		(×)	
Measurements on common channel signalling system		×		×	×	(×)	×	
Call records	×	×	×	×	×	×	×	×

Table 1 (T/CS 54-12). Relations between classes of objectives and classes of measurements.

Note: (×) means for further study.

5. PRESENTATION OF THE RECOMMENDED SET OF MEASUREMENT TYPES

A certain combination of entities and objects is called a measurement type. Measurement types are fixed in the system by the design and implementation and cannot be created, removed or changed by MML commands. Only new programs in the system may change these types according to new requirements.

When a measurement type is applied to more than one objective the raw information is the same but the frequency of recording and the subsequent use are different. For example, the completion ratio might be determined on an hourly basis to describe the performance of the network and at 5-minute intervals for network management purposes.

Owing to the variability of signalling methods and switching system designs administrations may require more detailed, but system dependent entities to allow meaningful call failure analysis to be performed.

Furthermore the traffic types to which any measurement relates may vary from that shown in the following list depending on system design, since for example there may be certain causes of failure which effect all traffic types.

5.1. Overall traffic measurements in the exchange

For these measurements the objects have been identified as:
— totality of subscribers,
— totality of incoming circuits.

Measurement types for teminating traffic and outgoing traffic are not recommended although these types are not completely coverd by measurement types for internal traffic, transit traffic, incoming terminating traffic and originating outgoing traffic due to system generated and system terminated traffic.

5.1.1. *Measurement on originating traffic*

Entities: — number of originating seizures,
- — number of call attempts not routed due to external cause:
  - — false start (e.g. no dialling)
  - — incomplete dialling (1)
  - — invalid address (4),
- — number of call attempts not routed due to exchange (2).

5.1.2. *Measurement on incoming traffic*

Entities: — number of incoming seizures,
- — number of call attempts not routed due to external cause:
  - — incomplete dialling (5)
  - — invalid address (4)
  - — false start,
- — number of call attempts not routed due to exchange (2).

5.1.3. *Measurement on internal traffic*

Entities: — number of internal call attempts,
- — number of call attempts not routed due to exchange (2),
- — number of successful call attempts:
  - — with called-party free/no answer (3)
  - — answered (completed)
  - — not routed due to called party condition (7).

5.1.4. *Measurement on transit traffic*

Entities: — number of transit call attempts,
- — number of call attempts not routed due to exchange (2),
- — number of call attempts in overflow to next route,
- — number of successful call attempts getting
  - — no answer (3)
  - — answer or metering pulse(s),
- — number of unsuccessful call attempts not routed due to network condition (6),
- — number of call attempts not routed due to forward exchange (8).

5.1.5. *Measurement on incoming terminating traffic*

Entities: — number of incoming teminating call attempts,
- — number of call attempts not routed due to exchange (2),
- — number of successful call attempts
  - — not completed routed due to called party condition (7)
  - — with called-party free/no answer (3)
  - — answered (completed).

5.1.6. *Measurement on originating outgoing traffic*

Entities: — number of originating outgoing call attempts,
- — number of call attempts not routed due to exchange (2),
- — number of call attempts in overflow to next route,
- — number of successfull call attempts getting:
  - — no answer (3)
  - — answer or metering pulse(s),
- — number of call attempts not routed due to network condition (6),
- — number of call attempts not routed due to forward exchange (8).

Notes:

(1) Not enough digits to discriminate if internal or outgoing call.

(2) When possible broken-down by reason of congestion, e.g. blocking through the switching network, unavailability of common resources, system faults.

(3) Expiring of time-outs or calling-party's abandon.

(4) When possible broken-down by reason, e.g. not allocated, not allowed.

(5) Not enough digits to discriminate if terminating or transit call.

(6) When possible broken-down by reason, e.g. overflow from last choice route, affected by network management control.

(7) When possible broken-down by reason, e.g. called party busy, out of service, intercepted or rerouted.

(8) When possible broken-down by reason, e.g. unsuccessful backward call set-up signal, no backward call set-up signal.

5.2. Circuit group measurements

5.2.1. *Measurement on incoming traffic*

Objects: Incoming and bothway circuit groups.

Entities: — number of incoming seizures,
— traffic intensity,
— number of completed call attempts,
— number of call attempts not routed due to internal congestion,
— number of circuits in service,
— number of circuits out of service.

5.2.2. *Measurement on outgoing traffic*

Objects: Outgoing and bothway circuit groups.

Entities: — traffic intensity,
— number of bids,
— number of lost bids,
— number of seizures,
— number of successful call attempts,
— number of unsuccessful call attempts
  — not receiving a backward call set-up signal
  — receiving an unsuccessful backward call set-up signal
  — receiving a backward call set-up signal, but not answered,
— number of circuits in service,
— number of circuits out of service.

5.3. Measurement of traffic directed to various destinations

Objects: Destination codes.

Entities: — number of call attempts (bids),
— number of seizures,
— number of completed call attempts.

This measurement is applicable in a limited number of destination codes.

Note: Some administrations may provide also for traffic intensity measurement on destination codes for traffic engineering purposes. Whether this should be included in this recommendation is for further study.

5.4. Traffic measurements on subscriber lines and subscriber line groups

5.4.1. *Measurement on subscriber line group*)*

Objects: Subscriber line group, e.g. by subscriber concentrating stage.

Entities: — number of originating outgoing call attempts,
— number of internal call attempts,
— traffic intensity of originating traffic,
— number of incoming terminating call attempts,
— traffic intensity of terminating traffic,
— number of successful originating outgoing call attempts,
— number of successful internal call attempts.

*) *Note:* A group may be a single line.

5.4.2. *Measurement on PABX-groups*

For further study.

5.4.3. *Measurement on groups of operator lines*

For further study.

5.5. Traffic measurements on auxiliary units

5.5.1. *Traffic measurement on auxiliary units without a waiting facility*

For further study.

5.5.2. *Traffic measurement on auxiliary units with a waiting facility*

For further study.

5.6. Measurements on control units

These measurements are highly system dependent and therefore no specific recommendation on relevant entities can be made. However, it is essential that systems will have provisions for determining the utilization of control units as required for dimensioning, planning, and grade of service monitoring of the exchange.

5.7. Common channel signalling measurements

A reference is made to CCITT Recommendation Q.791. For further study.

5.8. Call records

Calls are sampled either on a one to n basis or on the basis of a particular attribute of the call.

The information included in each individual call record should be related both to significant events characterising a call and to relevant times of occurrence and/or durations.

The following examples of entities forming a call record are given, and are for further study:

— identity of the incoming circuit/originating subscriber,
— dialled digits,
— identity of routing choice (1st, 2nd, ..., last choise),
— type of result of the call-attempt (e.g. answer release due to blocking, etc.),
— time of occurrence of particular events (e.g. incoming seizure, address-complete signal, answer signal, etc.) and/or duration between particular events (e.g. duration of conversation , duration of ringing phase, etc.).

6. PRELIMINARY REQUIREMENTS ON THE VARIOUS PARAMETERS

6.1. Parameters of the measurement types

The length of the scanning interval is an important parameter related to all those measurement types in which traffic volume or intensity is measured. It defines the frequency at which the sampling is executed.

In order to reduce the complexity of the measurement procedure, a possible solution could be the adoption of fixed values instead of varying the parameter values. Accordingly the scanning interval could be defined in relation to the required accuracy as follows:

— at most x seconds for measurements on circuit groups,
— from y to z seconds for measurements on centralized units.

In the same way the accounting of duration times (holding and conversation) should be made with the fixed accuracy of w seconds.

Note: Values for x, y, z and w should be defined after further studies.

6.2. Parameters of the measurements

Associated with each measurement the related parameters can be specified by means of MML commands (see CCITT Recommendation Z. 332.).

DEFINITIONS RELATED TO TRAFFIC MEASUREMENTS

The definitions were taken from COM II-R18 (report of the meeting of WP II/4—29 August-2 September 1983). Some of them are still under review.

1. **CALLS**

1.1. **Call**

A single continuous circuit switched connection.

1.2. **Bid**

A single attempt to obtain the service of a resource of the type under consideration.

Note: In a network management context, the absence of qualification implies a bid to a circuit group, a route or a destination.

1.3. **Seizure**

A successful bid.

1.4. **Call attempt**

A call attempt by a user is a single unsuccessful bid, or a successful bid and all subsequent identifiable activity related to the establishment of a connection using the resource seized and ending not later than its freeing.

1.5. **Busy**

Condition of a resource which is in use, following its seizure.

1.6. **Release**

The event which is the end of a busy state.

1.7. **Holding-time (completion time)**

The time interval between the seizure of a resource and its next release.

Note: Interruptions by higher-priority demands should not be counted as releases.

1.8. **Delay time**

The interval between the enqueuing or arrival of a demand for a resource and the completion of its service there, or its abandonment if earlier.

1.9. **Congestion (blocking)**

The state when the immediate establishment of a new connection is impossible owing to the inaccessibility of any of the resources of the system being considered.

Note 1: When blocking or congestion is used as an abbreviation for probability of blocking or probability of congestion, it should always be made clear whether it refers to time congestion or call congestion probabilities.

Note 2: Blocking does not necessarily result in the loss of a call attempt, because it may be possible to establish the connection after a certain delay or by using alternative resources.

1.10. **Internal blocking**

The condition in which a connection cannot be made between a given inlet and any suitable free outlet owing to the impossibility of establishing a path, within the switching element being considered.

1.11. **External blocking**

When referring to a switching stage, the condition in which no suitable resource, connected to that switching stage, is accessible.

1.12. **Call congestion (probability of loss; loss)**

The probability that a bid to a particular group of resources is blocked.

1.13. **Time congestion**

The probability that a system is congested at an arbitrary instant of time.

1.14. **Call attempt, abandoned**

A call attempt aborted by the calling party.

1.15. **Call attempt, lost**

A call attempt that is rejected due to an equipment shortage, error or failure in the network.

1.16. **Call attempt, successful (call-attempt, fully-routed)**

A call attempt, in which the calling station is either switched through to the exchange line terminating unit of the dialled number, or receives busy tone when the dialled number is busy.

Note: A successful call attempt does not necessarily result in a successful call.

1.17. **Call attempt, completed (call attempt, effective) (call attempt, answered)**

A call attempt answered by a called station; in international service this should always be followed by an answer signal.

Note: The station reached might not be the one wanted by the caller, due to dialling error or network malfunction.

1.18. **Successful call**

A call that has reached the wanted number and allows the conversation to proceed.

1.19. **Completion ratio (efficiency ratio; answer seizure ratio)**

The ratio of number of completed (or effective) call attempts to the total number of call attempts, as measured at as given point of a network.

2. DELAYS

2.1. **Dial-tone delay**

Time interval between subscriber off hook and reception of dial tone.

2.2. **Incoming response delay**

The interval from the instant when an incoming seizure signal has arrived at the incoming side of the exchange to the instant when the exchange is ready to receive the signalling, or to the instant when a proceed-to-send signal is returned to the preceding exchange by the receiving exchange. This definition is only applicable in case of channel associated signalling.

2.3. **Exchange call set-up delay**

The interval from the instant when the address information required for setting up a call is received at the incoming side of the exchange to the instant when the seizing signal or the corresponding address information is sent to the subsequent exchange, or to the instant when the ringing signal is sent to the appropriate user.

2.4. **Through-connection delay**

The interval from the instant when the informaiton required for setting up a through-connection in an exchange is available for processing in the exchange, to the instant when the switching network through-connection is established between the incoming and outgoing circuits.

3. TRAFFIC

3.1. **Traffic offered**

The traffic that whould be served by a pool of resources sufficiently large to serve that traffic without limitation by the finite size of that pool. Its usage is as a calculating quantity similar to a traffic intensity.

3.2. **Traffic carried**

The traffic which is served by a given pool of resources.

3.3. **Overflow traffic**

That part of the traffic offered to a pool of resources which is not carried by it, but is offered to additional resources provided to handle such traffic.

3.4. **Lost traffic**

That part of the traffic offered to a pool of resources which is not carried and has no additional resource provided to handle such traffic.

3.5. **Traffic volume**

The sum of the holding times of the traffic carried by a pool of resources, for a given period of time.

3.6. **Traffic intensity (traffic load)**

The traffic intensity on a pool of resources is equal to the volume of traffic divided by the duration of the observation, provided that the period of observation and the holding times are expressed in the same units. It is therefore equal to the average number of simultaneously busy resources.

Traffic intensity calculated in this way is expressed in Erlangs.

Note 1: When there is no ambiguity, "traffic" may be used for traffic intensity.

Note 2: "Traffic flow" is deprecated synonym for traffic intensity.

3.7. **Erlang**

The unit of traffic intensity.

3.8. **Destination**

The location of the called station. This may be specified to whatever accuracy is necessary; in international working the area or country code is usually sufficient.

3.9. **Traffic matrix**

A matrix of which the element at the intersection of row i and column j gives the traffic which originates at point i and is destined for point j. The points i and j may typically be switching centers in a network or the incoming and outgoing circuit groups of a switching center.

Note: Additional traffic generated by the normal operation of the system in setting up and controlling the establishment of the calls needs to be taken into account in any design process using this matrix.

3.10. **Traffic relation (traffic stream: traffic item; parcel of traffic; point-to-point traffic)**

The traffic originating at a particular source and intended for a particular destination.

4. CIRCUITS

4.1. **Unidirectional**

A qualification which implies that the transmission of information always occurs in one direction.

4.2. **Bidirectional**

A qualification which implies that the transmission of information occurs in both directions.

4.3. **One way**

A qualification applying to traffic or circuits, which implies that the call set-up always occurs in one direction.

4.4. **Both way**

A qualification applying to traffic or circuits which implies that the call set-up occurs in both directions.

Note: The amount of the traffic flowing in the two directions is not necessarily equal either in the short term or in the long term.

4.5. **Channel**

A means of unidirectional communication.

4.6. **Pair of complementary channels**

Two channels, one in each direction, which provide a bidirectional communication.

4.7. **Trunk circuit**

A pair of complementary channels with associated equipments terminating in two switching centers. It is said to be a national (international) circuit if it connects exchanges in the same (different) countries.

Note: Where there is no ambiguity the prefix "trunk" may be omitted.

4.8. **Circuit group**

A group of circuits which are traffic-engineered as a unit.

4.9. **First choice circuit group**

(With respect to a particular traffic stream), the circuit group to which this stream is first offered.

4.10. **High usage circuit group**

A circuit group that is traffic engineered to overflow to one or more other circuit groups.

4.11. **Final circuit group**

A circuit group which receives overflow traffic and for which there is no possible overflow. It may also carry first choice parcels of traffic, for which it is said to be fully provided.

4.12. **Only route circuit group**

A circuit group which is the one and only route for all the parcels of traffic it carries. It is said to be fully provided for each of these parcels of traffic.

4.13. **Fully provided circuit group**

With respect to a particular parcel of traffic, a circuit group which is the first choice circuit group for this traffic and which is not traffic engineered as a high usage group.

4.14. **Last choice circuit group**

(With respect to a particular traffic stream), a circuit group from which there is no possibility of overflow.

5. TRAFFIC ENGINEERING AND NETWORK MANAGEMENT

5.1. **Route (under review)**

A set of circuits or interconnected circuits from one reference point to another such that the routing of any call over this set is wholly controlled from the first-named reference point.

Note: The set need not define a single circuit vgroup, though it frequently does.

5.2. **Routing (under review)**

The particular route or sequence of routes which is used to establish a path for a call.

5.3. **Alternative (alternate) route**

A second, or subsequent choice route between two reference points usually consisting of two or more circuit groups in tandem.

5.4. **Network cluster**

A final circuit group and all the high usage circuit groups which have at least one terminus in common with it and for which the final circuit group is in the last choice route.

5.5. **Traffic routing**

The selection of a route or routes, for a given traffic stream; this term is applicable to the selection of routes by switching systems or operators, or to the planning of routes.

5.6. **Busy hour**

The busy hour refers to the traffic volume or number of call attempts and is that continuous 1-hour period lying wholly in the time interval concerned for which this quantity is greatest.

5.7. **Peak busy hour (bouncing busy hour; post selected busy hour)**

The busy hour each day; it is usually not the same over a number of days.

5.8. **Time consistent busy hour**

The 1-hour period starting at the same time each day for which the average traffic volume or call-attempt count of the observed exchange or resource group concerned is greatest over the days under consideration.

5.9. **Day to busy hour ratio**

The ratio of the 24-hour day traffic volume to the busy hour traffic volume.

Note: Busy hour to day ratio is also used.

5.10. **Effective traffic**

The traffic intensity corresponding only to the conversational portion of successful calls.

5.11. **Grade of service**

A number of traffic engineering parameters used to provide a measure of adequacy of plant under specified condition; these grade of service parameters may be expressed as probability of loss, probability of delay, etc. The numerical values assigned to grade of service parameters are called grade of service standards.

The achieved values of grade service parameters under actual conditions are called grade of service performances.

Note: When there is no likelyhood of ambiguity, the term grade of service may be used as an abbreviation for the term grade of service performance.

5.12. **Originating traffic**

Traffic generated by sources located within the network considered, whatever its destination.

5.13. **Terminating traffic**

Traffic destined for sinks located within the network considered, whatever its origin.

5.14. **Internal traffic**

Traffic originating and terminating within the network considered.

5.15. **Incoming traffic**

Traffic entering the network considered, generated by sources outside it, whatever its destinaiton.

5.16. **Outgoing traffic**

Traffic leaving the network considered, destined for sinks located outside it, whatever its origin.

5.17. **Transit traffic**

Traffic passing through the network considered, generated by sources outside it and destined for sinks outside it.

References

[1] CCITT Recommendation E.600.
[2] Nomenclature Committee 5th International Teletraffic Congress, New York, 1967.
[3] CEPT Recommendations T/CS 62-01 to 62-04. *Digital Local Exchanges.*
[4] CCITT Recommendation E.410 series.
[5] CCITT Recommendations Q.501-Q.507, Q.511-Q.517.
[6] CCITT Recommendation E.500 series.
[7] Recommendations T/CS 68-01 to 68-04. *Digital transit exchanges for international and national applications.*
[8] CCITT Recommendations Q.701-Q.795.
[9] Recommendation T/CS 20-01. *Exchange and network features.*
[10] CCITT Recommendation Z.332.
[11] CCITT Recommendation Q.791.

Recommandation T/CS 54-12 (adoptée en 1984)

Information de la suite donnée

a = La Recommandation est appliquée.
b = L'application de la Recommandation est prévue.
c = L'application de la Recommandation n'est pas prévue.

N°	Pays	Information	Remarques
1	2	3	4
1	*Allemagne (Rép. féd. d')*		
2	*Autriche*	b	
3	*Belgique*	a	
4	*Chypre*		
5	*Danemark*		A l'étude.
6	*Espagne*		
7	*Finlande*	a	
8	*France*	b	
9	*Grèce*		
10	*Irlande*		
11	*Islande*		
12	*Italie*		
13	*Liechtenstein*		
14	*Luxembourg*		
15	*Malte*		
16	*Monaco*		
17	*Norvège*		
18	*Pays-Bas*		
19	*Portugal*		
20	*Royaume-Uni*		
21	*Saint-Marin*		
22	*Suède*	a	En partie.
23	*Suisse*	a	
24	*Turquie*		
25	*Vatican (Cité)*		
26	*Yougoslavie*	b	